MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION

Federal State Autonomous Educational Institution of Higher Education "National Research Technological University "MISIS" branch in Almalyk of the Republic of Uzbekistan

TRAINING AND METODOLOGY COMPLEX
in the discipline " Mining ecology "

Direction of preparation: **05/21/04 – “Mining”**

Almalyk - 2023

UDC [330.15+557.4]:622

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The educational and methodological complex for the discipline " Mining Ecology " is compiled in accordance with the requirements of educational standards of NUST "MISIS" on the basis of curricula in the relevant areas of training and is a presentation of the issues "Subject and tasks of Mining ecology, problems of the impact of mining on the environment, rational the use of various types of natural resources in the exploitation of mineral deposits, engineering methods and means of environmental protection, new environmental thinking. General and special issues of mining ecology, a new direction in mining sciences, are outlined. The main processes in the biosphere and features of technogenic impact on the environment are considered. Information is provided on the legal basis for environmental protection and the system of state environmental management in Uzbekistan. The types of impact of mining production on all elements of the biosphere are analyzed: air and water basins, natural landscape and subsoil. The characteristics of mining environmental monitoring and environmental aspects of mining industrial ecology are given."

For students of higher educational institutions studying in the direction of training certified specialists “Mining”.

1 PLANNED RESULTS OF TRAINING IN THE DISCIPLINE

1.1. Purpose and objectives of the discipline

The discipline “ Mining Ecology ” is a compulsory discipline of the basic part of the professional cycle of disciplines and was developed in accordance with the OS of NUST MISIS: Educational standard of higher education in the field of study **05.21.04.**

The purpose of the academic discipline : To acquire a complex of knowledge on the problem of the impact of mining on the environment, the rational use of various types of natural resources during the exploitation of mineral deposits, engineering methods and means of protecting the environment, acquiring skills in performing engineering calculations, and developing new environmental thinking among students.

Objectives of the discipline:

substantiation of theoretical principles and practical approaches in solving the problem of ensuring environmental safety of mining production, to understand modern environmental problems arising in the mining industry. The ability to show connections between mountain ecology and other sciences and determine that the object of study is the natural mining and industrial complex. carrying out an analysis of anthropogenic impact on the biosphere and public administration systems in the environmental sphere. Studying the legal framework of environmental protection in Uzbekistan and information about environmental law.

study of special issues of mining ecology, strategy for the development of the mineral resource base and mining industry of Uzbekistan, as well as the impact of mining on the environment , the impact of mining on air and water basins, natural landscapes and subsoil.

1.2. Planned learning outcomes

The discipline "Mining Ecology" belongs to the basic part of the professional cycle of disciplines and is mandatory when mastering the general education program in the specialty "Mining".

The ability to develop the necessary technical and regulatory documentation as part of creative teams and independently, to monitor the compliance of projects with the requirements of standards, technical specifications and industrial safety documents, to develop, coordinate and approve in the prescribed manner technical, methodological and other documents regulating the procedure, quality and safety of mining , mining construction and blasting works

As a result of mastering the discipline, graduates will:

Know:

basic methods for assessing the state of the environment in the area of mining operations principles and methods of conducting environmental assessments, fundamentals of environmental legislation for a mining enterprise

methods and means of environmental protection when conducting comprehensive research in the field of mining ecology

basic laws when assessing the state of the environment in the area of mining operations

methods and techniques for reducing the impact of mining on the environment

physical, chemical and biochemical processes occurring in the hydrosphere, atmosphere and lithosphere during the development and operation of mining enterprises

basic sanitary and hygienic, industrial and comprehensive environmental quality standards, SanPins, GOSTs for environmental protection of mining enterprises

modern methods for analyzing environmental indicators at mining enterprises

the current system of regulations in the field of environmental safety of mining enterprises

current legislation and regulatory framework in the field of mining ecology

general environmental issues, patterns of distribution of pollutants, their interaction with elements of the biosphere, the impact of mining on the environment

Be able to:

assess the impact on the environment and the consequences of its changes, find compromise solutions in conditions of multi-criteria and uncertainty

monitor the state of the environment

develop measures to reduce the technogenic load of a mining enterprise on the environment

be able to conduct environmental assessments at mining enterprises

carry out calculations of pollutant concentrations, select methods and means of protection

use regulations when developing environmental protection measures at mining enterprises

demonstrate knowledge of current legislation and regulatory framework in the field

develop technical documentation, EIA and environmental sections as part of projects for the extraction and processing of mineral resources

conduct comprehensive research in the field of mining ecology

use scientific laws when assessing the state of the environment in the area of operation of mining enterprises

apply methods for assessing the state of the environment during the extraction and processing of minerals at mining enterprises

Own:

skills to develop environmental protection measures as part of creative teams and independently during the extraction and processing of mineral resources

methods for assessing damage from the impact of a mining enterprise during environmental assessment

willingness to demonstrate skills in developing systems to ensure environmental and industrial safety during operational exploration, mining and processing of solid minerals, construction and operation of underground facilities

methods of analysis and calculation of emissions and discharges of pollutants into the environment, as well as the development of environmental protection measures at mining enterprises

demonstrate knowledge of current legislation and regulatory framework in the field of professional activity;

skills to use the current legislation and regulatory framework in the field of mining ecology

demonstrate a systematic understanding of the applied technical solutions, technologies and processes in the field of mining;

skills to use methods and means of environmental protection in complex research in the field of mining ecology ability to analyze objects, processes and systems within broad interdisciplinary areas

methods of analysis, patterns of distribution of pollutants and their transformation in the biosphere

ability to use the basics of legal knowledge in various spheres of life

the main regulatory and legal acts in the field of environmental protection and use them in the development of environmental protection measures at mining enterprises

willingness to demonstrate skills in developing action plans to reduce the technogenic impact of production on the environment during operational exploration, mining and processing of solid minerals, as well as during the construction and operation of underground facilities;

qualitative and quantitative methods of ensuring environmental safety at a mining enterprise

principles of calculation of basic devices and environmental protection systems

ability to use a computer as a means of managing and processing information arrays

skills to use methods when assessing the state of the environment of mining enterprises

skills to use scientific laws when assessing the state of the environment in the area of operation of mining enterprises

2. THE PLACE OF DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM

Requirements for preliminary preparation of the student:

Physics
Chemistry
Physics of rocks
Measurement of electrical and non-electrical quantities
Mine Surveyor
Metrology and standardization
Geology
Mathematics
Mechanics
Construction geotechnology
Philosophy

Disciplines (modules) and practices for which mastering a given discipline (module) is necessary as a prerequisite:

Rational use and protection of natural resources
Chemical and biochemical processes in mining
Environmental assessment in mining
Reclamation of disturbed lands
Protection and rational use of subsoil
Environmental risks
Wastewater treatment and circulating water conditioning
Geomechanical support for mining operations
Mineral beneficiation
Aerology of mining enterprises
Energy of mining enterprises
Mining thermophysics
Movement and deformation of rock masses and the earth's surface
Blasting technology and safety
Mining safety and mine rescue
Mine surveying ensuring the safety of mining operations

Economics and management of mining production
Preparation for defense and defense of final qualifying work
Undergraduate practice

3. SCOPE OF DISCIPLINE AND TYPES OF STUDY WORK

4.

3.1 . The total labor intensity of mastering the discipline “Mining Ecology” is 180 hours.

Students are allocated 72 hours for contact work (classroom sessions) with the teacher, including 36 hours for lectures, 18 hours for practical classes and 18 hours for laboratory classes. Independent work 81 hours. 27 hours for control.

The program provides 13 independent works, 2 tests (intermediate control) and a final test with a graded test.

3.2. Topics of abstracts (presentations)

1. Current state of the environment.
2. Legislation in the field of nature conservation.
3. Impact of mining on the natural environment.
4. Rational placement of environmental pollution sources.
5. Air protection at mining enterprises.
6. Methods for cleaning harmful emissions into the atmosphere.
7. Protection of water resources.
8. Devices and structures for wastewater treatment from mining enterprises.
9. Land protection at mining enterprises.
10. Types of reclamation of disturbed lands.
11.Economic aspects of environmental management.
12. Rational use of the earth's interior.
13.Comprehensive use of mineral matter.
14.Use of associated minerals.
15.Disposal of production waste.
16. Extraction of minerals from the bottom of seas and oceans.
17. Technology for extracting placers, nodules, silts, etc.
18. Thermal resources of the earth's interior.
19.Use of underground space of the earth's bowels.
20.Technology of environmentally closed production.
21.Principles of utilization and use of coal mine methane.
22.Monitoring of air pollution and emission sources.
23.Methods of storing coal-containing and radioactive rocks.
24. The influence of gas and dust waste on the biosphere and climate of the planet. 25. Extraction of metals and other useful compounds from waste.

Abstract (presentation) – 10 – 15 pages of A-4 format, printed text with photographs, graphics, drawings.

4. To obtain admission to an exam or test, defense of an abstract (presentation) and laboratory (practical) work is required.

5. Passing tests or exams using tickets

6. Each pass is one question in addition to the ticket.

INFORMATION SUPPORT OF DISCIPLINE (MODULE)

5.1 Basic literature:

1. Pevzner M.E. Mountain ecology: Textbook for universities - M.: MGGU, 2003. - 395 p.
2. Chmykhalova S.V. Mining Ecology. Textbook.-M.: House of MISIS, 2016.-111 p.

5.2. Additional literature:

1. Belozersky R.N. Radiation ecology: Textbook for higher students. textbook institutions - M.: Publishing center "Academy" 2008, - 384 p.
2. Brodsky A.K. General ecology. Textbook for higher education students. textbook establishments - 4th ed. erased - M.: Publishing center "Academy" 2009, - 256 p.
3. Vlaskin Yu.K., Shekhovtsov V.S. “Special methods of field development”, textbook, SibGIU, Novokuznetsk, 1992 г., 93 pp.
4. Gorelov A.A. Ecology: Textbook. A manual for universities.-M.: Yurayt, 2001.-312 p.
5. Davinho P., Tang M. The biosphere and the place of man in it (ecological systems and the biosphere) / Transl. from French - M.: Progress, 1973.-266 p.
6. Lavtsevich V.P. “Environmental protection during underground mining minerals", textbook, SibGIU, Novokuznetsk, 1996., 172 p.
7. Lavtsevich V.P. “Protection of subsurface resources”, textbook, SibGIU, Novokuznetsk, 2000 г., 48 p.
8. Slastunov G.V., Koroleva V.N., Kulikov K.S. et al., “Mining and the Environment”, textbook, M., Ed. "Logos", 2001., 272 pp.
9. Law of the Republic of Uzbekistan “On Environmental Protection”.
10. Law of the Republic of Uzbekistan “On the Protection of Atmospheric Air”,
11. Ruz Law “On Waste”.
12. "Rules for the protection of subsoil", PB 07-601-03, 2003.
13. “Rules for the protection of subsoil during the processing of mineral raw materials”, PB 07-600-03, 2003.

ELECTRONIC SOURCES .

http :// big - archive . ru
http :// dic . academic . ru / dic . nsf 7 ecolog
http : //photo.sci-lib.com
http://www.calend.ru/person
http://www.cnshb.ru
http://www.ecosystema.ru

5.3 Material and technical support of the discipline

The educational process uses: - classrooms for conducting lectures and seminars, group and individual consultations, ongoing monitoring and intermediate certification, a set of multimedia equipment, including a multimedia projector screen, a computer for demonstrating presentations; educational visual aids providing thematic illustrations and classroom furniture (tables, chairs, classroom board); - the library for independent work is equipped with computer tables, chairs, a classroom blackboard, computer equipment with the ability to connect to the Internet and provide access to the electronic information and educational environment of the university.

6. ASSESSMENT FUND FOR INTERMEDIATE CERTIFICATION

The student knowledge assessment system pursues the following objectives:

- organization of systematic and timely mastery of the subject;
- regular assessment of student performance;
- objective and accurate assessment of students’ knowledge;
- regular notification of students and analysis of assessment results.

6.1. Types and forms of the rating system

Assessment of student performance in the subject is carried out regularly and is achieved by the following types of control:

- current control (TC);
- intermediate control (PC);
- final control.

Current control involves the assessment of knowledge and practical skills on each topic of the discipline and is carried out in practical and laboratory classes.

Intermediate control assesses the theoretical knowledge of students after classes in 8 (PC-1) and 17 (PC-2) weeks and determines the student’s ability to answer questions on the covered topics of the discipline. PC form – written test.

Final control is carried out for the entire course of the subject at the end of the semester.

The assessment fund is formed on a 100-point scale. 100 points are distributed as follows:

- current control 50 points
- intermediate control (PC-1 + PC-2) 10 points
- final control 40 points

The following standard criteria for assessing student knowledge are taken into account:

Point	Grade	Student knowledge level
86-100	Excellent (5)	- decision making and conclusions; - ability to think creatively; - independent thinking - ability to practically apply acquired knowledge; - understanding of the essence of the issue, knowledge and ability to present; - have an idea about the subject being studied.
71-85	Good (4)	- independent thinking - ability to practically apply acquired knowledge; - concept of the essence of the issue; - ability to present acquired knowledge.
55-70	Satisfactory (3)	- concept of the essence of the issue; - ability to present acquired knowledge; - - have an idea about the subject being studied.
0-54	Unsatisfactory	- not having an accurate idea; - lack of knowledge of discipline

Lecture No. 1. (2 hours).

Introduction. Goals and objectives of mining ecology.

The bulk of waste is generated in industry. At the same time, the largest amount falls on the mining and processing complexes. Here, up to 100 million tons of waste are stored annually in the form of overburden rocks, flotation tailings, various slags, and clinkers, of which 14% is classified as toxic.

In the non-ferrous and mining metallurgy industries, up to 300 thousand tons of metallurgical slag are generated annually. A significant amount of toxic waste is also generated at chemical industry enterprises, which supply a significant amount of waste such as phosphogypsum, lignin, manganese sludge, and sulfur to the environment. At the same time, the volume of phosphogypsum formed is about 70 million tons, lignin 15 million tons. In total, there are currently about 2 billion tons of waste of various types in storage facilities. The accumulation of such large volumes of industrial waste, in addition to disturbing the landscape, is associated with the problem of their placement and requires constant additional alienation of land.

Currently, over 10 thousand hectares of land are occupied by industrial waste storage facilities in the republic.

The largest amount of toxic waste is generated in Navoi, Tashkent, and Jizzakh regions. The bulk of this waste is sent to organized storage sites without preliminary processing.

At the same time, waste often contains a high proportion of usable secondary resources, chemical compounds, various metals, including rare earths, but only 0.2% of the generated industrial waste is used as secondary raw materials.

Thus, the main waste produced by Ammophos JSC is phosphogypsum, which is stored in sludge storage tanks. The total area of sludge reservoirs is 254.61 hectares. The amount of phosphogypsum accumulated in sludge reservoirs today is more than 64.0 million tons. At the same time, the annual formation of phosphogypsum increases by an average of 100 thousand tons per year.

It should be noted that specialists from the Institute of Chemical Technology with the support of the State Committee for Ecology of the Republic of Uzbekistan. A technology has been developed to obtain raw materials from phosphogypsum for the production of phosphate fertilizers, and the introduction of this technology will help not only to completely utilize a huge amount of waste, but also to partially satisfy the republic’s need for fertilizers.

It should be borne in mind that in the United States, at the federal level, a goal has been set to achieve recycling of 25% of waste nationwide. In many American cities and states this figure is 40%. In Seattle, 60% of all waste is recycled.

The Government of the Republic of Uzbekistan pays special attention to the disposal of mercury-containing lamps and devices that are classified as particularly hazardous toxic waste. For these purposes, the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan “On streamlining the activities of enterprises for the use and disposal of mercury-containing

lamps and devices" dated October 23, 2000 No. 405 was adopted.
During the implementation of this resolution, special enterprises for the disposal of mercury-containing lamps and devices were built and are currently operating in the cities. Tashkent, Andijan, Fergana, Navoi, Zarafshan, Bukhara. A branch of the Fartozakhavo Research and Production Enterprise has been opened in the Surkhandarya region for the disposal of mercury-containing lamps and devices. The technology used at these enterprises meets international requirements and is protected by international patents.

Share of waste by industry sector

- mining industry – 55.5%,

- metallurgy - 34.0%,

- chemical industry - 5.0%,

- electric power industry - 2.0%,

- rest of industry - 3.5%.

The term "Mining ecology" includes two interrelated and interdependent concepts.

The first concept is mining. There are quite a lot of definitions of this concept in the literature . Let's take one of them as an example. which is used quite often today.

Mining _ *engineering*) - a sphere of human activity related to the development and use of the Earth's interior. Includes all types of human impact on the earth's crust, primarily for the purpose of extracting minerals, their primary processing, as well as scientific research related to mining technologies.

In the modern understanding, the concept of mining, in addition to human activities for the extraction of mineral resources (coal, ore and non-metallic mines, borehole mining, open-pit mining, concentration plants, research work related to mining technologies), also includes human activities in construction urban underground structures, underground structures for industrial, agricultural, cultural and defense purposes, heat and power supply facilities.

Taking this into account, we can formulate the concept of mining as an area of human activity for the development of the Earth's subsoil, which includes the extraction of minerals and their primary processing , the construction of underground structures, as well as the construction of underground structures for industrial, agricultural, cultural and defense purposes.

Mining (or mining) enterprises have a number of specific - features that distinguish them from the general idea of industrial enterprises. These features include large-scale mechanical destruction and transformation of the landscape and ecological environment in the technological process of mining. From a buried state in the geological environment, minerals and accompanying rock masses are extracted into the natural and anthropogenic environment under the influence of certain technological operations and are distributed in it over vast territories.

The second concept is ecology. The term was first proposed by the German biologist Ernst Haeckel in 1866 in his book “General Morphology of Organisms ” (“ Generelle Morphologie der Organismen ").

Ecology (ancient Greek *oikos* - abode, dwelling, house, property and logos - concept, doctrine, science) - the science of the interactions of living - organisms and their communities with each other and with the environment.

The natural basis for the existence of society is the natural environment, i.e. a set of objects and conditions of nature in which the activity of a subject takes place. People extract, process and use what can be obtained from the Earth, therefore mineral resources occupy a leading position among the sources of material production, and ***mining*** *is a set of technological techniques, the task of which is to extract minerals from the bowels of the earth and bring them into a suitable state. for subsequent use in various areas of human activity, one of the main industries.*

Influencing natural components, a person in the process of his activity often disrupts natural relationships, transforming them not only positively, but also negatively.

The study of technogenic influence on nature has shown that if a person, through his activity, transforms at least one of the natural components, then the result of his labor activity always affects two or three natural spheres, and not necessarily in the area of direct impact. Thus, the increasing consumption of energy raw materials changes the natural potential of not only the upper part of the lithosphere, but also the atmosphere and hydrosphere. For the extraction and processing of one ton of fuel resources, tens of tons of fresh water are consumed, which amounts to only 2% of 1.6 billion . km ^{3} of the total amount of water that makes up the Earth's hydrosphere. In Russia alone, more than 11 billion are needed to burn fuel extracted from the subsoil . tons of air, which is much more than the annual biological need of the country's population. More than 100 million US cars, when burning gasoline, consume 2 times more oxygen than it is recreated in the natural metabolism in this territory.

However, due to the fact that nature interacts with society - through its individual components, an objective opportunity is created to “remove” the undesirable consequences of disturbances in the ecological balance. Nature is a living organism with self-regulating interdependence of processes, so it adapts to changing conditions. The rates of self-regulation of natural systems vary depending on regional conditions and the nature of the influencing factors. By understanding the mechanism of interdependence within natural, environmental complexes, society can discover an “antidote” to the disruption of natural processes.

In mining, the main types of activities in which certain environmental disturbances of varying intensity occur are:

- carrying out mining operations for the extraction of minerals and maintenance of mining operations;
- transportation of rock mass by rail, conveyor, motor transport or hydraulic method;
- mineral processing;
- storage of minerals and mineral waste and their subsequent disposal;
- ventilation of mine workings, neutralization and disposal of harmful substances released into the atmosphere during the operation of machinery and equipment, dust suppression and dust collection;
- purposeful change in the properties of the rock mass where the working is located (freezing, plugging, thermal effects, etc.);
- energy supply to mining enterprises;
- reclamation and backfilling works;
- drainage and drainage measures.

Therefore, environmental management in mining comes down to two main areas:

- taking into account the impact of mining on the air, water, terrestrial environment and subsoil;
- finding methods for engineering protection of the natural environment from the harmful effects of mining operations.

In the second direction, in the process of mining, it is necessary to ensure rational and complete use of subsoil resources, prevent their damage, preserve areas of the subsoil and the earth's surface that are of scientific and cultural interest, reduce losses during the extraction, transportation and processing of minerals; prevent deformation and depletion of the earth's surface resources; promote the conservation of water resources, prevent energy pollution of the environment, and create mining technologies of the future.

The choice of the method of engineering protection when conducting mining operations is determined by a number of features of the problem of preserving the environment in mining in comparison with other industries and, first of all, the priority of mining over other types of economic activity in the area.

The second important feature is the temporary nature of mining - operations: when the mineral deposit is depleted, they stop. In this regard, to minimize damage to the environment, the design and production of mining operations should be carried out in such a way that the new landscapes formed, excavations, dumps, surface complexes, shafts, adits, etc. could subsequently be used with maximum effect for other economic purposes.

The essence of the third feature comes down to the definition of clear quantitative criteria for acceptable environmental violations that do not have a harmful impact on the overall ecology of the area. The introduction of such criteria makes it possible to more reasonably protect the environment from various types of impacts by eliminating the harmful consequences of industrial activities.

Despite the temporary nature of the impact of mining on the environment, one cannot ignore the intensive large-scale - transformations of the natural environment in mining areas: alienation of territories required for agriculture; hydrogeological and geochemical changes unfavorable for local ecological systems; pollution by harmful substances and chemical elements of soil and water bodies, changes in microclimate, etc. Therefore, solving the problem of environmental protection in mining should be preceded by the development of a clear strategy and tactics for its engineering protection from harmful influences.

*Thus, the discipline " **Mining Ecology** " is intended to study the types of impacts of mining processes on the environment; standards for assessing various environments of a mining enterprise; methods and means of monitoring the state of these environments and measures of engineering protection of nature from the negative impact of mining.*

What does the environment consist of?

The atmosphere plays an important role in all natural processes ; it not only determines the climate of a given area and planet, but also protects it from harmful cosmic radiation. The modern nature of gas circulation was formed about 50 million years ago. The atmosphere consists of 78.08% nitrogen, 20.9% oxygen, 0.93% argon, and 0.03% carbon dioxide. The share of other gases (neon, helium, methane, xenon, radon, etc.) accounts for approximately 0.06%.

The mass of the planet's gas shell is estimated at 51,610 tons, while the share of annual pollution, for example carbon dioxide, is below 0.0003%; for other pollutants this figure is many times lower . However, it is by no means possible to draw a conclusion about the inexhaustibility of air resources based on these data. The main reason for this is the growth rate of the Earth's population, which, according to some estimates, doubles every 32 years, and the intensive development of industry and transport. Thus, on a global scale, the flow of carbon dioxide into the atmosphere is constantly increasing due to the intensive combustion of fossil fuels. Over the past 100 years, its concentration in the atmosphere has increased from 0.029 to 0.032%, i.e. by more than 10%.

Atmospheric pollution refers to the entry into the air of gases, vapors, solid and liquid substances that adversely affect living organisms and vegetation, worsen the Earth's climate or cause material damage (i.e., they disturb natural systems from a state of equilibrium). And although hundreds of different substances enter the atmosphere , a very limited number of them are significant for pollution. First of all, these are gases: oxides of nitrogen, carbon, ammonia, gaseous freons, as well as substances that can be in the aerosol and vapor phases, for example hydrocarbons, mercury.

It should be noted that air pollution occurs extremely unevenly and is associated with the location of the main centers of production and consumption of energy resources, which in the Northern Hemisphere account for about 70% of production and almost 90% of consumption of the world volume, amounting to more than 11,000 million tons of standard fuel.

But even in the Northern Hemisphere there are industrial conglomerates , the level of atmospheric pollution of which can be thousands or more times higher than the average planetary values. Thus, about 150 million tons of sulfur dioxide enters the atmosphere, which is about 70 kg per 1 km ^{2} of the planet’s surface. But in such industrial areas as the Ruhr or Donetsk, the supply of sulfur dioxide reaches 100 tons per 1 km ^{2}, which exceeds the average value by 1400 times.

Based on territoriality, the following types of pollution are distinguished : local, regional, global. The former are mainly associated with cities and large industrial areas. The latter spread over vast territories and affect the biosphere of the entire planet.

Global and regional environmental pollution is almost entirely caused by long-distance atmospheric transport and subsequent entry of pollutants into other environments: soil, water, biota. The determining factor is the lifetime of a substance or the products of its transformations in natural environments, toxicity, and the ability to cause negative effects in these environments.

The speed of propagation of air masses during long-distance transport usually ranges from several hundred to thousand kilometers per day. Therefore, substances with a lifetime in the atmosphere of more than 0.5 days can spread over long distances. A noticeable accumulation of a substance when it enters water and soil from the atmosphere occurs if its lifetime in these environments is at least a year.

Negative effects from pollution can only appear with sufficiently large volumes of emissions, at which significant quantities accumulate and relatively high concentrations are achieved. For most substances, such accumulation occurs with the release of at least tens and hundreds of millions of tons per year.

Based on their lifetime in the atmosphere, two groups of substances can be distinguished:

- with a lifespan of about a year or more. The concentration of such substances in the atmosphere depends little on the distribution of sources emissions around the globe;
- with a lifetime of about 10 days or less. The concentration of these substances in the atmosphere is closely related to the spatial distribution of emission sources and differs by several orders of magnitude for industrial and background areas. There are also pollutants of natural and artificial (anthropogenic) origin. Among the former, natural dust occupies a special place, playing the role of water vapor condensation nuclei. Artificial air pollution associated with human activity consists of 90% harmful gases and 10% aerosols.

Recently, emissions generated during the operation of various types of transport, especially cars, have become increasingly significant. The main share of toxic impurities enters the - atmosphere with exhaust gases from internal combustion engines (ICE). Thus, in the United States, 60% of air pollution is associated with vehicle exhaust gases. In megacities such as New York, Tokyo, and Moscow, the share of exhaust gas pollution reaches 90% of all atmospheric pollution. When operating internal combustion engines, per 1 ton of burned fuel produces more than 400 kg of emissions from carburetor engines and more than 120 kg from diesel engines. However, diesel engines emit a significant amount of soot, which actively adsorbs toxic and carcinogenic substances.

It is worth highlighting a group of components that enter the atmosphere during the combustion of fossil fuels - coal, oil products and gas - in heat and power and other industrial enterprises, and in vehicles. In addition to the reaction products, the emissions also contain starting substances, since in reality the fuel does not burn completely.

Sulfur oxide (sulfur dioxide) enters the atmosphere in large quantities with the flue gases of thermal power plants (CHP), combined heat and power plants (CHP) and other thermal installations; with exhaust gases from sulfuric acid plants, enterprises processing raw materials that contain sulfur; with exhaust gases from vehicles with internal combustion engines; from gas and oil production wells. The concentration of sulfur oxide dispersed in the air ranges from thousandths to several milligrams per cubic meter.

Carbon monoxide is also contained in the flue gases of thermal power plants, combined heat and power plants and other installations that burn organic substances. However, the main source of atmospheric air pollution with carbon monoxide is exhaust gases from vehicles. Its content in atmospheric air ranges from tenths to tens of units.

Hydrocarbons are one of the main pollutants of atmospheric - air. This class of substances consists of saturated hydrocarbons of unbranched (methane series) and branched (isobutane, isopentane) structure, unsaturated hydrocarbons (ethylene series, acetylene series), aromatic hydrocarbons (benzene, toluene, xylene), as well as derivatives of hydrocarbons (for example, chlorine derivatives, alcohols) and other compounds. They enter the atmosphere with the flue gases of thermal power plants, are released from liquid and gaseous fuel storage facilities, from oil and gas production wells and other sources. And again, the main contribution to total atmospheric air pollution with hydrocarbons comes from vehicle exhaust gases. It should be taken into account that all hydrocarbons, under certain conditions, can react to form carcinogenic substances. Under the influence of ultraviolet radiation from the sun, hydrocarbons participate in the formation of photochemical smog. In atmospheric air, the average content of total hydrocarbons varies from units to tens of milligrams per cubic meter.

Lecture No. 2 (2 hours)
Basic terms and definitions.

History of the development of mining ecology.

The development of technology and technology in the 20th century and the growth of the planet's population led to a decrease in biodiversity, a decrease in the number of living beings, and an increase in the consumption of natural resources. There was a need to study and research the human environment from different points of view, which somewhat changed the definition of the term ecology. Great contributions to the development of ecology as a science were made by such great scientists as V.I. Vernadsky, V.V. Dokuchaev, Yu.P. Odum. A.J. Tansley, N.V. Timofeev-Resovsky, G.F. Gauzs, N.F. Rsymsrs. N.N. Moiseev. AL. Yanshin, Yu.A. Israel et al.

It is necessary to note modern environmental scientists: V.I. Danilov-Danilyan - Corresponding Member of the Russian Academy of Sciences, Director of the Institute of Water Problems of the Russian Academy of Sciences (since 2003), a well-known scientist in the field of environmental economics, economic and mathematical modeling, theory of sustainable development, ecology; I.E. Chsstin is a member of the Public Chamber Commission on Environmental Safety and Environmental Protection, Director of the World Wildlife Fund of Russia; A.V. Yablokov is an ecologist, world-renowned scientist and active social and political figure.

The modern meaning of the term ecology is “the science of the joint development of humans, human communities as a whole and the environment (including all other organisms), studying the biotic mechanisms of regulation and stabilization of the environment, mechanisms that ensure the sustainability of life. Ecology examines the reasons for the violation of these mechanisms, the emergence of environmental problems and offers ways to overcome them, which would ensure the sustainability of the environment and the existence of humanity.

The mining complex of our country - the most important basic element of the national economy - plays a decisive role in the national economy and is the supplier of most of the mineral raw materials and fuel. Mining production is technologically interconnected with the processes of human impact on the environment in order to provide raw materials and energy resources to various areas of economic activity.

At the same time, the production activities of the mining complex have a significant impact on the environment: a huge amount of harmful substances are released into the atmosphere, contaminated wastewater is discharged into water bodies, and solid mining waste is stored on the surface of the earth.

Prof. M.E. Pevzner summarized previous experience in research into the impact of mining on the environment; for the first time in 1978, he proposed the concept of "mountain ecology." He then defined mountain ecology as a new direction that studies the patterns of human impact on the environment in the field of mining.

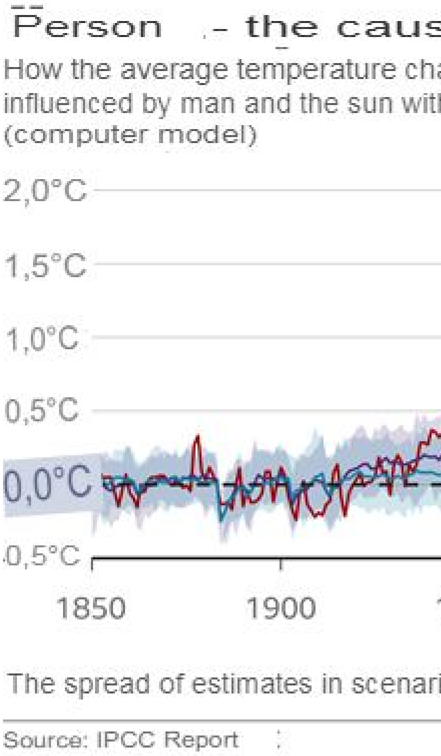
Already in this definition is the concept of "mining production". The goal of this direction, formulated by M.E. Pevzner, - "development of the scientific foundations of environmentally friendly mining production and recommendations for their practical implementation."

Mountain ecology studies the patterns of human impact on the environment in the field of mining, and primarily the relationship of the physical and chemical processes underlying the extraction and processing of minerals with the circulation of matter and energy in the biosphere.

However, the term "mining ecology" more accurately conveys the meaning of the discipline, since it already contains the main goal of the course - studying the relationship between mining and the environment, determining the impact of mining on the environment, the response of the environment to these impacts and the consequences of this impact on the environment natural environment and humans.

The following definition of mining ecology is given:

"Mining ecology is a new direction in the educational process of mining engineers, associated with the study of issues of both ecology in its "pure" form and mining technology in its entirety - from underground and open-pit methods of mining before beneficiation and mine and underground construction, well mining. Ensuring environmental safety in mining is a complex task associated with solving many problems that require an integrated approach. Mining ecology is the basis of environmental education for mining engineers of all profiles.” Thus, the subject of mining ecology is the study of the scientific basis of the influence of mechanical, physical, 6 chemical processes of mining and processing of minerals on the state of the natural environment, as well as the use of engineering means and methods of environmental protection to reduce this impact, taking into account the influence of environmental conditions on the choice of decisions during design, construction, operation (deposit drainage method, excavation method rock mass, disposal of production waste, choice of means of mechanization and transportation of rock mass, etc.) and liquidation (modernization) of mining enterprises.



nitrogen oxide pollutants, the most common are nitric oxide (II) NO and nitric oxide (IV) NO2. These compounds enter the atmosphere with the flue gases of thermal power and metallurgical enterprises, and with the exhaust gases of factories producing nitrogen mineral fertilizers. At the same time, it should be noted that over the past 20 years, due to the development of vehicles with internal combustion engines, they are the main contributor to atmospheric air pollution with nitrogen oxides. The content of nitrogen oxides in atmospheric air ranges from thousandths to tenths of a milligram per cubic meter.

Due to the rapid development of industry and transport, *the ozone* content in the ground layer of the atmosphere has increased sharply. The sources of its formation are all sparking installations that generate hard radiation: electric welding machines, internal combustion engine ignition systems, X-ray machines, as well as sparking on tram, trolleybus lines, electric train lines, etc. Ozone is not only very toxic (in toxicity it is superior to hydrocyanic acid), but also has the property of mutagenicity and a radiation effect.

Hydrogen sulfide is also highly toxic . It enters the atmosphere from gas and oil production wells, sulfur mineral springs , with emissions from gas processing plants, synthetic fiber plants, pulp and paper mills, and other sources.

Oxides of sulfur, carbon and nitrogen are acid- forming substances. The most important among them, in terms of contribution to acidity, is sulfuric acid. However, the role of nitric acid is also increasing, the contribution of which to the acidification of precipitation for Europe is about one third, and for the northeastern part of the USA in winter it can reach 60%. Anthropogenic emissions of sulfur and nitrogen compounds are characteristic of almost any type of industrial activity, and their absolute fluxes are comparable to the corresponding natural geochemical fluxes or are significantly higher than the latter. Global anthropogenic emissions of sulfur into the atmosphere are currently estimated at 113 million tons per year, of which 98 million tons enter the atmosphere in the form of sulfur oxide (IV) SO 2.3 million tons in the form of sulfur oxide (VI) SO 3.9 million tons - in the form of aerosol sulfates and 3 million tons - in the form of hydrogen sulfide. The emission of anthropogenic nitrogen oxides occurs in the form of nitrogen oxide (II) NO and nitrogen oxide (IV) NO2 , while the absolute amounts and their ratio depend sharply on the combustion mode and flame temperature. Estimates of the size of global emissions of nitrogen oxides are very uncertain (from 40 to 90 million tons per year).

Atmospheric pollution has always been undesirable for humans, animals and plants. The concentration of flue gases increases under unfavorable - meteorological conditions and leads to the formation of thick toxic fogs called smog. It comes to catastrophic cases of accumulation of toxic substances, accompanied by serious illnesses and deaths. Smog has been reported repeatedly in various places around the globe.

In London, smog has been known since the end of the last century. The fogs of 1952 and 1956 brought especially great disasters. In 1952, smog stood over the city from December 5 to 9, and then the content of harmful impurities in the air was 5...6 times higher than the normal level. Within 12 hours, many residents began to experience respiratory symptoms , headaches and dizziness. For most people suffering from chronic bronchitis, exposure to smog ended tragically. In January 1956, smog that hung over the British capital for 96 hours claimed about 1,000 lives. It should be noted that after the adoption of the Clean Air Act in 1968, air pollution has noticeably decreased.

Due to atmospheric pollution, the penetration of the ultraviolet part of the solar spectrum decreases, the lack of which leads to the development of rickets and vitamin deficiency in children.

Harmful impurities in the air can cause poisoning and death of domestic and wild animals. In veterinary medicine, poisoning of sheep and cattle by emissions from aluminum smelters, which contain many fluoride compounds, is known. Precipitating from the air, these compounds end up on the grass, and livestock grazing on it become ill with fluoride catechia. In Switzerland, near such a plant, about a third of all local livestock died over 9 years .

In a number of places in France and Italy with a constantly smoky atmosphere, the fluorine content in mulberry leaves is 20 times higher than normal. Feeding leaves with a high fluoride content to silkworms leads to atrophy of the glands that secrete mulberry gluten. Fluoride and arsenic compounds contained in industrial emissions cause high bee mortality and reduce honey production. Arsenic poisoning is the cause of the formation of ulcers on the body of cattle.

In various countries of the world, the death of wild animals, including roe deer, deer, hares, pheasants and other game, has been repeatedly noted as a result of atmospheric contamination with sulfur dioxide, arsenic, and antimony. /

Air pollutants such as sulfur compounds, fluorine, carbon monoxide, chlorine and hydrocarbons are harmful to plants. They cause significant damage to agricultural and forest lands, gardens and parks, disrupting the process of photosynthesis, slowing down the growth and development of - plants, which gradually wither and die. It has been established that even small doses of sulfur dioxide have a negative effect on plants. Coniferous tree species are most susceptible to the harmful effects of industrial gases.

As a rule, in most CIS cities, around enterprises and along highways, the concentration of sulfur dioxide, nitrogen dioxide, carbon monoxide and dust is below the maximum permissible concentration (per person) and does not pose a particular danger to him. However, for vegetation this amount of gas, especially sulfur dioxide, and dust is not indifferent. The effect of acid on plants can be of a different nature: acute or chronic, direct or indirect, through the soil, but in any form it negatively affects both the development of an individual plant and the plant ecosystem as a whole.

Three mechanisms of the influence of sulfur oxide on vegetation can be distinguished . In the first case , SO_2 , penetrating inside the leaf, disrupts the process of photosynthesis, binding, in particular catalytically, active iron. In the second mechanism , SO2 , penetrating into cells and dissolving there, changes the pH of the cellular environment, the acidification of which, reducing the stability of biocolloids and even their coagulation, strongly affects the state of the cells, causing their damage and death. In accordance with the third mechanism, a gradual accumulation of sulfur occurs in the leaves, leading to sulfate poisoning, chlorosis and necrosis (death) occur.

Depending on the concentration of gases and the duration of their exposure, three types of plant damage are distinguished: acute, chronic and latent (physiological). Acute damage occurs when plants are exposed to high concentrations for a short period (minutes or hours). In this case, irreversible processes occur in assimilation tissues, leading to disruption of gas exchange and death of the plant. Acute damage is easily diagnosed visually , by the external state of the plant (change in leaf color, leaf fall, etc.).

Chronic damage to plants is the result of long-term (periodic or systematic) exposure to low concentrations of SO_2 . This is characterized by a decrease in the size of assimilation organs, a decrease in growth, premature leaf fall, cessation of fruiting, etc. At the same time, gas exchange is disrupted for a long time.

Latent (or physiological) damage occurs with prolonged exposure to minor concentrations. In the absence of visually observable symptoms, the vital activity of plants decreases: the growth and functions of the body are disrupted, for example, the intensity of gas exchange decreases.

Of the grain crops, barley and oats are the most sensitive to this gas; of the vegetable crops, spinach, cabbage, radishes, and lettuce are the most sensitive.

Due to air pollution, the yield of crops such as potatoes, sugar beets, tomatoes, beans, oranges, grapes, peanuts, soybeans, and tobacco decreases noticeably.

Sulfur dioxide, interacting with water and air vapor, enters building materials in the form of sulfurous acid, contributing to - the aging and destruction of buildings. Acidic rain and vapors cause corrosion of metals.

According to experts, the total annual cost of losses from air pollution in France alone is 4% of national income, in the USA - 3%, in Japan - up to 8%. This is one side of economic damage. The other side is associated with the loss of a large amount of valuable raw materials entering the air along with industrial emissions. It has been calculated that if we achieve complete purification of emitted gases from sulfur dioxide, we can obtain an additional amount of sulfur that will cover all needs for it.

Lecture No. 3, (2 hours)

Legislation in the field of mining ecology

LAW OF THE REPUBLIC OF UZBEKISTAN
ABOUT NATURE CONSERVATION
December 9, 1992
No. 754-XII

This Law establishes the legal, economic and organizational basis for preserving the conditions of the natural environment and rational use of natural resources. It aims to ensure the balanced harmonious development of relations between man and nature, the protection of ecological systems, natural complexes and individual objects, and guarantee the rights of citizens to a favorable environment.

I. GENERAL PROVISIONS

Article 1. Environmental legislation of the Republic of Uzbekistan

Relations in the field of nature protection and rational use of natural resources in the Republic of Uzbekistan are regulated by this Law, as well as land, water, forestry legislation, legislation on subsoil, on the protection and use of atmospheric air, flora and fauna, and other acts of legislation of the Republic of Uzbekistan.

Relations in the field of nature conservation in the Republic of Karakalpakstan are also regulated by the legislation of the Republic of Karakalpakstan.

Article 2. Nature conservation sites and protected natural areas

Objects of nature conservation (land, subsoil, water, flora and fauna, atmospheric air) are subject to protection from pollution, spoilage, damage, depletion, destruction, destruction, and irrational use.

Protected natural areas include state reserves, complex (landscape) reserves, natural parks, state natural monuments, territories for the conservation, reproduction and restoration of individual natural objects and complexes, protected landscapes, territories for the management of individual natural resources, state biosphere reserves, national parks interstate protected natural areas.

Article 3. Objectives of nature conservation

The goals of nature conservation are:

creating favorable conditions for human health, maintaining ecological balance, rational, non-exhaustive use of natural resources in the interests of effective and sustainable socio-economic development of the republic;

preservation of the wealth of species and genetic fund of wildlife;

preservation of the diversity of ecological systems, landscapes and unique natural objects;

ensuring environmental safety;

preservation of objects of tangible cultural heritage associated with natural objects.

Article 4. Achieving nature conservation goals

To achieve the goals of nature conservation in the process of economic, managerial and other activities, local government bodies, ministries and departments, enterprises, institutions, organizations, farms and cooperatives, as well as individuals are required to be guided by the following principles:

maintaining the sustainability of the biosphere and its ecological systems as a human habitat and caring for the environmental safety of people, the gene pool of man and his future generations;

ensuring the rights of citizens to a favorable natural environment for life, mandatory environmental education in all types of educational institutions;

scientifically based combination of environmental, economic and social interests of society;

payment for special and free of charge for general use of natural resources;

mandatory environmental impact assessment;

promoting rational environmental management and conservation;

the need to reproduce natural resources, avoid harmful, irreversible consequences for the natural environment and human health;

transparency in solving environmental problems;

combination of national, regional and international interests in the field of nature conservation;

liability for violation of environmental legislation.

Article 5. Ownership of natural resources

In accordance with the Constitution of the Republic of Uzbekistan, land, its subsoil, water, flora and fauna and other natural resources are national wealth, subject to rational use and protected by the state.

The conditions, procedure for the provision, use and protection of natural resources are determined by the legislation of the Republic of Uzbekistan.

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Article 6. General and special use of natural resources

In the Republic of Uzbekistan, general and special environmental management is carried out.

General use of natural resources is carried out by citizens free of charge to meet vital needs without assigning natural resources to individual users and without providing appropriate permits.

In the process of special use of natural resources , enterprises, institutions, organizations and citizens are granted possession, use or lease of natural resources on the basis of special permits for a fee to carry out production and other activities.

II. POWERS OF STATE AUTHORITIES AND MANAGEMENT IN THE FIELD OF REGULATING LEGAL RELATIONS ON NATURE PROTECTION

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Article 7. Competence of the Legislative Chamber and Senate of the Oliy Majlis of the Republic of Uzbekistan in the field of regulation of legal relations on nature protection

The joint jurisdiction of the Legislative Chamber and the Senate of the Oliy Majlis of the Republic of Uzbekistan includes:

determination of the main directions of state policy in the field of nature conservation;

approval of state environmental programs;

development and adoption of legislative acts in the field of nature conservation;

declaring territories as zones of environmental emergency, environmental disaster and environmental catastrophe, establishing the legal regime of these zones and the status of the victims;

coordination of control over the implementation of environmental legislation;

establishing maximum fees for the use of natural resources, as well as benefits for collecting payments;

resolving other issues provided for by law.

Article 8. Public administration in the field of ecology and environmental protection

Public administration in the field of ecology, environmental protection, rational use and reproduction of natural resources in the Republic of Uzbekistan in accordance with laws and other regulations is carried out by the Cabinet of Ministers of the Republic of Uzbekistan, the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection, government bodies on places.

Article 9. Competence of the Cabinet of Ministers of the Republic of Uzbekistan in the field of nature conservation

The competence of the Cabinet of Ministers of the Republic of Uzbekistan in the field of nature conservation includes:

implementation of a unified environmental policy;

regulation of the use of natural resources;

establishing order and ensuring the maintenance of state cadastres of natural resources, approval of reserves of natural resources of republican significance;

development of measures to prevent environmental crisis situations, natural disasters and catastrophes;

implementation of measures to eliminate the consequences of natural disasters and major accidents;

establishing a procedure for payment for the use of natural resources, environmental pollution, waste disposal, other types of harmful effects, as well as limits on the use of natural resources and waste disposal;

creating a system of environmental education and training, ensuring its functioning;

approval of the boundaries of areas of special environmental management, regimes of nature protection and economic activity;

development of interstate relations in the field of nature conservation and environmental management;

implementation of other measures provided for by acts of legislation of the Republic of Uzbekistan.

Article 10. Competence of local government authorities and management in the field of nature conservation

The competence of local government authorities and management in the field of nature conservation includes:

determination of the main directions of nature conservation on its territory, approval of regional (territorial) environmental programs;

accounting and assessment of the state of natural resources, accounting of environmentally harmful objects;

logistics support for environmental protection activities;

issuing permits for the right to use natural resources in the prescribed manner;

charging for the use of natural resources;

control over environmental protection, making decisions on the suspension, termination and repurposing of the activities of local facilities that have a harmful impact on the environment;

regulation of other issues provided for by the legislation of the Republic of Uzbekistan.

Suspension (except for cases of suspension of activities for a period of no more than ten working days in connection with the prevention of emergencies, epidemics and other real threats to the life and health of the population) or termination and repurposing of the activities of local facilities that have a harmful impact on the environment, which are business entities , carried out in court.

Article 11. Powers of the State Committee of the Republic of Uzbekistan on Ecology and Environmental Protection

The State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection carries out:

public administration in the field of ecology, environmental protection, rational use and reproduction of natural resources;

state control over compliance with legislation on waste management;

state environmental control over compliance with legislation on the protection and use of lands, subsoil, waters, forests, protected natural areas, flora and fauna, and atmospheric air protection;

coordination of work on ecology and environmental protection, ensuring interdepartmental interaction in the development and implementation of a unified environmental and resource-saving policy.

The State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection may exercise other powers in accordance with the legislation.

The State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection in its activities is accountable to the Cabinet of Ministers of the Republic of Uzbekistan.

Decisions of the State Committee of the Republic of Uzbekistan on Ecology and Environmental Protection, adopted within the limits of its powers, are binding on state and economic management bodies, local government bodies, economic entities, regardless of their form of ownership and departmental subordination, and citizens.

III. RIGHTS AND OBLIGATIONS OF RESIDENTS OF THE REPUBLIC OF UZBEKISTAN IN THE FIELD OF NATURE PROTECTION

Article 12. Human right to a natural environment favorable for life and obligations to preserve it

Residents of the Republic of Uzbekistan have the right to live in a natural environment favorable to their health and the health of future generations, and to protect their health from adverse environmental influences.

For these purposes, residents of the Republic of Uzbekistan have the right to unite in public organizations for nature protection, demand and receive information about the state of the natural environment and measures taken to protect it.

Residents of the Republic of Uzbekistan are obliged to rationally use natural resources, treat the wealth of nature with care, and comply with environmental requirements.

Article 13. Powers of public environmental associations

The powers of public associations operating in the field of nature conservation are determined by their charters, adopted in accordance with the legislation of the Republic of Uzbekistan.

IV. REGULATORY REGULATION OF ENVIRONMENTAL QUALITY

Article 14. Norms and standards of environmental quality

The adverse impact of economic activities on the natural environment is limited by regulations and environmental quality standards that guarantee the environmental safety of the population, reproduction and protection of natural resources.

When forming territorial production complexes, developing industry, agriculture, construction and reconstruction of cities and other populated areas, maximum permissible norms of load on the natural environment are established.

Article 15. Development and approval of environmental standards

Enterprises, organizations and institutions are required to develop environmental and other criteria regulating the maximum permissible load on the environment.

The use of chemicals in agriculture is permitted in accordance with the legislation of the Republic of Uzbekistan.

V. REGULATION OF THE USE OF NATURAL RESOURCES

Article 16. Conditions for the use of natural resources

The use of natural resources is permitted subject to compliance with environmental legislation, maintaining the integrity of natural communities, preventing disturbance of the habitat and growth of wildlife, and not violating the rights of other users of natural resources.

Article 17. Conditions for using soil

The surface fertile layer of the earth's crust, covered by vital activity and functioning together with the vegetation cover, is considered as soil.

The soil is used to obtain yields of natural and cultivated plants without reducing its fertility.

The humus layer of soil falling under the structures must be removed and transferred to improve soil fertility in other places.

Article 18. Conditions for the use of subsoil and minerals

The use of subsoil and mineral resources is permitted subject to:

ensuring the integrated and economical use of subsoil and minerals and related natural resources during production, as well as preventing pollution of the environment and subsoil;

reclamation of lands disturbed by mining;

use of renewable mineral resources only within the limits of their natural renewal;

compliance with established rules in the field of use of subsoil and common minerals;

the presence of a positive conclusion from the state environmental assessment of projects for the development of mineral deposits, as well as projects for the construction, reconstruction and expansion of enterprises for the extraction and processing of mineral raw materials;

availability of a permit for the right to use subsoil plots or a production sharing agreement, which provides for the provision of subsoil plots for use;

placement of overburden and host rock dumps, tailings dumps, waste heaps, ensuring minimal harmful impact on the environment.

Article 19. Conditions for the use of waters and reservoirs

Surface, underground and sea waters on the territory of the Republic of Uzbekistan are used subject to the preservation of the required amount of water in the natural circulation, ensuring its standard purity, preserving aquatic flora and fauna, preventing pollution of reservoirs, maintaining ecological balance in them and not causing damage to the reservoir as an element of the landscape.

Local authorities, forestry and water management authorities are obliged to carry out reforestation and afforestation in zones of river flow formation, coastal strips of water bodies and ensure their safety.

Article 20. Conditions for using atmospheric air

The airspace above the territory of the Republic of Uzbekistan is considered as atmospheric air . Air is used under the condition that there is no change in the air quality of a given area, its pollution or depletion in excess of established standards.

In accordance with the international agreement, ministries and departments, enterprises, institutions, organizations, and individuals are obliged to reduce and subsequently completely stop the production and use of chemicals that have a harmful effect on the ozone layer.

Article 21. Conditions for the use of wildlife objects

Wildlife is considered to be natural flora, including forests, free-living animals and other living organisms.

Wildlife objects are used on condition that:

maintaining their ability to recover;

preservation of their species diversity and stability of communities;

preventing biological pollution of the natural environment.

Article 22. Conditions for waste management

Waste management is carried out in accordance with the procedure established by law.

Waste owners are responsible for environmentally safe waste management. The decision on the placement of waste management facilities in the relevant territory is carried out by local government authorities.

Article 23. Deprivation of the right to use natural resources

A user who systematically violates the requirements for the use of natural resources may be deprived of the right to use them.

VI. ENVIRONMENTAL ASSESSMENT

Article 24. State environmental examination

State environmental assessment is a mandatory measure of environmental protection that precedes the adoption of an economic decision.

The state environmental assessment is carried out in the manner determined by the legislation of the Republic of Uzbekistan.

Article 25. Objects of state environmental expertise

Objects of state environmental impact assessment are established by law.

The implementation of projects without a positive conclusion from the state environmental assessment is prohibited.

Article 27. Public environmental review

Public environmental assessment is carried out by independent groups of specialists at the initiative of public associations at their own expense or on a voluntary basis.

The conclusions of the public environmental review are advisory in nature.

VII. ENVIRONMENTAL CONTROL

Article 28. Environmental monitoring

In order to ensure observations, accounting, assessment and forecast of the state of the natural environment and its resources on the territory of the Republic of Uzbekistan, a system of state environmental monitoring is being created.

Monitoring the state of the natural environment and the use of natural resources is carried out by specially authorized bodies, as well as enterprises, organizations and institutions whose activities lead or may lead to deterioration of the state of the natural environment.

Specially authorized bodies, as well as specified enterprises, organizations and institutions, are obliged to transfer materials of their observations to the relevant government bodies free of charge.

The procedure for environmental monitoring is developed by the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection and approved by the Cabinet of Ministers of the Republic of Uzbekistan.

Article 29. Main tasks of environmental control

The main objectives of environmental control are:

prevention, detection and suppression of violations of legal requirements in the field of environmental protection and rational use of natural resources;

monitoring the state of the environment, identifying situations that could lead to environmental pollution, irrational use of natural resources, and pose a threat to the life and health of citizens;

determining compliance with environmental requirements of planned or ongoing economic and other activities;

ensuring compliance with the rights and legitimate interests of legal entities and individuals, their fulfillment of responsibilities in the field of environmental protection and rational use of natural resources;

informing government and other organizations and citizens about changes in the environment, forecasts of its condition, the use of natural resources and appropriate measures taken;

increasing the efficiency of environmental activities and ensuring the participation of self-government bodies of citizens, non-governmental non-profit organizations and citizens in the implementation of state and other environmental programs.

Article 30. State service for monitoring the state of the natural environment

The state service for monitoring the state of the natural environment is organized with the aim of monitoring the physical, chemical, biological processes occurring in it, the level of pollution of atmospheric air, soil, surface and groundwater, the consequences of the influence of pollution on flora and fauna, providing assistance to interested organizations and the population current and emergency information about changes in the natural environment and forecasts of its condition.

Information on the state of the natural environment is open; its main indicators are regularly provided by government agencies for ecology and environmental protection for publication.

State bodies for ecology and environmental protection are obliged to immediately inform the public about accidents and other cases that result in excess pollution of the natural environment.

To take into account the quantitative, qualitative and other characteristics of natural resources, the volume, and the nature of their use, state cadastres of natural resources are maintained.

Objects that have a harmful effect or may have an adverse effect on the state of the natural environment, the types and quantities of harmful substances entering the natural environment, and the volume and composition of waste are also subject to observation and state registration.

The composition, procedure for organizing and operating the state service for monitoring the state of the natural environment, the procedure for maintaining state cadastres of natural resources, state registration of objects that adversely affect the environment are established by the Cabinet of Ministers of the Republic of Uzbekistan.

Article 31. Legal regulation of relations in the field of environmental control

Legal relations arising in connection with the implementation of environmental control and the exercise of powers of subjects of environmental control are regulated by law .

VIII. ECONOMIC MEASURES TO ENSURE NATURE PROTECTION

Article 33. Economic mechanism for ensuring environmental protection

The economic mechanism for ensuring nature protection provides for:

charging fees for the special use of natural resources, for pollution of the natural environment (including waste disposal) and other types of harmful effects on it;

collection of a recycling fee to ensure environmental safety, protect the health of citizens and the environment from the harmful effects of waste generated after the loss of consumer properties of wheeled vehicles, self-propelled vehicles and trailers for them (hereinafter referred to as the recycling fee);

tax, credit and other benefits provided to enterprises, institutions and organizations, as well as individuals when introducing low-waste and resource-saving technologies, carrying out activities that have an environmental and restoration effect;

introduction of special taxation of enterprises, institutions, organizations for the use of environmentally hazardous technologies and the implementation of other environmentally hazardous activities;

obtaining licenses (permits) for the right to emit, discharge substances polluting the environment or to carry out other environmentally harmful activities;

imposing responsibilities on enterprises, institutions, organizations and citizens to restore the favorable state of the natural environment that they have violated;

recovery in accordance with the established procedure of monetary compensation for damage caused as a result of damage or destruction of natural objects;

complete or partial deprivation of officials or other employees of bonuses and other remuneration issued based on the results of the main production activities, in cases of failure to implement plans and measures for environmental protection, violation of regulatory, technical and other requirements of legislation in the field of environmental protection;

incentive prices and premiums for environmentally friendly products;

application of economic sanctions to natural resources users for wasteful, excessive use of natural resources and economic incentives for their saving and rational use;

material incentives for teams and individual employees of state, cooperative, public and other enterprises, institutions and organizations, as well as individuals who have achieved the highest results in the field of environmental protection and in the production of environmentally friendly products.

The legislation of the Republic of Uzbekistan, decisions of local government authorities and management may establish other types of economic incentives for environmental protection activities.

The application of measures of economic incentives for environmental protection activities is carried out in the manner determined by the legislation of the Republic of Uzbekistan, as well as decisions of local government authorities and administration.

Article 34. Payments for special use of natural resources and for environmental pollution

Payments for special use of natural resources and for environmental pollution consist of taxes and other obligatory payments for the use of natural resources, recycling fees, as well as compensation payments for environmental pollution (emissions, discharges of pollutants and waste disposal), fees for the protection and reproduction of natural resources.

Tax rates and amounts of other mandatory payments, including rent, for the use of natural resources, taking into account their prevalence, quality, reproduction capacity, accessibility, complexity, productivity, location, possibility of processing and disposal of waste and other factors, as well as corresponding limits are determined and approved in the manner prescribed by law.

The amount of compensation payments for environmental pollution is approved by the Cabinet of Ministers of the Republic of Uzbekistan on the proposal of the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection.

The amounts of payments for the protection and reproduction of natural resources are established by the Cabinet of Ministers of the Republic of Uzbekistan.

Payments for the use of natural resources are included in the cost of products (works, services) of enterprises using natural resources.

Compensation payments for environmental pollution, as well as excess (exceeding the norm) and other irrational special use of natural resources are collected from the income (profit) of a legal entity.

Payments for the use of natural resources, their protection and reproduction go to the state budget.

Amounts of compensation payments for emissions and discharges of pollutants into the environment and waste disposal go to the Ecology, Environmental Protection and Waste Management Fund.

The amounts of the recycling fee are transferred to the treasury personal income account.

Benefits for payments for special use of natural resources and compensation payments for environmental pollution are established by law.

Payment of fees for the use of natural resources and compensation payments for environmental pollution does not relieve legal entities and individuals from carrying out environmental measures and from the obligation to compensate for the harm caused.

Article 35. Fund for Ecology, Environmental Protection and Waste Management

To finance activities related to ecology and environmental protection, including in the field of waste management, conservation and reproduction of biological resources, conducting research activities in the field of ecology, environmental protection and monitoring, organizing propaganda and education, training, retraining and to improve the qualifications of specialists in the field of ecology and environmental protection, the Foundation for Ecology, Environmental Protection and Waste Management is being formed in the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection.

The procedure for the formation and use of the Fund for Ecology, Environmental Protection and Waste Management is determined by the Cabinet of Ministers of the Republic of Uzbekistan.

Article 36. Environmental insurance

In the Republic of Uzbekistan, voluntary and compulsory insurance of property and income of enterprises, institutions and organizations, life, health and property of citizens is carried out in case of damage resulting from pollution of the environment and deterioration in the quality of natural resources.

The procedure and conditions of environmental insurance are established by the legislation of the Republic of Uzbekistan.

Article 37. Incentives in the nature conservation system

Stimulation of rational use of natural resources and protection of the natural environment is carried out by:

providing tax benefits to enterprises, institutions, organizations and citizens in cases where they implement measures for the rational use of natural resources and nature conservation;

provision of short-term and long-term credits (loans) on preferential terms to implement measures to ensure the rational use of natural resources and nature conservation;

establishing increased depreciation rates for fixed production assets;

transfer of part of the funds of the Fund for Ecology, Environmental Protection and Waste Management on contractual terms under interest-bearing loans to enterprises, institutions, organizations and individuals for the implementation of measures to reduce emissions and discharges of pollutants.

IX. ENVIRONMENTAL EMERGENCIES

Article 38. Elimination of accidents and their harmful environmental consequences

In the event of an accident, an enterprise, institution or organization is obliged to immediately begin its liquidation in accordance with its action plans in environmental emergencies. At the same time, they immediately notify local government authorities, ecology and environmental protection authorities, as well as specialized services for eliminating the harmful environmental consequences of these accidents about the accident and the measures taken to eliminate it.

Article 39. Zones of environmental emergency and environmental disaster

Zones of environmental emergency are areas of territories, including water and air space, where, as a result of economic and other activities, the destructive influence of natural forces or an accident or catastrophe, sustainable negative changes occur in the natural environment that threaten human health and the state of natural ecological systems. , genetic funds of plants and animals.

Environmental disaster zones are areas of territories where sustainable or irreversible changes in the natural environment have occurred or are occurring, associated with the disruption of natural balance, the destruction of natural ecological systems.

Decisions to declare zones of environmental emergency or environmental disaster are made in the manner established by law.

In areas of environmental emergencies and environmental disasters, the work that caused this situation is suspended, activities (except those related to serving the population) that have a harmful effect on the natural environment are prohibited, and measures are taken to restore and improve it.

Article 40. Potentially environmentally hazardous situations

Environmentally potentially dangerous are situations associated with the threat of increased pollution of the natural environment, damage to natural systems, harm to human health and life during storage, transportation and use of highly toxic, highly toxic, radioactive and other substances classified by the State Committee of the Republic of Uzbekistan for Ecology and environmental protection to the first hazard class.

In the event of environmentally potentially hazardous situations arising around the relevant production facilities, along transport highways, the bodies of the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection establish a special legal regime.

X. ENVIRONMENTAL REQUIREMENTS FOR

ECONOMIC AND OTHER ACTIVITIES

Article 41. Environmental requirements for the placement, design, construction, reconstruction, operation and liquidation of enterprises, structures and other facilities

When locating, designing, constructing reconstruction, expansion and technical re-equipment, operation and liquidation of enterprises, structures and other facilities, environmental safety requirements must be met and measures for nature protection must be provided.

Enterprises, organizations, institutions, individuals are obliged to introduce waste-free and low-waste technologies, reduce the generation of waste, neutralize it, process it, and comply with the rules for sorting, storing, burying and recycling.

Decisions on the development and location of large national economic facilities, the activities of which can have a significant harmful environmental impact on the environment, are made by the Cabinet of Ministers of the Republic of Uzbekistan on the basis of the conclusion of the state environmental assessment.

Commissioning of facilities that do not meet environmental requirements is prohibited.

Article 42. Environmental requirements for handling radioactive and chemical substances

Enterprises, institutions, organizations and individuals are obliged to comply with environmental requirements, established standards and rules during the production, storage, transportation, use, neutralization and disposal of radioactive and chemical substances, take measures to prevent and eliminate the harmful consequences of their use, immediately inform radiation authorities and chemical safety when these standards are exceeded.

Disposal of radioactive waste and chemicals is permitted if there is a positive conclusion from the state environmental assessment in agreement with local government authorities and state sanitary and mining supervision authorities.

Article 43. Protection of nature from the influence of noise, vibration, electromagnetic fields and other harmful physical influences

Local government authorities and management, enterprises, institutions, organizations, individuals are obliged to take measures to prevent and eliminate harmful industrial noise, vibration, exposure to electromagnetic fields and other factors that have a harmful physical effect.

Article 44. Protection of nature from uncontrolled and harmful biological effects

Enterprises, institutions, organizations that have or may have a harmful biological impact on nature are obliged to take measures to prevent and eliminate the consequences of such impact.

The production and use of new microorganisms, viruses and forms, as well as their import into the Republic of Uzbekistan, are permitted only if there is a positive conclusion from the state sanitary inspection authorities.

Article 45. Protection of nature from waste pollution

It is prohibited to store and bury waste on lands of populated areas, environmental, health, recreational purposes, lands occupied by objects of tangible cultural heritage, in other places where there may be a threat to the life and health of citizens, as well as harm to environmental protection objects and protected natural areas.

Disposal of waste in the subsoil is permitted in exceptional cases based on the results of special studies in compliance with the requirements for ensuring the safety of life and health of citizens, the environment, and the preservation of natural resources.

Waste processing, burial and storage of waste at landfills are carried out in the presence of a positive conclusion from the state environmental assessment.

Article 46. Environmental certification

It is prohibited to use raw materials and materials, introduce technological processes and produce finished products (including food products) without environmental or hygienic certificates, as well as with deviations from the parameters specified in them. Environmental certification is also carried out in cases provided for by law.

The procedure for environmental certification is approved by the Cabinet of Ministers of the Republic of Uzbekistan

XI. RESPONSIBILITY FOR VIOLATION OF ENVIRONMENTAL LEGISLATION, RESOLUTION OF DISPUTES IN THE FIELD OF NATURE PROTECTION

Article 47. Liability for violation of environmental legislation

Persons guilty of:

violation of standards, norms, rules and other regulatory and technical requirements for nature protection, including violations of the established ecological capacity of the territory, environmental standards, rules for planning, construction, reconstruction, operation or liquidation of enterprises, structures, vehicles and other objects, export, import of environmentally hazardous products;

unauthorized use of natural resources, failure to comply with the requirements of the state environmental assessment;

refusal to pay the established fee for the use of natural resources, as well as compensation payments for environmental pollution and other types of harmful effects on it;

failure to implement plans for the construction of environmental facilities and other environmental protection measures;

failure to take measures to restore the natural environment, eliminate the consequences of harmful impacts on it and reproduce natural resources;

failure to comply with the instructions of the bodies exercising state control and supervision of nature protection;

violation of the legal regime of environmental protection objects and protected natural areas;

violation of the rules for accounting for harmful effects on the environment;

violation of environmental requirements during storage, transportation, use, neutralization and disposal of waste, chemical agents, as well as radioactive and harmful chemicals;

preventing officials exercising state control and supervision in the field of environmental protection from visiting sites, and preventing individuals and public environmental organizations from exercising their rights and obligations;

refusal to provide timely and reliable information about the state of the natural environment and the use of its resources incur disciplinary, administrative, criminal and other liability in accordance with the legislation of the Republic of Uzbekistan.

Article 48. Restriction, suspension, termination and repurposing of the activities of facilities that have a harmful impact on the environment

In cases of a harmful impact on the health or living conditions of people, on natural resources, protected natural areas, or the threat of such an impact arises, the activities of enterprises, organizations, structures and other objects may be limited, suspended, and if it is impossible to eliminate the causes of the harmful impact, terminated or repurposed .

Decisions to limit, suspend, terminate, or repurpose the activities of such facilities with the simultaneous termination of their financing are made by state authorities and management bodies, ecology and environmental protection authorities in accordance with their powers. The specified measures are applied to business entities in court, with the exception of cases of suspension of activities for a period of no more than ten working days in connection with the prevention of emergencies, epidemics and other real threats to the life and health of the population.

Article 49. Obligation to compensate for damage caused by violation of environmental legislation

Enterprises, institutions, organizations and individuals that have caused harm to the natural environment are obliged to compensate it, including lost profits, in accordance with the law.

Bringing administrative or criminal liability to those responsible for violating environmental requirements does not relieve them of the obligation to compensate for damage caused to the environment.

Article 50. Liability for violation of environmental legislation

For irrational special use of natural resources, above-standard and above-limit emissions and discharges of pollutants into the environment, waste disposal, enterprises, institutions, organizations and individuals are subject to increased taxation in accordance with the legislation of the Republic of Uzbekistan.

In appropriate cases, by decision of local government authorities, ecology and environmental protection authorities, financing of economic activities of legal entities and individuals may be suspended until the causes of these violations are eliminated. This measure is applied to business entities in court, with the exception of cases of suspension of financing of economic activities for a period of no more than ten working days in connection with the prevention of emergencies, epidemics and other real threats to the life and health of the population.

Article 51. Liability of officials and other employees guilty of causing harm due to violation of environmental legislation

Officials and other employees, through whose fault an enterprise, institution, or organization suffered damage related to compensation for damage caused to the environment, health and property of people and the national economy, bear financial liability in accordance with the legislation of the Republic of Uzbekistan.

Article 52. Claims for termination of environmentally harmful activities

Legal entities and individuals have the right to apply to the court with claims to stop environmentally harmful activities that cause harm to the environment, health, property of people and the national economy.

A court decision to stop environmentally harmful activities is grounds for stopping financing of these activities.

Article 53. International treaties in the field of nature conservation

In cases where an international treaty concluded by the Republic of Uzbekistan establishes rules other than those contained in this Law or other legislative act of the Republic of Uzbekistan on nature protection, the rules of the international treaty are applied, except in cases where the legislation of the Republic of Uzbekistan establishes more stringent requirements .

WASTE LAW

April 5, 2002,

Article 1. Purpose and main objectives of this Law

The purpose of this Law is to regulate relations in the field of waste management.

The main objectives of this Law are to prevent the harmful effects of waste on the life a
reduce the generation of waste and ensure their rational use in economic activities.

Article 2. Basic concepts

The following basic concepts apply in this Law:

waste management - activities related to accounting and control in the field of waste man
of waste disposal and disposal sites, generation, collection, placement, transportation, neu
and sale of waste;

waste disposal - activities related to the neutralization, decontamination, disinfection, deme
thermal treatment and disposal of waste;

waste management facilities - facilities used for collection, placement, transportation, neu
and sale of waste;

waste passport - a document certifying the place of origin and individual properties of was

waste - remnants of raw materials, materials, semi-finished products, other items or prod
production or consumption, as well as goods (products) that have lost their consumer prop

waste disposal limit - the maximum amount of waste allowed for disposal for a certain per

waste disposal facility - a specially designated and equipped place for storing and neutraliz

waste disposal - waste isolation aimed at preventing pollutants from entering the enviro
further use of this waste;

waste storage - keeping waste in specially equipped storage tanks until they are remo
processing or disposal;

waste recycling - extraction of valuable components f
other purposes;

waste processing - the implementation of technologica
properties of waste in order to prepare them for enviro

waste generation standard - an established amount of w
of raw materials;

hazardous waste - waste containing substances that ha
hazard, fire hazard, high reactivity, radioactivity) and a
potential danger to the life and health of citizens, the e

Article 3. Legislation on waste management

Legislation on waste management consists of this Law

Legislation on waste management does not apply to rel
bodies.

Relations in the field of waste management in the Repu
of Karakalpakstan.

If an international treaty of the Republic of Uzbekista
Republic of Uzbekistan on waste management, then th

Article 4. Ownership of waste

The right of ownership of waste belongs to the owner o
as well as goods (products) as a result of the use of wh

Ownership of waste can be acquired by another person
transaction for the alienation of waste not prohibited by

Waste owners own, use and dispose of waste within th

The transfer of ownership of waste and liability for ha
located is changed is decided in accordance with the la

Article 5. Powers of the Cabinet of Minister

Cabinet of Ministers of the Republic of Uzbekistan:

approves state waste management programs and ensur

establishes the procedure for state accounting and cont

establishes the procedure for maintaining the state cad

establishes the procedure for the development and app

establishes the procedure for the import, export and tra

establishes the procedure for certification of waste;

approves the list of hazardous wastes and wastes, the t

resolves issues regarding the provision of land plots fo establishes the procedure for circulation of non-deposit containers and containers;

establishes the amount of compensation payments for waste disposal;

exercises other powers in accordance with the law.

Article 6. Specially authorized state bodies in the field of waste management

Specially authorized government bodies in the field of waste management are:

State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection

Ministry of Health of the Republic of Uzbekistan;

Uzbek agency “Uzkommunkhizmat”;

State Committee for Industrial Safety of the Republic of Uzbekistan.

Article 7. Powers of the State Committee of the Republic of Uzbekistan on E in the field of waste management

State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection:

carries out state control over compliance with the requirements of legislation [illegible]

coordinates the activities of specially authorized state bodies in the field of waste management;

maintains the state cadastre of waste disposal and disposal sites;

conducts state environmental assessment of scientific research and technological developm
waste management;

gives consent to the established waste generation standards and waste disposal facilities;

approves waste disposal limits;

exercises other powers in accordance with the law.

Article 8. Powers of the Ministry of Health of the Republic of Uzbekistan in th

Ministry of Health of the Republic of Uzbekistan:

carries out state sanitary and epidemiological supervision over compliance with establis
handling waste;

determines measures to protect the life and health of citizens from the harmful effects of w

issues conclusions of the state sanitary and hygienic examination of waste management fa

establishes sanitary and hygienic requirements for goods (products) released from waste a

provides methodological support in determining the degree of danger of waste to the life a

exercises other powers in accordance with the law.

Article 9. Powers of the Uzbek agency “Uzkommunkhizmat” in the field of wa

Uzbek agency “Uzkommunkhizmat”:

develops and submits for approval in the prescribed manner to the Cabinet of Ministe
programs for the management of household waste;

monitors the state of collection, transportation, processing and disposal of household wast

exercises other powers in accordance with the law.

Article 10. Powers of the State Committee f
management

The State Committee for Industrial Safety of the Repu

state control and supervision over the accounting, stora

state control over radiation safety during storage, trans

other powers in accordance with the law.

Article 11. Powers of local government autho

Local government authorities:

participate in the implementation of national waste ma

approve local waste management programs;

create conditions for the development of business activ

[illegible] placement of waste management facili

exercise control over compliance with legislation on wa

promote the creation [illegible] collection and recyclin

exercise other powers in accordance with the law.

Article 12. Powers of citizens' self-governme

Citizens' self-government bodies:

participate in resolving issues of siting waste managem

promote sanitary cleaning of populated areas and timel

carry out public control over the sanitary and environm

exercise other powers in accordance with the law.

Article 13. Rights and obligations of citizens

Citizens have the right to:

safe conditions for their life and health when handling

obtaining, in the prescribed manner, complete and rel
residence, the safety of waste management facilities b

participation in the discussion of draft decisions on the

compensation for damage caused to their life, health a

participation in public control over the sanitary and en

Citizens are obliged:

comply with established sanitary standards and rules a

pay in accordance with the established procedure a f
collection of household waste.

Citizens may have other rights and bear other responsi

Article 14. Rights of legal entities in the field

Legal entities have the right to:

receiving from specially authorized state bodies in the field of waste management [illegible]

standards and rules, environmental standards in the field of waste management;

storage of waste at waste disposal sites in accordance with sanitary standards and rules for

submission to specially authorized state bodies in the field of waste management, local go

to the placement, design, construction and operation of waste management facilities;

participation in the development of state waste management programs;

compensation for harm caused to them by other persons [illegible]

Legal entities may have other rights in the field of waste management in accordance with

Article 15. Obligations of legal entities in the field of waste management

Legal entities are obliged:

comply with established sanitary standards and rules, environmental standards in the field

keep records of waste and submit reports on it in the manner prescribed by law;

determine in the prescribed manner the degree of danger of waste to the life and health of

develop draft waste generation standards and waste disposal limits;

prevent the throwing out and storage of construction and household waste on public lands on roadways;

ensure waste collection, install containers (urns) near or on the adjacent territory of their bu storage of solid household waste;

ensure proper storage and prevention of destruction and damage to waste that has resource

take measures to develop and implement waste disposal technologies of which they are th

do not allow mixing of waste, except in cases provided for by the production technology;

do not allow storage, processing, recycling and neutralization of waste, as well as placeme places or objects;

do not burn waste without the use of special technical devices;

not violate the requirements for the placement and operation of sanitary cleaning infrastru

exercise control over the sanitary and environmental condition of its own waste disposal f

carry out work on the reclamation of disturbed land plots when handling waste;

implement a set of measures to maximize waste recycling, sell or transfer them to other l the collection, storage and disposal of waste, as well as ensure environmentally safe dispo

submit, in the prescribed manner, to local government authorities, specially authoriz management, information on cases of unauthorized release of waste into the environment

make compensation payments for waste disposal in accordance with the established proce

compensate for damage caused to the life, health and property of citizens, the environmen management.

Legal entities may also bear other responsibilities in th

Article 16. Rights and obligations of individu

Individual entrepreneurs in the field of waste manager

for legal entities.

Article 17. Ensuring safety when handling w

The activities of legal entities in the field of waste m

environment.

The activities of legal entities may be limited, suspen

violation of the requirements of the legislation on wa

environment, as well as in cases of hazardous waste ge

for life and the health of citizens and the environment.

Article 18. Standardization in the field of wa

In order to ensure the protection of life and health of

standards and waste disposal limits are being develope

Waste generation standards are developed and approv

bodies in the field of waste management.

Waste disposal limits are developed by legal entities ar

management.

The procedure for developing and approving waste ger

Article 19. Environmental certification of wa

Waste that is the object of purchase and sale, export-in

undergo environmental certification for compliance wi

management, based on the results of which the owners

The procedure for environmental certification of waste

Article 20. Transportation of hazardous was

Transportation of hazardous waste is carried out by veh

waste certificate and a permit issued in the manner pre

The transport organization is responsible for the safe tr

Article 21. Import of waste

The import of waste, including any types of radioactive

the purpose of storage and burial is prohibited.

In accordance with the procedure established by law, th

ensuring the safety of life and health of citizens and th

Article 22. Requirements for storage and dis

Waste storage is carried out in accordance with sanitary

that ensure the rational use of waste or its transfer to o

Disposal of industrial and household waste without special technical devices is prohibited

The place for disposal of waste (except for hazardous waste) is determined by local govern

by law.

Disposal of waste for the disposal of which appropriate technologies exist in the Republic

It is prohibited to store and neutralize waste on lands of populated areas, environmental, occupied by objects of tangible cultural heritage, in other places where there may be a th well as harm to environmental protection objects and protected natural areas.

Disposal of waste in the subsoil is permitted in exceptional cases based on the results of requirements for ensuring the safety of life and health of citizens, the environment, and th

Article 23. Compensation payments for waste disposal

Compensation payments are collected for the disposal of waste in specially designated and

The amount of compensation payments is determined in accordance with the established p depending on the degree of danger to the life and health of citizens and the environment.

Article 23 1 . Recycling collection

In order to ensure environmental safety, protect the health of citizens, and the environm generated after the loss of consumer properties of wheeled vehicles, self-propelled vehicle paid.

The recycling fee is charged:

State Customs Committee of the Republic of Uzbekistan - when placing wheeled vehicles them under the customs regime of "release for free circulation (import)";

State Tax Committee of the Republic of Uzbekistan - in the production (assembly, ma propelled vehicles and trailers for th

The size of the recycling fee, the types and categories of wheeled vehicles, self-propelled of which the recycling fee is paid, as well as the procedure for collecting, returning and u accordance with the law.

The costs of creating infrastructure for handling waste generated after the loss of consum propelled vehicles and trailers for them are financed from funds received from the recyclin

Article 24. Stimulating activities for recycling waste and reducing its formatio

Legal entities and individuals developing and implementing technologies aimed at rec creating enterprises and workshops, producing equipment for waste disposal, taking an eq for waste disposal and reducing their generation are provided with benefits in accordance

Local government authorities may establish, within their competence, additional measur and reduce their generation.

Article 25. Financing of waste disposal and reduction measures

Financing of waste disposal and reduction activities is from the Fund for Ecology, Environmental Protection from legal entities and individuals, as well as funds fro

Article 26. State accounting of waste

Waste imported, exported, available and generated on is subject to state registration.

The form of state statistical reporting on waste and th Republic of Uzbekistan on Statistics.

Article 27. Certification of waste

Waste generated on the territory of the Republic of Uz

A waste passport is drawn up by legal entities for ea associated with production technology, changes and

The procedure for certification of waste is established

Article 28. State cadastre of waste disposal a

In order to ensure the effective processing, storage cadastre of waste disposal and disposal sites is maint information on their handling and measures to reduce t

The state cadastre of waste disposal and disposal sites

Article 29. Dispute resolution

Disputes in the field of waste management are resolved

Article 30. Liability for violation of legislatio

Persons guilty of violating waste management laws are

Lecture No. 4, (2 hours).

Classification of impacts of a mining enterprise on the environment

Environmental protection in the mining industry.

- Sources of pollution –

Sources of emissions of harmful substances into the atmosphere - are divided into organized and unorganized, stationary and mobile.

Organized industrial emissions into the atmosphere are caused by the activities of industrial and municipal boiler houses; drying plants for processing, sintering and briquette factories; aspiration systems for processing and briquette factories, coal sorting plants and industrial complex buildings.

The main sources ***of unorganized*** industrial emissions into the atmosphere are open warehouses of minerals and enrichment products; burning rock dumps; tailings ponds of processing plants; technological and transport equipment ; blasting operations in open-pit mines and quarries.

To ***stationary*** Sources of environmental pollution include industrial and municipal boiler houses, drying installations and aspiration systems, burning rock dumps, and main ventilation fans.

Mobile sources of pollution - vehicles, excavators , bulldozers running on gasoline or diesel fuel.

Among the main harmful substances emitted into the atmosphere are ***solid*** - coal, mine and rock dust, ash, soot and ***gaseous*** - sulfur dioxide, hydrogen sulfide, nitrogen and carbon oxides, hydrocarbons.

The general trend in changes in indicators for the protection of the atmosphere , for example in the coal industry, according to data from the Moscow Research Institute of Economy and Economy, shows that the amount of harmful substances generated in 2000 amounted to 4.94 million tons, in 2005 - 5.61 million tons, including solids, respectively 3.91 and 4.54 million tons, and gaseous - 1.03 million tons and 1.06 million tons, respectively, the amount of captured and neutralized harmful substances in 2000 amounted to 3.1 million tons, in 2005 - 4, 13 million tons, of which 3.09 and 4.12 million tons are solid, respectively, i.e. the degree of capture of harmful substances in 1990 was 73.6%, of which 90.8% were solid and only 0.6% gaseous.

The most important characteristics of emissions are the qualitative composition, determined by the type of production and its technology, the concentration of pollutants, power - the amount of substance emitted per unit of time.

The composition of the air entering underground mine workings changes due to the influx of gases contained in the mountain range; oxidative processes; conducting blasting operations; mine fires; dust formation during the destruction of rocks and minerals; methane and dust explosions. As a result of these processes, harmful toxic impurities are released into the air: carbon dioxide, carbon monoxide, hydrogen sulfide, nitrogen oxides, sulfur dioxide gases, methane, hydrogen, heavy hydrocarbons, etc. In some mines, ammonia, arsenic and mercury vapors, hydrogen cyanide and various aldehydes are found .

The emission of harmful substances into the atmosphere is determined by ***natural and industrial factors*** . The former include the composition of host - rocks and minerals, oxidation processes, mine and quarry waters, and the latter mainly include the use of explosives during mining operations. When developing coal deposits, natural factors predominate, while ore deposits are dominated by industrial factors, to which a significant contribution is made by the exhaust gases of the self-propelled equipment used and drilling and blasting operations.

In mines, the bulk ***of carbon dioxide*** (90...95%) is formed during the oxidation of wood and coal, the decomposition of rocks by acidic mine waters, and the release of carbon dioxide from coal and rocks. The determining factor is the length of the mine workings and the volume of mined-out space. The composition and flow rate of gas emerging from the rock mass depends on the gas zoning of the field, the depth of development and the volume of production.

The main sources of ***carbon monoxide pollution*** include - mine fires, coal dust and methane explosions, and blasting operations. Fires caused by spontaneous combustion of coals pose a particular danger, since their detection is difficult.

Hydrogen sulfide in mines is released during the rotting of organic substances , decomposition of sulfurous pyrites and gypsum by water, as well as during fires and blasting operations. Sulfur dioxide is released in small quantities from rocks and coal along with other gases.

Methane is the main gas released from coal and host rocks ; heavy hydrocarbons can also be released in small quantities. If coal seams were subjected to thermometamorphism (Norilsk deposit), the content of heavy hydrocarbons increases significantly. Most of the methane in coal seams is in a bound state, in a free state - no more than 10... 15%. When coal breaks down, free gas is first intensively released, and then bound gas is desorbed. There are ordinary, souffle and sudden release of methane.

The main source ***of dust pollution*** during underground mining is the surface complex of mines and mines. The greatest dust emissions occur during processes associated with transportation, sorting, crushing, storage and shipping of minerals. The maximum dust content is observed in overload areas. Thus, above the surface of a coal warehouse, dust content in the air reaches 70 mg/m ^{3} , and in places of refilling it ranges from 125 to 160 mg/m ^{3} . In the absence of dust suppression measures in places where coal is unloaded from a bunker, it can reach several thousand milligrams per cubic meter. The intensity of dust formation is significantly influenced by the fractional composition, physical and mechanical properties, humidity, air flow speed and a number of other factors.

When developing mineral deposits, rock is also removed to the surface. The technological chain that ensures its delivery, reception, loading, transportation and dumping forms a rock complex that “significantly” pollutes the atmosphere not only with dust, but also with gases. When developing coal deposits, - the rock exposed to the surface contains combustible substances (coal, carbonaceous shale, pyrite), the proportion of which ranges from 5 to 30 *%.* Under favorable thermodynamic - conditions (oxygen access and heat accumulation), the oxidation process of flammable components turns into spontaneous combustion.

In ***open-pit mining,*** according to the nature of the action, sources of pollution *are divided into periodic (blasting operations) and continuously active, and according to geometric - parameters - point, linear and evenly distributed.*

One of the most intense sources of atmospheric pollution are massive explosions in quarries, which result in the formation of a dust and gas cloud with a volume of 15..20 million ^{m3}. Within a radius of 2...4 km, from 200 to 500 tons of fine dust are dispersed, containing 93.6...9 9.6% of particles less than 5 microns in size. A significant - amount of fine dust is formed during drilling wells and when loading rock mass.

Roller-cone drilling rigs without dust collection emit up to 2200 mg/s into the atmosphere, with water washing - 3...5 mg/s, pneumatic impact drilling rigs with dust collection - up to 30 mg/s, when extracting coal with a rotary excavator - 8000 mg/s, when loading by excavator - 6000 mg/s.

Another source of atmospheric dust during mining operations is internal quarry roads, in the area of which the air dust content averages 100 mg/m ^{3}. Technological machines and mechanisms also pollute the air with exhaust gases : bulldozers, scrapers, loaders, tractors, etc. About half of the harmful substances emitted into the atmosphere come from industrial and municipal boiler houses.

MAXIMUM PERMISSIBLE CONCENTRATIONS AND THEIR REGULATION

There are four levels of air pollution: no influence , irritation, chronic diseases, acute diseases .

In Russia, when establishing MPCs, the lowest level of pollution is accepted, regardless of the nature of the effect: general toxic, irritating, carcinogenic, etc.

The first MPCs were determined for work zones (MPC $_{rz}$) in 1925. Subsequently, average daily concentrations (MPC $_{SS}$) and maximum one-time concentrations (MPC $_{mr}$) were established (Table 1.1).

MPC is the concentration of a harmful (pollutant) substance in the air of the working area, which does not cause diseases or health problems in workers upon daily inhalation throughout their entire working experience.

MPC is the concentration of a harmful substance in the air, which does not have a direct or indirect harmful effect (toxic , carcinogenic, mutagenic) under conditions of indefinitely long round-the-clock inhalation.

Table 1.1

Maximum permissible concentrations (mg/m ^{3}) for the main types of atmospheric pollution (CH245-71)

Substance	MPC $_{MV}$
Dust is non-toxic	0.5
Carbon monoxide	3
Nitrogen dioxide	0.085
Sulfur dioxide	0.5
Hydrogen sulfide	0.008
Carbon disulfide	0.03
Sulfuric acid	0.3
Ammonia	0.2
Acetone	0.35
Gasoline (converted to C)	5
Soot (soot)	0.15
Phenol	0.01
Formaldehyde	0.035
Phosphoric anhydride	0.15
Chlorine	od

MPC $_{mr}$ is the concentration of a harmful substance in the air, which does not cause reflex reactions in the human body. When establishing MPCs, they are guided by the following main criteria for the harmfulness of atmospheric pollution:

- such a concentration of a substance in the atmospheric air may be considered acceptable if it does not have a direct or indirect harmful or unpleasant effect on a person, does not reduce his performance, and does not affect his well-being;
- adaptation to harmful substances should be considered as an unfavorable moment and evidence of the inadmissibility of the concentration being studied;
- unacceptable concentrations also include those concentrations of harmful substances that adversely affect vegetation, climate, atmospheric transparency and living conditions.

Since ***MPCs are determined in experiments*** with warm-blooded animals, their use is acceptable. The main emphasis in establishing the maximum permissible concentration is on studying the influence of this component on the body, and it can manifest itself in the form of unfavorable changes in physiological and biochemical parameters, disturbances in the functioning of individual organs, changes in conditioned reflex activity, etc.

The toxicity and nature of the effect of the studied harmful substance on the body is studied by introducing it either into the lungs along with inhaled air, or into the stomach with or without food, or into the abdominal cavity or muscle tissue, as well as by applying it to the skin and mucous membranes of the mouth and nose. , eyes are usually animals. ***Lethal doses (LD)*** are determined by introducing harmful substances or their solutions, emulsions, suspensions into the animal's body.

When establishing the maximum permissible concentration of a harmful substance in the air of a working area, the most important and responsible stage is the determination of the minimum effective (***threshold) concentration (MC)*** in a long-term (chronic) experiment.

To approve **the maximum permissible concentration of the Republic of Lithuania** and include it in the sanitary legislation, a method is being developed for determining this harmful substance in the air, providing estimates of the maximum permissible concentration in the analyzed volume of air with sufficient accuracy.

MPC and other indicators of toxic effects, all harmful substances are divided into 4 hazard classes (Table 1.2).

Table 1.2

Indicators of the toxic effect of harmful substances depending on the hazard class

Index	1	**2**		
MPCrz, mg/m	0.1	0.1...		
LD50 when administered into the stomach, mg/kg	15	15...150	150...500	5000
LD50k when applied to skin , mg/kg	100	100...500	500...2500	2500

The anthropogenic impact on the environment, as well as the effectiveness of measures to reduce its pollution, are assessed not by maximum permissible **concentrations** , but by a system of maximum permissible emissions **(MPE),** the calculation method of which is set out in Sanitary Standards 369-74. The calculation is carried out taking into account the background concentrations of harmful substances in the air (Сф) and other sources of pollution (*C)* according to the formula:

C+ Sph < MPC.

From an environmental and socio-economic point of view, the most effective is a set of preventive measures aimed at preventing air pollution from dust and gas emissions from mining operations.

Protection of atmospheric air from pollution by harmful emissions from mining enterprises includes the following areas: establishing actual concentrations of emissions and levels of surface air pollution; creation of a regulatory framework for planning environmental protection measures; introduction of technological processes and equipment with minimal rates of formation of harmful substances; reduction of organized and unorganized sources of harmful emissions; sanitary cleaning of waste gases up to the maximum permissible emission standards.

When several substances that are capable of summing up their harmful effects are simultaneously present in the atmospheric air, either the dimensionless concentration is calculated, or the concentration values of harmful substances for each of them are reduced - conditionally to the concentration value of one of them. In this case, the following condition must be met :

$$\Sigma C_i / MPC_i < 1.$$

For each stationary source of operating, reconstructed and projected enterprises, a MPE level is established at which emissions of pollutants in a given area, taking into account the prospects for its development, will not lead to exceeding sanitary and hygienic standards for populated areas and maximum permissible levels harmful to the atmosphere.

Each mining or processing enterprise has the right to release into the air only those substances that are specified in a written release permit (issued in the prescribed manner by the relevant authorities), in a certain quality and at a specified time. In case of violation of the requirements stipulated by these permits, as well as in case of accidents or natural disasters, when a threat to public health arises, the release of pollutants must be changed, suspended or prohibited by decision of the authorities exercising control over air protection.

If the concentration of harmful substances in the air of populated areas exceeds the maximum permissible limits, and the MPE values for various objective reasons cannot currently be achieved, then a gradual reduction in emissions of harmful substances by operating enterprises is introduced to values that ensure compliance with the maximum permissible concentrations, or until complete prevention emissions. For each stage of this procedure, the values of emissions of harmful substances **(HES) are established,** temporarily agreed upon with an enterprise with the best production technology, similar in capacity and technological processes. *VSV values for operating enterprises are established using the same methods as MPE.*

For sources of fugitive industrial emissions and a set of small single sources (ventilation emissions from one technological complex located indoors or outdoors), a total MPE (VEL) is established for the enterprise or facility as a whole. MPE values are reviewed at least once every 5 years.

For vegetation and the biosphere as a whole, MPCs have not yet been established, since it was believed that they should be equal to or close to sanitary standards. In the modern period, the anthropocentric approach to this has no scientific justification. Experience has shown that producers are more sensitive to the effects of many toxic gases than humans, and this is explained by the presence of a photosynthetic apparatus in producers, as well as their ability to absorb toxic gases at a high rate along with or instead of carbon dioxide. To establish the maximum permissible concentration of gases for plants, a special technique is used, based on determining the suppression of photosynthesis. The need to establish biosphere MPCs is obvious, since quality control is the main task of the global environmental monitoring system.

For atmospheric pollutants, MACs should be set at the minimum threshold concentration that does not yet cause disturbances to organisms, including producers. In this regard, it is necessary to standardize maximum permissible concentrations not only for humans, but also for plants. The maximum permissible concentrations of many gases (sulfur dioxide, ammonia, nitrogen oxide (IV) NO 2, chlorine) for plants and the biosphere should be below sanitary standards. Only the maximum permissible concentrations of carbon monoxide (II) CO and hydrogen sulfide turned out to be higher for plants than for humans, since plants can easily oxidize carbon monoxide (II) CO to CO_2 and bind it photosynthetically.

- Impact of mining on the natural environment.
  - Carbon and heavy hydrocarbons,
  - Methane ($CH_4 + H_2O = CO + 3H_2$ or $CH_4 + CO_2 = 2CO + 2H_2$),
  - Dust.

Lecture No. 5 (4 hours).

Atmospheric pollution during underground mining

Air protection at mining enterprises.

LAW OF THE REPUBLIC OF UZBEKISTAN

ON THE PROTECTION OF ATMOSPHERIC AIR

December 27, 1996,
No. 353-I

Article 1. Atmospheric air as an object of environmental protection

Atmospheric air, as an integral part of natural resources, is a national wealth and is protected by the state.

Article 2. Legislation on atmospheric air protection

Legislation on atmospheric air protection consists of this Law and other legislative acts.

If an international treaty of the Republic of Uzbekistan establishes rules other than those provided for by the legislation of the Republic of Uzbekistan on the protection of atmospheric air, then the rules of the international treaty apply.

Article 3. Main objectives of legislation on atmospheric air protection

The main objectives of legislation on atmospheric air protection are:

preservation of the natural composition of atmospheric air;

prevention and reduction of harmful chemical, physical, biological and other effects on atmospheric air;

legal regulation of the activities of government bodies, enterprises, institutions, organizations, public associations and citizens in the field of atmospheric air protection.

Article 4. Rights and obligations of citizens in the field of atmospheric air protection

Citizens have the right to:

use of atmospheric air favorable to their life and health;

obtaining reliable and timely information from relevant government agencies about the state of atmospheric air and measures taken to protect it;

compensation for damage in case of damage to their health and property by emissions of pollutants and biological organisms into the air and the harmful effects of physical factors on it;

participation in conducting public opinion research on issues of air protection and public environmental assessment.

Citizens are obliged:

comply with the requirements of legislation on atmospheric air protection;

not to perform actions that lead to pollution, depletion of atmospheric air and harmful effects of physical factors on it.

Article 5. State administration in the field of atmospheric air protection

State administration in the field of atmospheric air protection is carried out by the Cabinet of Ministers of the Republic of Uzbekistan, the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection, and local government bodies.

Article 5 ^{1} . Powers of the Cabinet of Ministers of the Republic of Uzbekistan in the field of atmospheric air protection

Cabinet of Ministers of the Republic of Uzbekistan:

ensures the implementation of a unified state policy in the field of atmospheric air protection;

ensures the development and implementation of state programs in the field of atmospheric air protection;

approves technical regulations regulating emissions of pollutants into the air and the harmful effects of physical factors on it;

establishes the procedure for monitoring in the field of atmospheric air protection.

Article 5 ^{2} . Powers of the State Committee of the Republic of Uzbekistan for Ecology and Environmental

Protection in the field of atmospheric air protection

State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection:

ensures interdepartmental interaction in the development and implementation of a unified state policy in the field of atmospheric air protection;

participates in the development and implementation of state and other programs in the field of atmospheric air protection;

participates in the development of regulations in the field of atmospheric air protection;

within the limits of its powers, develops and approves regulations in the field of atmospheric air protection;

carries out state environmental control in the field of atmospheric air protection.

Article 5^3. Powers of local government authorities in the field of atmospheric air protection

Local government authorities:

participate in the development and implementation of state and other programs in the field of atmospheric air protection;

develop and approve territorial programs in the field of atmospheric air protection and ensure their implementation;

carry out state environmental control in the field of atmospheric air protection in the relevant territory.

Article 5^4. Participation of self-government bodies of citizens, non-governmental non-profit organizations in ensuring the protection of atmospheric air

Self-government bodies of citizens, non-governmental non-profit organizations:

participate in the implementation of state, territorial and other programs in the field of atmospheric air protection;

carry out public environmental control over the implementation of legislation on atmospheric air protection;

take part in conducting explanatory work among the population aimed at increasing the legal literacy and environmental culture of citizens in the field of air protection.

Article 6. Standards in the field of atmospheric air protection

Standards in the field of atmospheric air protection determine the regime for the protection of atmospheric air, methods for monitoring its condition, and establish other requirements for the protection of atmospheric air.

Standards (sanitary norms) in the field of protection of atmospheric air for humans are approved by the Ministry of Health of the Republic of Uzbekistan.

Standards in the field of atmospheric air protection for environmental objects, climate and ozone layer conservation are approved by the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection.

Article 7. Ambient air quality standards

To assess the state of atmospheric air, uniform air quality standards are established for the territory of the Republic of Uzbekistan:

maximum permissible concentrations of pollutants and biological organisms in the atmospheric air for humans and objects of the natural environment;

maximum permissible levels of acoustic, electromagnetic, ionizing and other harmful effects of physical factors on atmospheric air for humans and objects of the natural environment.

For certain regions, legislation may establish increased requirements for air quality standards.

Ambient air quality standards are developed and approved in accordance with the procedure established by law.

Article 8. Standards for harmful effects on atmospheric air from stationary sources of pollution

Standards for maximum permissible emissions of pollutants, biological organisms into the atmospheric air and maximum permissible harmful effects of physical factors on it are established for each stationary source of emissions or harmful physical effects on the atmospheric air for each of the pollutants, biological organisms and physical impact factors.

Standards for maximum permissible emissions of pollutants, biological organisms into the atmospheric air from stationary sources of pollution and maximum permissible harmful effects of physical factors on it are developed by enterprises, institutions, organizations and approved accordingly by the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection and the Ministry of Health of the Republic of Uzbekistan.

The procedure for developing and approving standards for maximum permissible emissions of pollutants and biological organisms into the atmospheric air, standards for maximum permissible harmful effects of physical factors on atmospheric air from stationary sources of pollution is established by the Cabinet of Ministers of the Republic of Uzbekistan.

Article 10. Standards for harmful effects on atmospheric air from mobile sources

For mobile sources produced and operated on the territory of the Republic of Uzbekistan, standards are established for the content of pollutants in exhaust gases and the harmful effects of their physical factors on the atmospheric air. The procedure for the development and approval of these standards is established respectively by the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection and the Ministry of Health of the Republic of Uzbekistan.

Article 11. Regulation of emissions of pollutants into the atmospheric air by stationary sources of pollution

Emissions of pollutants into the atmospheric air by stationary sources of pollution are allowed in accordance with the standards for maximum permissible emissions of pollutants, determined based on the results of the state environmental impact assessment.

Article 12. Regulation of the harmful effects of physical factors on atmospheric air

The harmful effects of physical factors on atmospheric air should not exceed the corresponding maximum permissible levels.

Article 13. Limitation, suspension or cessation of harmful effects on atmospheric air

Activities related to violations of the standards for maximum permissible emissions of pollutants into the air by stationary and mobile sources of pollution may be limited, suspended, and if it is impossible to eliminate the causes of harmful effects, terminated by decision of the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection, the Ministry of Health of the Republic of Uzbekistan, the Ministry of Internal Affairs of the Republic of Uzbekistan in accordance with their powers. Restriction, suspension (except for cases of restriction, suspension for a period of no more than ten working days in connection with the prevention of emergencies, epidemics and other real threats to the life and health of the population) or termination of the activities of business entities are carried out in court.

Article 14. Requirements for fuel and fuels and lubricants

All types of fuel and fuels and lubricants used on the territory of the Republic of Uzbekistan must comply with the requirements of standards, technical regulations agreed upon with the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection.

Article 15. Conditions for the import and entry into the territory of the Republic of Uzbekistan of transport and other mobile vehicles and installations

Import and entry into the territory of the Republic of Uzbekistan of transport and other mobile vehicles and installations is permitted provided that their negative impact does not exceed the standards for the content of pollutants in exhaust gases and the harmful effects of their physical factors operating on the territory of the Republic of Uzbekistan.

Article 16. Production and operation of transport and other mobile vehicles and installations

The production and operation of transport and other mobile vehicles and installations, in the emissions of which the content of pollutants in the exhaust gases or the harmful effects of their physical factors exceeds the standards, is prohibited.

Owners of transport and other mobile vehicles and installations must ensure compliance with standards for the content of pollutants in exhaust gases and the harmful effects of their physical factors.

Article 17. Requirements for enterprises and organizations performing repairs and maintenance of transport and other mobile vehicles and installations

Enterprises and organizations that carry out repairs and maintenance of transport and other mobile vehicles and installations that have a harmful effect on the atmospheric air ensure verification and regulation of the content of pollutants in exhaust gases and the harmful effects of their physical factors on compliance with standards.

Article 18. Production and use of chemicals

Enterprises and organizations that produce or use chemicals develop their maximum permissible concentrations in the atmospheric air, control methods and environmental and toxicological passports in the manner established by the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection and the Ministry of Health of the Republic of Uzbekistan.

The neutralization of prohibited and deteriorated chemicals is carried out in agreement with the Ministry of Health of the Republic of Uzbekistan in the presence of a positive conclusion from the state environmental assessment.

The use of chemicals as plant protection products, growth stimulants, mineral fertilizers and other preparations is permitted in accordance with the regulations for the use of agricultural plant protection products.

Article 19. Requirements for preventing harmful effects on the ozone layer

When designing, constructing, reconstructing, overhauling facilities, carrying out economic and other activities, enterprises, institutions and organizations must comply with measures to regulate the use and application of ozone-depleting substances, equipment and technical devices containing ozone-depleting substances.

Enterprises, institutions and organizations operating and repairing products containing ozone-depleting substances must ensure their accounting and replacement with ozone-safe substances.

Import or export of ozone-depleting substances and products containing them is carried out on the basis of permits issued by ecology and environmental protection authorities.

Article 20. Requirements for the protection of atmospheric air during mining, transportation and processing of mineral raw materials

Extraction, transportation and processing of mineral raw materials must be carried out in compliance with the rules for preventing or reducing levels of air pollution in ways agreed upon with the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection.

Article 21. Requirements for the placement or disposal of production and consumption waste

The placement on the territory or near populated areas of man-made formations that may be sources of air pollution or other harmful effects on it is prohibited.

Industrial and consumption waste, which is a source of air pollution, is subject to processing, purification, deodorization or storage at special landfills, the location of which is determined by local government authorities in agreement with the Ministry of Health of the Republic of Uzbekistan in the presence of a positive conclusion of the state environmental assessment.

Article 22. Placement, design, construction, reconstruction and commissioning of enterprises, structures, transport routes and other objects affecting the state of atmospheric air

The placement, design, construction, reconstruction and commissioning of enterprises, structures, transport routes and other facilities, improvement of existing and introduction of new technological processes and equipment must be carried out in compliance with legislation on atmospheric air protection.

The determination of construction sites, construction projects and reconstruction of enterprises, structures, transport routes and other objects that affect the state of atmospheric air are coordinated with local government authorities, the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection and the Ministry of Health of the Republic of Uzbekistan.

Article 23. Compliance with requirements for the protection of atmospheric air when introducing discoveries, inventions, industrial designs, use of equipment and technologies

The introduction of discoveries, industrial designs, the use of equipment, technologies, devices, equipment, raw materials, materials, fuel and the production of finished products that may have a harmful effect on the state of atmospheric air, climate and the ozone layer, without a certificate with deviations from the parameters defined in it, is not are allowed.

Article 24. Responsibilities of enterprises, institutions and organizations for the protection of atmospheric air

Enterprises, institutions and organizations whose activities are related to the release of pollutants, biological organisms, greenhouse gases and ozone-depleting substances into the atmospheric air and the harmful effects of physical factors on it are obliged to:

comply with the rules of operation and operation of structures, installations and equipment for purifying emissions into the atmospheric air and reducing the harmful physical impact on it, as well as means of controlling them;

keep records of ozone-depleting substances, prevent their release into the atmosphere, and carry out recycling (primary purification for the purpose of their reuse);

create sanitary protection zones around economic facilities;

establish standards for maximum permissible emissions of pollutants into the air;

take measures to reduce and (or) prevent emissions of pollutants into the air and harmful physical effects on it;

exercise control over compliance with standards for maximum permissible emissions into the atmospheric air and the harmful effects of physical factors on it, keep records of them and submit statistical reports;

ensure sampling and make measurements to determine the quantitative and qualitative composition of emissions of pollutants into the atmospheric air;

do not allow the combustion of fuel, substances or mixtures of substances used as fuel in places and (or) devices not intended for its combustion, as well as the combustion of materials and waste that are not fuel, except in cases where combustion is carried out using special devices and compliance with the requirements of legislation on atmospheric air protection and legislation on waste;

take measures to introduce energy-saving and (or) resource-saving technologies and the use of environmentally friendly energy sources;

carry out measures agreed with the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection to reduce emissions of pollutants and biological organisms into the air in connection with expected adverse meteorological conditions;

assess the harmful effects on the environment and public health in the zone of influence of enterprises and transport communications;

comply with the conditions of storage, transportation, rules for the use of highly toxic substances and volatile compounds and the neutralization of containers containing them;

take measures to prevent volley and emergency emissions of pollutants into the atmospheric air, the occurrence of potentially dangerous situations, as well as to reduce transboundary air pollution;

ensure waste disposal and take measures to prevent air pollution during its accumulation and processing.

Implementation of measures to protect atmospheric air should not lead to contamination of soil, water and other environmental objects.

Article 25. Compensation payments for harmful effects on atmospheric air

Compensation payments for harmful effects on atmospheric air are collected from enterprises, institutions and organizations in the manner and amount established by law.

Making compensation payments for emissions of pollutants and biological organisms into the atmospheric air, the harmful effects of physical factors on it does not relieve enterprises, institutions and organizations from carrying out air protection measures and the obligation to compensate for the damage caused.

Article 26. State accounting in the field of atmospheric air protection

The following are subject to state registration:

objects that have or may have a harmful effect on the state of atmospheric air;

types and amounts of pollutants, biological organisms, greenhouse gases and ozone-depleting substances emitted into the air;

types and sizes of harmful effects of physical factors on atmospheric air.

State accounting in the field of atmospheric air protection is carried out according to a unified system in the manner determined by the Cabinet of Ministers of the Republic of Uzbekistan.

Article 27. Atmospheric air monitoring

Observation, collection, synthesis, analysis of information and forecast of the state of atmospheric air is carried out according to a unified system of state monitoring of the natural environment in the manner prescribed by law.

Article 28. Control over atmospheric air protection

State environmental control over the protection of atmospheric air is carried out by specially authorized state bodies and local government bodies within the limits of their powers.

Specially authorized state bodies for environmental control over the protection of atmospheric air are the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection, the Ministry of Health of the Republic of Uzbekistan, the Ministry of Internal Affairs of the Republic of Uzbekistan.

The State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection carries out:

state environmental control over the state of sources of atmospheric air pollution, compliance by legal entities and individuals with the requirements of legislation on the protection of atmospheric air;

coordination of the activities of state and economic management bodies in the field of state and departmental environmental control.

The Ministry of Health of the Republic of Uzbekistan carries out state environmental control over the harmful effects on atmospheric air in sanitary protection and residential zones.

The Ministry of Internal Affairs of the Republic of Uzbekistan carries out state environmental control over motor vehicles, the operation of which is accompanied by harmful effects on the atmospheric air.

Departmental, industrial and public environmental control over the protection of atmospheric air is carried out in accordance with the law.

Article 29. Liability for violation of legislation on atmospheric air protection

Persons guilty of violating the legislation on atmospheric air protection bear responsibility in accordance with the established procedure.

Enterprises, institutions, organizations and citizens are obliged to compensate for damage caused by violation of legislation on atmospheric air protection in the manner prescribed by law. Compensation for damage does not relieve the perpetrators of liability in accordance with the law .

The quality of atmospheric air is subject to periodic monitoring - checking the compliance of atmospheric air indicators with the requirements of regulatory and technical documentation. Air quality, emissions and other atmospheric parameters are assessed using ***single and complex*** indicators of air pollution. ***A single*** indicator characterizes atmospheric pollution by one harmful substance, ***while a complex indicator*** characterizes several. In addition to the above indicators, the average level of atmospheric pollution, the concentration of impurities in the atmosphere, the surface concentration of impurities, single and average daily concentrations, the maximum of the average daily impurity concentrations, the average monthly concentration of impurities in the atmosphere, the maximum of the average monthly impurities in the atmosphere, the background concentration of an atmospheric pollutant, the **approximate safe level of exposure to** air pollutants **(SEL),** average level of air pollution by sectors of the national economy.

When recording harmful emissions , indicators of gas flows such as speed, pressure and rarefaction , humidity, temperature, dust content, and concentration of gaseous harmful substances are determined. Using these data, the volumes of gas - flows, the amount of harmful substances released with them, the degree of capture of the latter by gas cleaning and dust collection installations, and the amount of these substances emitted into the atmosphere are identified.

The ground concentration of impurities in the atmosphere is measured at a height of 1.5...2.5 m from the earth's surface.

A single concentration of impurities in the atmosphere is determined by a sample taken over a 20...30 minute interval, **average daily** - based on an average daily sample taken continuously over 24 hours, **monthly average** - according to one-time concentrations measured according to the full program at least 20 times a month, **average annual** - based on average daily or one-time concentrations measured according to the full program at least 200 times a year.

When measuring the concentrations of harmful substances in the atmosphere, the background should be taken into account. The background refers to the concentration of pollution in the atmosphere created by all sources except the one under consideration.

Air pollution control is carried out in accordance with GOST by a network of observation posts, which are divided into stationary, route, and flare (mobile).

Stationary posts are installed at special testing sites and provided with equipment for continuous recording of concentrations of pollutants in the atmosphere. They are designed to provide long-term measurements of the major and most common pollutants.

Route observation posts are located on certain routes. Air samples are taken according to a schedule using portable equipment and mobile - laboratories.

Mobile (under-flare) posts are placed under the torch of a pollution source to identify the area of influence of this source.

Control posts are installed on an open, ventilated area on all sides with a dust-free surface (asphalt, lawn). Their number and location depend on the area of the settlement, the population, the terrain, the number of industrial enterprises and their location, transport routes, the presence of resorts, houses and recreation areas.

Locations for **stationary and route** posts are selected on the basis of a preliminary survey - covering typical areas of the most intense pollution, recreation areas and on the border of the sanitary protection zone.

The number of **stationary** posts, depending on the population size, is established at least one up to 50 thousand inhabitants, two up to 100 thousand, two to three - up to 200 thousand, three to five - up to 500 thousand, fifty - more than 500 thousand, ten to twenty - more than 1 million inhabitants. On flat terrain in populated areas, one stationary post is placed on an area of 10... 20 km ^{2} , and on rough terrain - on an area of 5... 10 km ^{2} .

During **under-flare** control, samples are taken at different distances from specific sources of pollution.

Under unfavorable meteorological conditions that can lead to a significant increase in the amount of main pollutants , measurements are carried out after 3 hours in places with the highest population density under the plumes of pollution sources.

Air pollution control is carried out according to ***full, incomplete and reduced programs*** .

The full program involves - measuring the concentration of basic and specific air pollutants that are characteristic of a given locality, as well as meteorological parameters (wind direction and speed, air temperature and humidity, weather conditions) at 1, 7, 13 and 19 hours. by local time. The main atmospheric pollutants include dust, sulfur dioxide, carbon monoxide and dioxide. Specific pollution is determined by the nature of production.

An incomplete control program measures only basic and specific air pollutants. The number of measurements using it is reduced to thre 7.13, and 19.00. local tim

In ***the abbreviated*** progra concentrations of the mai pollutants and one or two most common specific substances for a given loc are assessed , measureme carried out at 7 and 13 ho When monitoring the stat atmospheric air (table) wi operating gas cleaning de the physical parameters o atmospheric air and gas fl are determined (quantity, rate, pressure, temperatur humidity, as well as the composition and concentr of harmful substances and in them).

Gas flows are controlled l following devices: volume - meters, flow meters; temperature - thermometers; pressure - liquid, piston, spring, electric, piezoelectric pressure gauges; humidity - psychrometers, hydrometers and various types of hydrographs.

Methods for controlling the content of harmful substances

Substance	**Method of measurement**
Ammonia	Photometric Titrometric
Acetone	Gas chromatographic Photometric
Petrol	Gas chromatographic
Sulfur dioxide	And odometric Titrometric Photometric
Iron	Complexometric Atomic absorption
Calcium	Same
Copper	Photometric Atomic absorption
Nitrogen oxides	Photocalorimetric Photometric
Carbon monoxide	Gas chromatographic
Dust	Weight
Sulfur anhydride	Nephelometric
Hydrogen sulfide	Photometric
Phenol	Gas chromatographic Photometric
Zinc	Atomic absorption

Methods for monitoring atmospheric air quality are described in detail in *"Guide to Air Pollution Source Control."*

Currently, the guiding document for determining the dispersion of harmful substances in the atmosphere is *the " Methodology for calculating concentrations in the atmospheric air of harmful substances contained in emissions from enterprises."*

The methodology establishes requirements for calculating the concentrations of harmful substances in the atmospheric air when locating and designing enterprises, as well as when regulating emissions into the atmosphere. It is designed to calculate surface concentrations in a 2-meter layer above the earth's surface, as well as the vertical distribution of concentrations.

The degree of danger of pollution of the surface layer of atmospheric air is determined by the highest calculated surface concentration of harmful substances, which is established at a certain distance from the emission site under the most unfavorable weather conditions, when the wind speed reaches a dangerous value.

Employees of specialized **(sanitary and preventive) laboratories** of production associations or enterprises - inspect existing sources of pollution at least once a year, and burning rock dumps - in the autumn.

To develop effective measures in the atmospheric air cleanliness management system, the means used to measure the concentration of priority pollutants dispersed in the atmosphere must meet the following **requirements** :

- determination of the concentration of harmful substances should be carried out automatically, continuously, around the clock;
- the range of the gas analyzer must cover the limits of gas concentrations dispersed in the atmospheric air;
- the sensitivity threshold of the measuring instrument must ensure the determination of concentrations of harmful substances at the MPC level;
- gas analyzers must be cost-effective to operate and provided with accessible means for periodic checking and adjustment;
- it is advisable to use methods for analyzing each pollutant gas - that are generally accepted in world practice.

These requirements are implemented through the use of ***automatic gas analyzers*** , both independently and as part of stations (mobile and stationary).

Currently, we are introducing the second generation of gas analyzers into our control practice.

According to their functional purpose, gas analyzers for monitoring the atmosphere and emissions should be distinguished.

As a means of monitoring the atmosphere, **gas analyzers** mainly determine the content of oxides of sulfur, nitrogen, carbon, hydrocarbons , and ozone. The work of the first sulfur oxide gas analyzers was based on coulometric, polarographic, and electrochemical methods of analysis; they were later replaced by devices implementing *the photometric method* .

Emission flame photometry is based on measuring the radiation of analyzed atoms or molecules that are introduced into the flame or oxidizer and are excited in the combustion zone thermally or through chemical reactions. The disadvantage of this method is that, firstly, the concentration of all sulfur-containing compounds in the atmospheric air is measured, and secondly, luminescence requires the use of ultra-pure hydrogen, which complicates operation. A positive difference is the high sensitivity threshold (up to tenths of a billion to the minus first power).

Recently, devices whose operation is based on the fluorescence method of analysis and the independence of the fluorescence spectrum from the wavelength of exciting radiation have been mainly used.

A typical domestic gas analyzer 667FF-03, using this method, has a SO measurement range from 0 to 5 mg/m, an error of 20 and 15, respectively, and a power consumption of 400 and 250 W. It is designed to work both in stationary and mobile - laboratories, and can be used autonomously.

In nitrogen oxide gas analyzers, for example type 645HL-01, the chemiluminescent method is widely used .

Chemoluminescence occurs when nitrogen oxide interacts with ozone (or atomic oxygen) under certain conditions . A prerequisite for the control of all nitrogen oxides is the reduction of NO в NO2 . _

The 645X-03 gas analyzer allows you to determine the concentration of both N0 and NO2 in the range from 0 to 10 mg/m. This device is inferior to the best foreign analogues only in weight and size.

The operation of gas analyzers for monitoring carbon monoxide GIAM-1, GIAM-10-CO is based on the optical-acoustic method - absorption of CO in **the infrared** region of the spectrum. Measuring range up to 160 mg/m. The GTR-1 infrared analyzer is more advanced.

The ozone content in the atmospheric air is controlled by an outdated automatic gas analyzer 652ХЛ-01, which uses - the chemiluminescent method for its work. Modern foreign gas analyzers for determining ozone concentration are based on the spectroabsorbent method, which consists in the absorption of waves of a certain length.

For the analysis of hydrocarbons, the flame ionization method is used, implemented in gas analyzers 623IN-02, 623KPI-03 with a measurement range from 0 to 50 mg/m, an error of 15. In terms of its indicators, the 623KPI-03 analyzer is at the level of foreign analogues.

As a means of monitoring emissions, gas analyzers identify pollutants in vehicle exhaust gases and industrial emissions sources. To monitor exhaust - gases from vehicles during operation, domestic gas analyzers ***GAI-1 and GAI-2 have been developed*** . The optical-acoustic gas analyzer of carbon monoxide GAI-1, providing a CO measurement range from 0 to 10% (volume %), an error of 5%, is one of the most common.

To analyze hydrocarbons, gas analyzers GL1121, GL1122 are used, and to analyze the concentration of carbon monoxide, a gas analyzer 121FA-1 of optical absorption action is used. Gas analyzers GIAM-21 are designed to determine the concentration of carbon monoxide and hydrocarbons in hexane fractions in vehicle exhaust gases.

A simplified method of monitoring is to measure the carbon monoxide content using a chemical gas analyzer GC CO-A, consisting of a CO-5 indicator tube, an AM -5 bellows (fur) aspirator and a sampler.

The method of manual sampling into standard samplers followed by analysis in laboratory - conditions using chromatographic and photometric methods is widely used.

Chromatographic methods of analysis involve separating the initial mixture into its constituent components at the active centers of the absorbent or dissolving it in a fixed phase and subsequent detection of the components at the outlet using appropriate detectors (flame ionization, thermal conductivity, etc.). Typical domestic devices are “Tsvet-500”, KhPM-2, LKhM-8.

The most universal method is chromatography-mass spectrometry, in which the separation of components is carried out using **the chromatographic method** , and detection is carried out using mass spectrometry, i.e. ionization of molecules of the analyzed substance and identification of components by the deflection of their ions in a magnetic field. This method is implemented in the GC-mass spectrometer MX -132.

The photometric method is based on determining the degree of absorption of light energy in a characteristic part of the spectrum. This principle is used in photoelectrocolorimeters (FEK-256M, FEK-50) and spectrophotometers (SF-26, SF-39).

Recently, **the dynamic dilution method has become widespread** , which is based on diluting a sample from a flue with clean air or nitrogen in a given ratio, which allows the use of microconcentration gas analyzers (atmospheric gas analyzers) and unheated gas lines.

The content of sulfur dioxide and hydrogen sulfide in the atmosphere is determined by the ***Atmosphere-1 coulometric gas analyzer.*** To analyze - atmospheric air for sulfur dioxide and carbon monoxide using automatic gas analyzers, automatic air sampling for subsequent chemical analysis of four gas ingredients simultaneously, the “Air-1” station is used (sensor information is recorded on punched tape, capacity 40 thousand samples per year , weight 5000 kg, located in a stationary pavilion).

To control the amount of harmful emissions from industrial enterprises into the atmosphere, a stationary monitoring station for industrial emissions SKPV-1 was created, which carries out continuous - sampling from the outlet, automatic measurement of the concentration of six harmful impurities (NO , NO_2, CO , SO_2, NH_3, CH) , measurement of two parameters of the gas flow (pressure and temperature) and output of information.

The listed local control methods complement remote methods, which make it possible to obtain information about the global three-dimensional component composition of the atmosphere. These methods are based on measuring and interpreting the characteristics of electromagnetic fields at various distances from the object under study.

Of these, the most commonly used methods are absorption spectrometry , in particular, the determination of microcomponents of the troposphere and stratosphere based on balloon measurements ***of infrared*** solar radiation. The capabilities of this method are significantly expanded by the use of lasers.

Based on the use of lasers with increased output energy, a stationary lidar system has been developed to monitor emissions of aerosol, NO_2, SO_2 in an area with a radius of 7...15 km. Mobile lidar units have a range of up to 1 km with ten detectable components.

Lecture No. 6, (2 hours). Atmospheric pollution during open-pit mining

And atmospheric emissions of harmful substances during open-pit mining of mineral deposits are mainly associated with mechanical impurities (dust) and chemical ones, among which, depending on the technology of work, carbon oxides, nitrogen oxides, sulfur dioxide, etc. predominate. At the same time, the intensity of a single source of pollution (car, bulldozer, excavator) mg/s, or specific mass of emission per unit of product (rock mass) mg/m3 , depend on the technological - characteristics of the equipment and process used, as well as the physical parameters of the environment. Gas emission into the atmosphere during operation of a single mechanism in open works is about 0.005 g/s CO, 0.002 g/s SO_x, 0.001 g/s SO_2 for bulldozer, 1.0 g/s CO, 0.03 g/s SO_x, 0.003 g/s SO_2 for auto. During blasting operations, gas and dust release is determined by the volume and type of explosive, as well as environmental conditions. The specific consumption of explosives per unit of broken rock mass is 0.5-0.8 kg/m^3 (strength coefficient f from 6 to 18), and the yield of harmful substances in terms of carbon oxides is 30-85 l/kg. This range is even wider in real conditions and reaches 20154 l/kg.

The main sources of dust formation and release into the atmosphere during open-pit - mining are: blasting, drilling, excavation, transportation of rock mass, storage and crushing. In addition to them, both during the work and after the cessation of the quarry, there are sources such as dumps (at least 30% of the area when self-overgrowing), beach areas of tailings and hydraulic dumps (25% of the area), erosion zones (Table) .

Dust generation in dumps at wind speeds (3-5 m/s) is 1-3 mg/(m ^{1}-s), and in beach areas of tailings up to 6.5 mg/(m ^{2} -s). At the same time, dust content in the air can reach 500 mg/ ^{m3} . Blasting operations are the most powerful source of dust emissions, the intensity of which depends on external factors (climate, moisture loss - irrigation, water content, etc.), as well as on the strength of the rocks. During massive explosions, the volume of the dust cloud reaches (0.5-10)-10 ^{3} m ^{3} , and dust can be transported by wind up to tens of kilometers from the source.

The total masses of atmospheric dust emissions from sources in a quarry can reach tens of thousands of tons per year, and specific gross emissions up to 0.1-0.15% of the volume of mined rock mass. Estimation of emissions and transport of dust aerosols by wind can be carried out based on known techniques . Calculated values of changes in the relative dust content in the air A_n and the relative mass of fallen dust A_m depending on the distance to the source are given.

$$An = (P/Po)100, \% \qquad (1)$$

where P is the actual dust content in the air (mg/m3 $^{)}$; Initial dust content at the place of formation (mg $_{/}$ ^{m3})

$$Am = (M/Mo)\text{-}100, \% \qquad (2)$$

where M and Mo are the mass of fallen dust at the calculated point and at the place of formation, respectively, t/(ha-year).

Field observations of the dust dynamics of large quarries indicate a significant extent of the zone of increased dust content around the quarries, reaching 40-45 km with P values 2-4 times higher than the background and dust falling weighing up to 10^6 t/(ha-year) at a distance up to 1-2 km and further. The dusty zone of land with a mass of fallen dust causing oppression of all plant species (700 kg/(ha-year)), with increasing depth of quarries, expands from 7 to 28 km (depth from 100 to 1000 m). The radius of the zone of maximum permissible air dust increases even more, from 35 to 68 km.

The negative impact of dust and gas emissions from sources in active quarries has an impact on the environment, people and can

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[1] *Boyko A.N., Kochetov A.V., Savitsky V.I.* Ensuring acceptable sanitary and hygienic conditions unical working conditions when working in the polluted atmosphere of quarries. Mining magazine No. 8, 1998.

cause disruption to the technological process.

Air dust content in quarries (workplaces) during stripping operations in winter ranges from 100 to 1000 mg/m3 , in summer - less than 100 mg/m3 , in mining operations in winter 1000-1500 mg/m3 , in summer up to 150 mg/m3 m ^{3} .

Measurements carried out at mining sites in the Leningrad region showed that even in the summer, at an air temperature of 15 ^{o} C, a relative humidity of 58%, the dust content of the atmosphere in the immediate vicinity of a bulldozer and excavator (10-20 m) reached 10-35 mg/m ^{3} , and in the cabin from 5 to 15 mg/m ^{3} (air temperature 24 ^{o} C, relative humidity 47-54%. When loading the rock mass into railway cars, the dust content of the atmospheric air near the excavator reached 80-100 mg/m ^{3} , in his cabin 16-56 mg/ ^{m3} .

Numerous field observations - have established a connection between the intensity of emissions of harmful mechanical and chemical impurities into the atmosphere and its thermodynamic parameters. It has been established [8, 9] that the pattern of dust content in atmospheric air is harmonic during the seasons, which is also confirmed for chemical impurities, but with a phase shift. The level ^{of} impact can be assessed by the relative magnitude of the active negative factor or phenomenon, equal to the ratio of the actual (instantaneous value) Pn $_{to}$ its maximum value $_{Pnmax}$. This indicator, to a certain extent, may correspond to the risk R if the actual maximum recorded is absolute for a given event.

$$R = Mon^{tah} / Mon \qquad (3)$$

The intensity of the manifestation of negative factors from the thermodynamic parameters of the atmosphere is confirmed by the flow of heat or mass of gas (steam), the involvement of atmospheric air in this process (convective currents) with phase transitions of water “liquid vapor” in the process of evaporation and condensation.” These phenomena change the rate of removal of aerosols and gas mixtures from the quarry, as well as the intensity of dust emission from sources (rock mass, dumps, etc.) and dust suppression (steam-condensation).

Research at mining enterprises and in laboratory conditions [8, 10] established the dependence of the relative dust content of air $A\ \Pi = \Pi/\Pi_o$ (Π - actual dust content of air, mg/m2 [2; 3] Π_o - dust content of air in the absence of mass transfer, mg/ m^3 ; ($A\ d = 0$) on the direction (condensation + , evaporation -) of the mass transfer process and the magnitude of the relative change in air moisture content A d , g/(kg-m) or the rate of change $A\ d_v$, g/(kg-s).

$$A\ d\ v = A\ d - V \qquad (5)$$

where V is the air speed, m/s.

Analysis of the obtained empirical curve (Fig. 5) indicates the presence of a symmetrical - “transition” period when the

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air dust content for the given conditions. A similar process can be observed during sublimation processes (evaporation of ice in spring) with maximum release of released dust and its aeration under the influence of air currents.

Under conditions of intensification of the condensation process, the limit for reducing the relative dust content of the air is theoretically close to zero, practically characterized by the level of moisture coagulation on dust particles (condensation nuclei) by their enlargement into droplets and precipitation in the form of rain or snow with additional capture of floating dust.

Source	Dust emission intensity		Dustin
	per unit time, mg/s	per unit of mg/m ^{3}	air, m
Imploding works		(30-170) 10^3	500-
Drilling (SBSh)	17-1900 (with dust suppression) 34-60000 (without dust	(0.24-3.4) 10^3 (0.32-148)-10^3	5- 20
Excavation	100-7000		40
Transportation of rock			
cars	6000	0.7-10^3	-
conveyors	400	—	2-
railway transport	100	-	-
Sorting and warehousing	115-150	-	15-

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[2] *Zelinskaya E.V., Shcherbakova L.M., Gorbunova O.I.* Impact of placer mining on the environment . Mining magazine. No. 5, 1998.

[3] *Kovalenko A.I.* Technological and environmental aspects of the development of adjacent ore deposits. - M., Nedra, 1994.

elled crushing nt	up to 12000 100-11000		- -	15-150 60-250

The study of these processes and the use of the noted physical effects make it possible to predict the level of atmospheric pollution during mining operations, as well as to design means for the prevention of atmospheric emissions and environmental protection, which confirms the positive experience in coal mines . The atmosphere plays an important role in all natural processes; it not only determines the climate of a given area and planet, but also protects it from harmful cosmic radiation. The modern atmosphere was formed 50 million years ago. Atmospheric composition: - 78.08%=nitrogen, 20.9%=oxygen, 0.93%=argon, 0.03%=carbon dioxide, 0.06%=neon, helium, methane, xenon, radon, etc. Further, it contains water vapor and other pollutants.

Mass of the gas shell = 51610 tons.

<u>CO_2</u> growth from 0.029% to 0.032% over 100 years, population growth rate = double growth every 32 years + industrial growth.

Northern Hemisphere – 70% of production and 90% of energy consumption. Emissions into the atmosphere - 150 million tons. sulfur dioxide (70 kg per 1 sq. km), and in some areas - (100 kg per 1 sq. km) - exceeding the norm by 1400 times.

Pollution – *local (city), regional, global* . Air propagation speed masses from several hundred to 1000 km per day, at these distances the lifespan is more than **<u>0.5 days</u>** .

By lifespan - 2 groups - with a lifespan **<u>of about a year</u>** or more and with a lifespan of **<u>10 days</u>** or less.

<u>-- Air pollution.</u>

Natural pollution - natural dust, which plays the role of condensation nuclei of water vapor, and *artificial (anthropogenic)* - 90% harmful gases and 10% aerosols. USA – 60% of air pollution is from cars, Moscow – up to 90% from cars. **Emissions** - 1 ton. gasoline - 400 kg, and diesel fuel - 120 kg (soot, collects and concentrates toxic and carcinogenic substances).

combustion *, petroleum and gas* pollution with gas and dust (fuel does not burn completely).

Sulfur oxide (**<u>sulfur dioxide</u>**) - combustion at state district power plants, thermal power plants -

content in the air from 0.001 to several mg/m ^{3} .

Carbon monoxide (**CO**)– State district power station, thermal power plant, main - auto, from tens of fractions to tens of units.

Hydrocarbons - *saturated* , unbranched - methane series, branched - isobutane, isopentane, *unsaturated* - such as ethylene, acetylene, *aromatic* - benzene, toluene, xylene, as well as *chlorinated* alcohols and other compounds. All hydrocarbons under certain conditions form *carcinogenic* substances; under the influence of the Sun (ultraviolet radiation), hydrocarbons participate in the formation of *photochemical* smog. The amount of hydrocarbons in the air ranges from units. up to tens of mg/ m^3 .

Nitrogen oxides (**NO) – flue gases + metallurgy** + nitrogen fertilizer plants + cars, Content from 0.001 to 0.1 mg per m ^{3} .

Ozone - ground layer of the atmosphere - sources, all sparkling installations that generate hard radiation (welding, internal combustion engine ignition systems, x-rays, sparking on trams, trolleybuses, electric trains, etc.). Very toxic (hydrocyanic acid) and + mutagenicity and radiation.

Hydrogen sulfide – oil and gas production, sulfur mineral springs, gas processing plants, synthetic fiber plants, pulp and paper mills, etc.

emissions - *113 million tons/year, nitrogen - 40-90 million tons/year* .

Fluorine, arsenic - aluminum factories - death of animals, bees, etc.

Plants, farmland, forests, gardens and parks are dying.

Losses from air pollution - France - 4% of national income, USA - 3%, Japan - up to 8%.

+ Loss of a huge amount of raw materials - release into the air, 100% purification of sulfur dioxide = additional quantity that will cover all needs for sulfur.

Dust – insoluble dust – pulmonary diseases – pneumoconiosis. Organic dust – allergic diseases. In Novokuznetsk the average concentration is 0.5 mg/m ^{3} and sometimes up to 10 mg/m ^{3} .

Lecture No. 7 (2 hours)

Methods and means for purifying gas-air emissions from dust and mists

When developing measures to protect the atmosphere at all industrial enterprises, the following is established or determined:

- sources of air pollution, composition and quantity of industrial emissions, levels of ground level air pollution in emission dispersion zones;

- MPE of harmful substances into the atmosphere by each source and by the enterprise as a whole;
- basic technical solutions to reduce industrial emissions from individual sources and a complete list of measures to protect the atmosphere, the implementation of which will ensure the maximum permissible limit for each source and sanitary standards for pollution of the ground layer at the location of the enterprise;
- schedule of measures to protect the atmosphere;
- the required amount of dust collection and gas cleaning equipment , capital investments and current costs for the implementation of measures to protect the atmosphere for each source and the enterprise as a whole.

When protecting the air basin, general measures are distinguished that help improve the condition of the air basin in the area of the mining enterprise, and special measures directly aimed at preventing air pollution.

The **first** group includes activities:

- territorial planning, providing for the placement of mining facilities - sources of dust and gas emissions, taking into account the natural and climatic conditions of the area, primarily wind roses, as well as the systematic restoration of land;
- to reduce the areas of eroded man-made surfaces by optimizing the parameters of man-made formations: open mine workings , dumps and waste heaps, tailings dumps, mineral raw materials warehouses, etc.;
- to prevent wind erosion and recycle disturbed lands for their use in the national economy;
- on the recycling of mining waste, the integrated use of mineral resources, helping to reduce both the areas of eroded surfaces and the volumes of dust and gas emissions.

The **second** group includes the following activities:

- to improve air quality directly in the mining area by preventing or reducing dust and gas emissions from various objects in the production process chain;
- for the collection, removal and purification of dust and gas emissions and emissions ;
- intersectoral nature, for example, to improve the gas balance of spent explosives, etc.

Systematization of measures to protect atmospheric air depending on the sources and types of pollution, is given in table. **14** .

Table 1.4

Measures to protect atmospheric air at mining enterprises

Sources pollution	**Factors pollution**
1	***2***
Underground mining method	
Ventilationonny production mines and underground mines	Burovzryvny works; breaker, by load, transporting mountainous genus; highlight removal of gases from arrays mountainous genus; collapsed
	roofing; destruction of pillars and other deformations of mine workings

Cracks on the surface, formation outcrops	Release of gases from rock masses	Local dispers secretions of constant actio
Open development method		
Open pit mines	Natural and technological processes	Large-area - concentrated emissions and emissions of continuous action
	Erosion of surfaces of mine workings (trenches, ledges, platforms, berms, etc.)	Large-area - discharges of periodic actio
	Transportation of rock mass	Dispersed _
		Catching
	autotransport	discharge and emissions permanent actions

		mountain pro-production (dumps, ter-ricons; tail-and sludge protection shingles, etc.)	formations	wild actions
	Drilling rigs bots			
	Massive explosions and others explosive work			
	Breakdown, according t load, trans porting mountain mass sy		Spontaneous combustion- mountain breeds in technical but genetic formations	Dispersed valuable discharge permanent actions
	Self-fertilizing early mountain breeds			
Open and underground mining met				
Technogenic education from waste	Erosion by surfaces man-made			

Warehouses products mountain production	Erosion surfaces

Table 6 1.4 (continued)

1	*2*
	Operations by warehouse productions
Concentrator-new, over-fighting and auxiliary body shops mountain production	Technological process production

Geotechnological development method (well production)		
Wells underground leaching-	Pumping liquid sulfur	Focused selected dew period-wild actions
	Emissions water and gas	Focused selected dew period-wild actions

actions	factual ditch and conditions development territories; perfect

Lecture No. 8, (2 hours).

-- Standardization of air quality in populated areas.

Hygienic standard – reflecting the impact on human health.
Environmental – reflecting the harmful effects on the environment.
MPC $_{rz}$ - in the air of the working area.
MPC $_{ss}$ – daily average.
MPC $_{mr}$ – maximum one-time.

All substances are toxic in certain doses.

LD – lethal dose.
MPC $_{rz}$ - divided into 4 classes.
Calculation method – $C + C_f < MPC$, where C is the concentration of individual sources of pollution and C_F is the background concentration.

Index	1	2	3	4
MPC $_{rz}$, mg/m ^{3}	0.1	0.1…1	1…100	10
LD50 when administered into the stomach, mg/kg.	15	15…150	150…500	50
LD50 when applied to skin, mg/kg.	100	100…500	500…2500	25

ce	**MPC $_{mr}$ (mg/m ^{3})**	**MPC $_{ss}$ (mg/m $_3$)**
n-toxic	0.5	0.15
onoxide	3	1
ioxide	0.085	0.085
xide	0.5	0.05
sulfide	0.008	0.008
ulfide	0.03	0.005
id	0.3	0.1
	0.2	0.2
	0.35	0.35
converted to C)	5	1.5
)	0.15	0.05
	0.01	-
yde	0.035	-
anhydride	0.15	0.05
	0.1	0.03

Each mountain resort has the right to release into the air only those substances that are specified in written permission.

-- Methods for purifying atmospheric emissions from harmful impurities.

During the development of MPI, *solid* (dust) and *gaseous* harmful substances are released. Accordingly, measures are divided into those that reduce dust and gas emissions.

Dust – pre-humidification, irrigation, dust suppression with foam, dust collection, washing off settled dust.

- dust deposition under the influence *of gravity* (dust settling chambers),
- release under the influence *of centrifugal force* (cyclones, multicyclones),
- collision of dust particles with the depositing body under the influence of *energy forces* (fabric filters, scrubbers),
- direct *deposition* , when a dust particle passes along the deposition body at a distance less than the radius of the particle and thus collides with it (fabric filters),
- deposition of particles on the surface of bodies under the influence *of diffusion* when a gas flow passes along these bodies (fabric filters, turbulent high-speed washers),
- Release of particles under the influence of *an electric field* (electric precipitators),
- release of dust by deposition on *cold* surfaces (thermoprecipitation effect).
- *wet* cleaning devices - gas passes through liquid.
- *combined* .

Air purification from harmful impurities.

- *Methane* – utilization and combustion,

Industrial gaseous wastes containing vapors and gases are purified in special washing chambers or adsorption, absorption purifiers, followed by their combustion.

- *Thermal afterburning* – where in gases there is a high concentration of impurities + a large amount of oxygen,
- *Catalytic afterburning* – oxidation of impurities in the presence of metal catalysts,
- *Absorption* method - absorption of toxic gases and vapors by liquid reagents,
- *Chemisorption* – removal of harmful gases by reacting with solvents and neutralizing them,
- *Adsorption* - solid absorbers (activated carbon, silica gel, zeolite), used to remove odors.

Tall pipes – uniform dispersion over long distances.

Green spaces.

Explosive substances – with zero oxygen balance + special additives.

METHODS AND FACILITIES SECURITY AIR SWIMMING POOL

As already noted, during underground mining of minerals, solid (dust) and gaseous harmful substances are released. Accordingly, measures are divided into those **that reduce dust and gas emissions** .

Measures that reduce dust emissions are divided into two groups, ensuring:

- reduction of dust formation and air pollution during various - technological processes;
- purification of air when it is released into the atmosphere.

The main activities of the first group are pre- humidification, irrigation, dust suppression with foam, dust collection, and washing off settled dust from the walls of mine workings.

Pre-humidification reduces dust formation. When extracting coal, irrigation through executive - bodies is widely used, which reduces dust by 80...90%. Recently, dust suppression with foam has been most commonly used during cleanup operations on steep seams. Using water-air ejectors, it is possible not only to suppress dust with dispersed water, but also to clean the air from suspended dust. When drilling holes and wells, dust is sucked off with special devices.

To reduce gas emissions, the mined-out space is isolated, diesel equipment is replaced with machines and equipment with electric drive.

When developing coal deposits, large amounts of methane are released, which must be disposed of to protect the atmosphere. The difficulty in solving this problem is due to the fact that the main - part of methane (up to 80...85%) is carried out by ventilation flows in which its concentration does not exceed 1 *%.* To utilize these methane-air mixtures, effective methods are needed to - increase methane concentrations. The rest of the methane is extracted by means of degassing, and its disposal is not difficult: it is mainly used in boiler rooms, sometimes in drying plants of enrichment plants and in mobile power plants.

Significant volumes of harmful gases are released into the atmosphere during fires. To prevent spontaneous combustion of coal, in addition to insulating the goaf, the remaining coal pillars are treated with antipyrogens, which stop or actively inhibit the processes of coal oxidation. If necessary, the mined-out space is silted with sand-clay pulp.

To reduce the formation of carbon monoxide and nitrogen oxides, an explosive with a zero oxygen balance and with special additives should be used both in the explosive itself and in the shells of cartridges and in the stopper. In addition, incomplete explosion of explosives and plugging of holes with fine coal should not be allowed.

The environment is greatly affected by rock dumps and warehouses of mined minerals. Thus, at coal industry enterprises alone there are 2,280 dumps, including more than 360 that are burning. To prevent spontaneous combustion, the dumps are given a flat shape , formed in layers with rolling each layer and alternating with a layer of clay, treated with antipyrogens, silted with a clay solution or covered with an inert material.

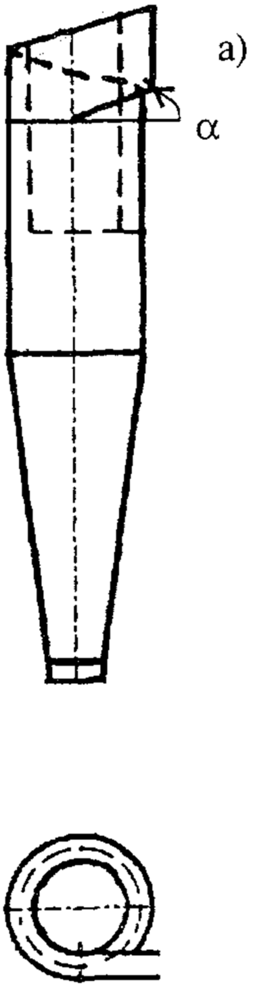
Burning rock dumps are extinguished by silting, and if conical or ridge dumps are burning, then they are mainly converted into flat dumps.

Almost all technological processes are accompanied by - the release of dust.

All existing methods of dust collection can be divided into dry and wet, and dust collection devices can be grouped according to the principle of action into those using gravitational-inertial deposition, including cyclone; gas filtration through porous materials; electrical dust deposition; hydraulic dust collection.

For dry gas purification, the most commonly used are cyclones of various types (Fig. 1.1), in which, under the influence of centrifugal force, particles move to the walls of the cyclone body and along them enter the hopper. The disadvantage of this method is the low efficiency of capturing particles smaller than 5...10 µm. coefficient for particles with a size of 15...20 microns is 98...99% and higher, almost regardless of the design; for particles of 10 microns - from 80 to 98% depending on the model of the device; for particles of 5 microns - from 50 to 90%.

The productivity of the cyclone increases with its diameter. The design differs between - cylindrical ones (CN, Fig. 1. 1a)



Scheme cyclones for dry cleaning gases

and conical (SDK-CN and SK-CN, Fig. 1.16) cyclones. Cylindrical cyclones, the efficiency of which decreases with increasing angle , a of the entrance to the cyclone, have high productivity, but a slightly reduced efficiency when collecting small particles; conical ones capture small particles better, but are characterized by increased pressure losses.

For large volumes of purified gases, group or battery cyclones are used. Group cyclones have a common gas inlet and outlet, divided into parallel channels according to the number of elements. In a battery cyclone, the elements are combined into one housing and have a common gas supply and outlet through a guide device that swirls the flow. The efficiency of battery cyclones is somewhat lower than the efficiency of individual elements.

Centrifugal devices also include rotary and vortex dust collectors. In radial dust collectors, solid particles are separated from the gas flow by the combined influence of gravitational and inertial forces, which are caused by the rotation of the gas flow. The efficiency of gas purification from particles with a size of 25...30 microns is usually 65...85%.

Simplicity of design and efficiency of 80% or more for particles with a size of at least 20 microns are distinguished by louvered dust separators, in which dust particles are released under the influence of inertial - forces.

In dust settling or dust chambers, dust falls out under the influence of gravity. Their main disadvantages are their - significant size, difficulty in cleaning, and low efficiency, especially for fine fractions. Therefore, they are currently only used for pre-cleaning, especially when the initial dust concentration is high.

A high degree of collection of the finest dust (up to 99.9 % or more) is provided by bag (fabric) filters, in which the purification of gases when filtering through a porous partition is based on the deposition of dust under the influence of several forces: inertia, adhesion, Brownian diffusion, electrostatic and others . In real filters, the gravitational mechanism of particle sedimentation does not play a noticeable role due to the low speeds of particle soaring compared to the filtration speed. This effect becomes noticeable only when filtering an aerosol with particles with a diameter of 1 micron at a speed of less than 0.05 m/s.

The inertial effect of particle deposition is practically absent when particles with a size of less than 1 micron move at a speed of less than 1 m/s. Brownian motion is caused by the collision of solid particles smaller than 0.5 microns with gas molecules. As the particle size decreases, the influence of the electric force increases compared to the - inertial force.

The adhesion of dust particles to fibers plays an important role in the overall collection capacity. The efficiency of adhesion depends on the properties of the filter material, the ratio of the characteristic sizes of pores and particles, and decreases with increasing particle speed.

In addition to these mechanisms of settling dust particles, processes such as the filtering of particles by a layer of sediment formed on the inlet surface, as well as the process of gradual clogging of pores with a layer of sediment, etc., are very significant.

Based on the type of partition, filters with granular layers are distinguished (stationary free-flowing materials, fluidized layers); with flexible porous partitions (fabrics, felts, sponge - rubber, etc.); with semi-rigid , porous partitions (knitted and woven mesh, pressed spirals, etc.); with rigid porous partitions (porous ceramics, porous metals, etc.).

According to their design, fabric filters are divided into bag and bag filters, according to the fabric regeneration system - into mechanical (shaking) and pneumatic (reverse, nozzle, pulsating blowing, etc.).

One of the conditions for normal operation of filters is to maintain the temperature of the gases being purified within certain limits: on the one hand, it should not exceed the maximum permissible for the filter material, and on the other, it should be 15...30°C higher than the dew point temperature.

Filters are used for fine purification of air with an - impurity concentration of no more than 50 mg/m3 ; if the initial concentration of impurities is higher, then the purification is carried out by a system of series-connected dust collectors and filters.

The disadvantages of fabric filters include their significant metal consumption and large dimensions, since gas filtration occurs at low speeds - 15...20 mm/s, for filters with pulse blowing - 50...75 mm/s. This is 1...2 orders of magnitude less than the gas velocities in the working area of the electrostatic precipitator and 2...3 orders of magnitude less than in the cyclone.

One of the most advanced types of dry fine gas purification from dust is **electrical purification.**

The principle of operation of electrostatic precipitators is based on the passage of a gas flow through a high voltage electric field, in which dust particles are charged and deposited on the electrodes.

The process of electrostatic deposition of a solid particle consists of four main stages: ionization of the gas, charging of the dust particle, movement of the particle in an electric field, and deposition on the electrode.

Gas ionization occurs due to high voltage supplied from the power source to the corona electrode. In industrial installations, the critical voltage corresponding to the start of the process is 20...40 kV. This process is stable only in a non-uniform electric field, characteristic of a cylindrical capacitor.

For the process of dust deposition on electrodes, the - electrical resistance of the dust layers is very important. Based on its value, dusts with resistivity are distinguished:

- less than 10 ^{4} Ohm-cm - upon contact with the electrode, they, - losing their charge, acquire a charge corresponding to the sign of the electrode, after which a repulsive force arises between the electrode and the particle, which is counteracted only by the adhesion force;
- from 10 ^{4} to 10 ^{10} Ohm-cm - they are well deposited on the electrodes and are easily removed from them by shaking;
- more than 10 ^{10} Ohm-cm - they are most difficult to capture in electric filters, since particles are discharged slowly at the electrodes, which significantly prevents the deposition of new particles. In real conditions, the resistivity of dust is reduced by humidifying or chemically conditioning the gas.

In air and flue gases, the mobility of negative ions is higher than that of positive ones; therefore, electric precipitators with a corona of negative polarity are usually used. The design of electric precipitators is determined by the composition and properties of the gases being purified, the concentration and properties of suspended particles, gas flow parameters, required purification efficiency, etc.

The advantages **of electric precipitators** include: the ability to obtain a high degree of purification (up to 99.9%); low aerodynamic drag; low electricity consumption (0.1...0.8 kWh per 100 m ^{3} of gas); the ability to purify gases at high - temperatures and with chemically aggressive components; full automation of work. Disadvantages: high cost, large dimensions (especially in height), requirement of highly qualified service, explosion hazard when collecting explosive dust , reduced efficiency of collecting dust with low electrical resistance.

Widespread wet gas **cleaning devices** are characterized by high cleaning efficiency from fine dust (0.3...1.0 microns), as well as the ability to clean hot and explosive gases from dust. Depending on the form of contact between gas and liquid media, wet cleaning methods can be conditionally grouped into: trapping in a volume of liquid (Fig. 1.2a), liquid films (Fig. 1.26), liquid sprayed in a volume of gas (Fig. 1.2c). In this case, an important factor is the wettability of particles by liquid.

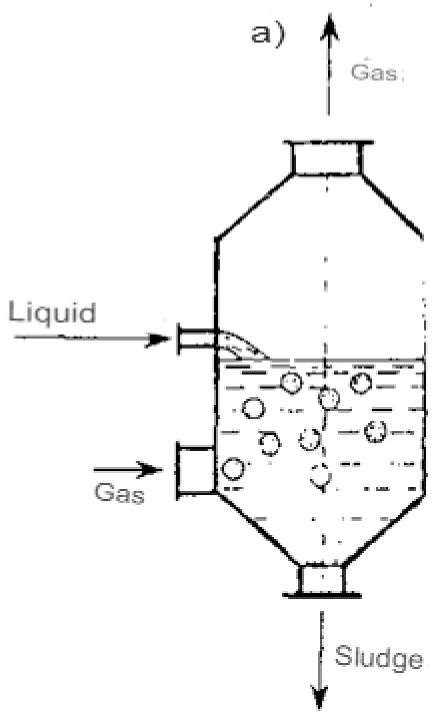


Figure 1.2. Sch

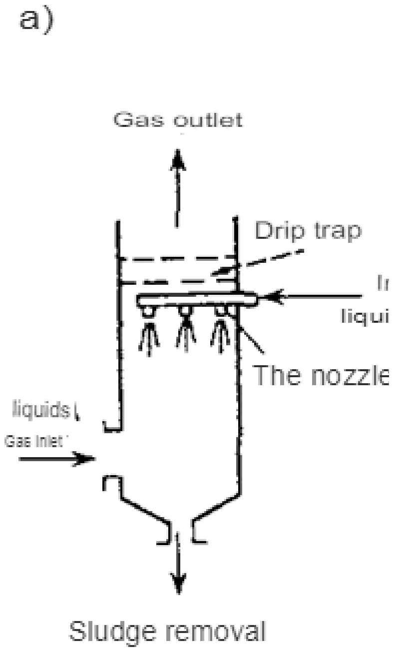


Figure 1.3. Schemes of m

Structurally, wet dust collectors are divided into scrubbers, Venturi devices, nozzle and centrifugal scrubbers, impact-inertial devices, bubbling-foam devices, etc.

Bubblers and foam machines use the first method of wet cleaning. In scrubbers with nozzles, wet cyclones, rotoclones, etc. the second method is implemented. The most common third cleaning method is performed using pressure nozzles or using the energy of the gas flow itself.

The first spraying method is used in hollow scrubbers (Fig. 1.3a), the second - in turbulent washers and Venturi scrubbers (Fig. 1.36).

The latter are widely used for purifying gases from mists. The efficiency of scrubbers varies widely. Thus, the efficiency of collecting fine particles (3...5 μm) varies from less than 10% in hollow scrubbers to more than 90% in Venturi scrubbers.

Wet cleaning devices are usually simple to manufacture, reliable in operation, quite effective, and allow you to simultaneously utilize the heat of heated gases and remove many gaseous , harmful components. The disadvantages of wet cleaning include increased energy consumption, splash removal and the need to organize sludge management.

The choice of methods and means of dust collection and dust suppression is greatly influenced by the properties of dust, such as particle density, their dispersion; adhesion, flowability, wettability, abrasiveness and hygroscopicity of dust, as well as the solubility of particles, their electrical and electromagnetic properties, the ability to spontaneously ignite and form explosive mixtures with air.

The choice of dust collection and dust suppression method is also determined by the type of technological process.

During preparatory work in quarries during mechanical - drilling, the most common methods are dust suppression with air-water and air-emulsion mixtures, as well as dry dust collection.

During blasting operations, dust and gas emissions are reduced by implementing technological and engineering measures. The first include such methods of explosion control as blasting high ledges; explosion in a compressed environment; charge dispersion.

Among the engineering and technical activities, the following should be highlighted:

- irrigation of the explosion site, adjacent areas and dust fall zones;
- use of a water stop;
- preliminary moistening of the massif;
- use of explosives with a positive oxygen balance;
- addition of neutralizers to the cutting material;
- intensification of dust and gas cloud dispersion;
- prevention of intense blowing up of dust settling from the dust and gas cloud;
- suppression of harmful impurities in the dust and gas cloud and many others.

When excavating and loading rocks, dust formation and release are reduced by pre-wetting the rock mass; moistening the loosened rock mass; dust collection.

Methods and means of combating dust and gas pollution during transportation are largely determined by the type of transport. When using motor transport, the main sources of dust emission are roads, and atmospheric pollution is associated with the release of harmful impurities from exhaust gases. During the operation of railway transport , dusting is mainly associated with the blowing away of small particles during the transportation of rock mass in open transport vessels - dump cars, gondola cars.

During conveyor transport, the formation of dust is caused by its blowing away during movement and movement of the rock mass from one conveyor to another. In combined transport, the causes of dust and gas contamination are associated with each type of transport included in the combination and, in addition, with a large amount of dust emitted at points of transshipment from one type of transport to another.

To prevent dust emissions on roads, they are sprayed with water or solutions of hygroscopic salts, as well as treated with emulsions and various binders.

In railway transport, the surface of the transported rock mass is fixed with dust-binding materials, covered with a film or moistened with water. During conveyor transport, various conveyor covers are used, and the conveyor belt is cleaned of adhering material. Transfer points are equipped with shelters with aspiration systems.

Dumps, quarry slopes, and sludge storage facilities are characterized by large volumes of dust emission.

To reduce them use:

- irrigation with water with additives of chemically active substances that ensure surface fixation;
- fixation with bitumen emulsion;
- securing the dusty surface with latexes;
- landscaping of non-working areas;
- hydroseeding.

There are ***technological; mechanical; physico-chemical; biological*** ; remediation methods to combat dust in hydraulic - dumps and tailings.

Technological methods involve changes in storage methods; changes in the composition and condition of stored products ; waste-free or low-waste enrichment technology; waste disposal. Mechanical methods include the creation of barriers that prevent the ***spread*** of dust and continuous covering of the dust-producing surface with material. Among ***the physicochemical ones,*** hydrodust removal should be noted; stabilization of dusty surfaces with polymers, organic and inorganic substances; change in the physical properties of the dusty surface (electrification, agni- zation, etc.).

Biological methods reduce dust emissions by creating a protective layer of lower plants or growing higher plants.

When performing all technological processes in open-pit mining, in addition to dust, harmful gases are emitted to one degree or another, especially during mass explosions, transportation of rock mass by road, during roasting and beneficiation of minerals , operation of boiler plants, etc.

Methods of purification from gaseous pollutants are divided into five groups according to the nature of physicochemical processes: absorption, adsorption, chemisorption, thermal neutralization and catalytic.

absorption method involves separating a gas-air mixture by absorbing one or more gas components (absorbates) with a liquid absorber (absorbent) to form a solution.

absorption process is often called scrubbing. The choice of absorbent is determined by the solubility of the extracted component in it and its dependence on temperature and pressure.

Depending on the realized gas-liquid contact, packed towers are distinguished; nozzle and centrifugal scrubbers; Venturi scrubbers, plate scrubbers, bubbling foam scrubbers and other scrubbers. A necessary element of collection technology is the regeneration of the absorbent. Desorption of dissolved gas is carried out either by decreasing the pressure, or increasing the temperature, or by using both simultaneously.

method , which is most advantageous when the concentration of harmful components in the exhaust gases is low, is based on the absorption of gases and vapors by solid or liquid absorbers with the formation of low-volatile or slightly soluble compounds. In most cases, these reactions are reversible, which is used for regeneration of the chemisorbent, especially when purifying nitrogen oxides.

The main disadvantage of absorption and chemisorption is the decrease in gas temperature, which leads to a subsequent decrease in the efficiency of dispersion of residual gases in the atmosphere.

The adsorption method is based on the property of some solids with an ultramicroporous structure to selectively extract and concentrate individual components of a gas mixture on their surface. The process can be either physical or chemical in nature . In the first case it is reversible, in the second, as a rule, it is irreversible. Activated carbons, simple and complex oxides (silica gel, zeolites and etc.).

Structurally, adsorbers are made in the form of vertical, horizontal or annular containers filled with a porous adsorbent through which the flow of the gas being purified is filtered.

Adsorption is effective at removing large concentrations of pollutants; when removing solvent vapors, organic resins, ether vapors, and acetone.

Adsorbents are also used to purify automobile exhaust gases and to remove radioactive gases and toxic components.

When emissions are large and pollutant concentrations exceed 300 ppm , afterburning (thermal neutralization) is used to destroy toxic organic matter .

The method is based on the ability of flammable components to oxidize to less toxic ones in the presence of free oxygen and a high temperature of the gas mixture and is implemented by direct combustion or thermal oxidation. The advantages of this method over adsorption and absorption include the absence of sludge management, the small size of the installations and the ease of their maintenance.

The main disadvantage is the significant energy consumption for heating the gases being purified.

The catalytic method is based on the transformation of toxic components of emissions into less toxic or harmless ones through the use of catalysts, which include platinum, platinum series metals, copper oxides, manganese dioxide, vanadium pentoxide, etc. This method is used to purify emissions from carbon monoxide for due to its oxidation to carbon dioxide.

In general, the procedure for selecting the type of cleaning devices and filters is determined by the following scheme: identifying the characteristics of emissions (temperature, humidity, type and concentration of impurities, toxicity, dispersity, etc.); determining the type of cleaning device or filter based on gas flow, the required degree of purification, production capabilities and other factors; estimation of operating gas velocity; technical and economic analysis of possible treatment options; calculation of the parameters of the treatment device; design and selection of a cleaning device or filter.

When choosing products for cleaning emissions into the atmosphere, you should keep in mind the following features:

- dry mechanical methods and devices are not effective in removing fine and adhering dust;
- wet methods are not effective in cleaning emissions that contain poorly adhesive and clump-forming substances (for example, cement);
- electroprecipitators are not effective in removing contaminants with low resistivity and poorly charged by - electricity;
- bag filters are not effective in cleaning emissions with solid and moistened contaminants;
- wet scrubbers are not suitable for outdoor use in winter conditions.

Recently, the problem of air pollution from internal combustion engine exhaust gases has become particularly relevant. Environmental performance can be improved by:

- improving the design and operating mode of internal combustion engines;
- replacement of gasoline internal combustion engines with diesel ones;
- transfer of internal combustion engines to the use of alternative fuel (compressed or liquefied gas, methanol, etc.);
- use of exhaust gas neutralizers.

A vehicle's fuel efficiency is improved primarily by improving the combustion process. Additional reserves are: reducing the weight of the car, improving aerodynamic performance, reducing the resistance of filters and mufflers, etc.

Converting gasoline engines to natural gas or methanol ensures a reduction in carbon monoxide and nitrogen oxide emissions by 1.5 to 2 times.

The toxicity of exhaust gases is significantly reduced by neutralizers : liquid, catalytic, thermal and combined. The most commonly used catalytic converters based on noble metals (primarily platinum) are characterized by good selectivity, durability, and temperature resistance. The main disadvantage is their high cost.

To reduce emissions of crankcase gases, a closed neutralization scheme is used with their supply into the engine intake pipeline with subsequent afterburning.

INFLUENCE EMISSIONS GREENHOUSE GASES TO STATE BIOSPHERE LAND

Carbon and its compounds are very important for global transformations on Earth . - Carbon emissions into the atmosphere are caused by the natural cycle and anthropogenic activities. The bulk of carbon in the form of carbon dioxide (about 94 % of the total mass) is introduced into the atmosphere from natural sources and only 6% as a result of human activity (in 1970, the human role in global CO_2 emissions was 4%).

The main gaseous carbon compounds include methane (CH4) , carbon dioxide (CO2) , carbon monoxide (CO) and a large number of various volatile heavy hydrocarbons released into the biosphere during the production of oil, natural gas, heavy petroleum products (bitumen , ozokerite, etc.) and in the process of plant life.

All gaseous natural and anthropogenic carbon compounds (CO2 , CH4 , CO and heavier hydrocarbons) play a

very active role in the lo
global pollution of the E
atmosphere, leading to c
in the composition and
properties of the planet'
atmosphere . In terms o
impact on the environm
(Earth's biosphere), onl
gases can be compared
carbon compounds: hyd
chloride and fluoride, s
dioxide, carbon disulfid
organic carcinogenic gases, aerosols of asbestos and heavy metals. But the volume of anthropogenic emissions of carbon compounds (especially CO $_2$) significantly exceeds other pollution.

Based on a qualitative geochemical assessment of the terrestrial carbon cycle, the dynamics of the ratio of natural and anthropogenic carbon emissions and the carbon content in the lithosphere and atmosphere were established (Table 1.5).

The following types of cycle operate in the Earth's biosphere: gas, i.e. movement of various gases in the earth's crust and in the surface layer of the biosphere ; energy based on the use of solar energy in the processes of photosynthesis and accumulation in rocks; water, i.e. circulation of water in the earth's crust (lithosphere), atmosphere and hydrosphere.

Table 1.5 Carbon content in the Earth's biosphere

Carbon collector	Carbon mass	
	10 ^{9} t	g/cm ^{2} of the Earth's surface
Animals	5	0.0015
Plants	500	0.1000
Atmosphere	640	0.1250
World Ocean	38000	7.5000
Main breeds	170000	33.0000
Granites and diorites	2900000	567.0000
Coals and shale	6400000	663.0000
Crystalline rocks	10000000	2000.0000
Carbonate rocks	13000000	2500.0000
Total:	32- 10 ^{15}	

In the gas (upper) and solid shells of the atmosphere, the main mechanism of metabolism and energy operates; The gas regime of the biosphere is determined by two main circulations in the “atmosphere-earth crust” geosystem: bioatmospheric biosphere-atmosphere interactions and biolithospheric biosphere-lithosphere interactions. In the first case, a large role in gas reactions is played by free gases of the atmosphere and gases released by animal organisms of the biosphere; in the second - gases coming from the depths of the earth's crust during its degassing and thermodynamic processes, including those released during mining.

All types of geological circulation of matter and flows of earthly energy , primarily hypergenesis (weathering), endogenesis, tectogenesis, hydrogenesis and biogenesis, are involved in biolithosphere interactions, diverse in genesis, geochemical reactions and physical processes.

In the development and evolution of the environment and, first of all, the biosphere (in the processes of photosynthesis, metabolism and respiration of living organisms, in aerobic and anaerobic processes), the gas composition, geochemical and geophysical properties of the atmosphere play a large role. Thus, mainly in the troposphere, geophysical processes take place that determine temperature, pressure, humidity, insolation and other properties of the atmosphere with which life on the planet and the economic activities of human society are associated.

Solar radiation entering the planet's surface through the troposphere is the main source of thermal energy for almost all natural processes in the planet's biosphere. Part of the thermal solar energy that reaches the surface of the planet (direct solar radiation) is distributed depending on the latitude and topography of the area on the Earth's surface. The solar radiation flux at an average distance from the Earth is approximately $41.9 \cdot 10^{9}$ J/m ^{2} per year.

The balance of solar radiation consists of reflected energy, equal to 40 % of all solar energy; absorbed by the earth's surface, equal to 44 %, and absorbed by the earth's atmosphere.

Consequently, the Earth's surface, together with the atmosphere, receives 60 % of all solar radiation, the difference between the inflow and outflow of which constitutes the rational balance of the planet. Thus, two streams of long wave radiation occur in the atmosphere: radiation from the Earth's surface and radiation from the atmosphere.

The effective radiation temperature of the Earth is determined from the condition of equilibrium between the infrared radiation of the planet and the absorbed solar radiation.

The Earth's troposphere, sufficiently turbid for infrared radiation , provides convective stability of the radiative vertical temperature gradient, giving impetus to atmospheric movements that contribute to vertical heat transfer.

Solar radiation is a stream of fast-moving electrically charged particles consisting of approximately 90% ionized hydrogen atoms and 10% helium atoms. The region of near-Earth space, including the upper layers of the atmosphere, is called the magnetosphere. Solar radiation causes two cycles of substances on Earth: geological (large), manifested in the circulation of the atmosphere and the water cycle, and biological (small), manifested in ensuring the reproduction of living matter and in actively influencing the biosphere. Both cycles are closely interconnected and interdependent and represent a single process .

In the development of the environment (in the processes of photosynthesis, metabolism , in oxidative and reduction reactions, in aerobic and anaerobic processes and the respiration of living organisms) and, first of all, the biosphere, a large role is played by the gas composition, geophysical and geochemical properties of the atmosphere and the transformation of the properties of the lithosphere and hydrosphere and atmosphere within the biosphere.

The molecules of the atmosphere are in a state of continuous random motion with a speed that increases with increasing temperature. In the denser lower layers of the atmosphere, very frequent collisions of moving molecules occur . Therefore, from the thickness of the dense lower atmosphere, moving molecules, due to frequent collisions, cannot “break through” into the upper layers of the atmosphere in noticeable quantities.

The scales of molecular and turbulent motions differ by several orders of magnitude. Therefore, gases located in the atmosphere up to an altitude of approximately 100 km (i.e., within the homosphere), due to their complete turbulent mixing, are not separated by molecular weights and up to an altitude of 100 km, the composition of the atmosphere is practically unchanged, although the partial pressure of gases sharply decreases with distance from the earth's surface .

The entry of methane and heavy gaseous hydrocarbons into the atmosphere causes the occurrence of oxidative reactions: the formation of ozone and oxygen is associated with the ionization of the atmosphere, and the destruction of ozone is associated with the oxidation of hydrocarbons. However, the processes of ozone formation and destruction are ambiguous. Thus, when gaseous hydrocarbons are released into the atmosphere simultaneously with nitrogen oxides, oxidative processes that intensively occur under the influence of solar radiation are caused mainly not by the destruction of ozone, but by its formation. In this case, the most important reaction is the decomposition of nitrogen dioxide into NO and O_2. A by-product of atmospheric oxidation of anthropogenic organic substances is ozone, which in the atmosphere of cities with high traffic intensity has a concentration in the ground layer of up to 0.60 ^{ppm}. In other words, nitrogen dioxide is a source of atomic oxygen, which, when combined with molecular oxygen, forms ozone.

Ozone formation depends on the type of hydrocarbons present in the atmosphere; Olefin oxidation occurs 3...4 times faster than paraffin oxidation.

The entry into the atmosphere of natural gases accompanying the - extraction of mineral resources and the ionization of air in the lower (up to a height of 60 km) and upper layers of the atmosphere determine the occurrence of various oxidative reactions. Very important geochemical processes on Earth are associated with the oxidation of methane, carbon monoxide, and hydrogen sulfide in the atmosphere .

For example, **ionization of air leads to the formation of ozone (O3) and oxygen (O2) in the atmosphere** , and ozone is a very active oxidizing agent even at ordinary temperatures. The participation of ozone in the oxidative reactions of hydrocarbons leads to its destruction and ultimately to a decrease in its concentration in the atmosphere.

Heavy hydrocarbons (HC). Hydrocarbons in the Earth's atmosphere and mine workings are represented by methane (CH4) and heavy saturated (saturated) and unsaturated (unsaturated) hydrocarbon gases. The limiting natural heavy hydrocarbon gases include ethane (C2H6), propane (C3H8) and butane (C4H10) , which are relatively rare in the natural gases of coal seams, but are constantly present in the gases of oil and ozokerite deposits. Unsaturated (unsaturated) heavy gaseous - hydrocarbons include acetylene (C_2H_2), ethylene (C_2H_4), propylene (C_3H_6) and butylene (C_4H_8), which are rare and in small quantities. Unsaturated technical specifications are formed during the thermal decomposition of coals, during the cracking of oil and petroleum products, as well as during the synthesis of hydrocarbons from CO and H_2

The half-conversion time of hydrocarbons in the atmosphere during the photooxidation of methane is very long: for ethane (C_2H_6) - days; propane ($C3H_8$) - 6...8 hours; propylene ($C3H_6$) - 2...3 hours; butylene (C_4H_8) - 1...2 days.

Heavy gaseous hydrocarbons are contained in coal seams from hundredths to 3...4 ml per 1 ton of coal. In mine air the content of natural heavy hydrocarbons rarely reaches 5...6% and only in free gas accumulations of coal origin - up to 50%. Severe heavy hydrocarbon gases of the methane series have high solubility in oil and ozokerites: under pressure of tens of megapascals, hundreds of cubic meters of gas dissolve in 1 m^3 of oil.

As the molecular weight of gas increases, their solubility in oil increases. As the mass of carbon dioxide molecules increases, the lower limit of the explosive concentration of gas in a mixture with air decreases.

Colorless, with the smell of gasoline or crude oil, 3 times or more heavier than air, CB vapors can be roughly divided into gasoline vapors and liquid CB. In the CIS they are found mainly in natural gases from oil (Ukhta) and ozocerite (Ukraine) fields. The most dangerous pollution of the biosphere with gaseous hydrocarbons is associated with aromatic (arene), methane (alkane), paraffin and naphthenic (polymethane) hydrocarbons, and the main threat to human health is posed by artificially formed polycyclic hydrocarbons polluting the atmospheric air: benzopyrene, peroxides , terpenes and gasoline derivatives, which are carcinogenic substances.

Aromatic TCs are very dangerous for humans because, together with certain viruses, they have an intense targeted carcinogenic effect: strong carcinogenic polycyclic aromatic compounds such as 3,4-

benzopyrene and benzanthracene accumulate in living organisms. The average content of 3,4-benzopyrene in the exhaust of carburetor internal combustion engines reaches 0.5 μg/ ^{m3} . In addition, it enters the atmosphere when mineral fuels (coal, shale, oil) are burned.

Low temperatures and poor combustion conditions for mineral fuels usually produce few hydrocarbons. When burning fuel, the presence of high molecular weight hydrocarbons is also noted - polycyclic aromatic compounds emitted from almost all combustion devices, regardless of whether the burned fuel contains these substances or not . In this case, the worse the fuel combustion conditions, the greater the concentration of polycyclic hydrocarbons.

The average content of BC in the Earth's atmosphere is 10...7%, and the global emission of gaseous BC from natural and anthropogenic sources is estimated at (590...650)-10 ^{6} t/year, including their global emission from anthropogenic sources sources reached (195...200)-10 ^{6} t/year.

Methane.

Under natural conditions , the most widespread of gaseous organic compounds are methane (paraffin) hydrocarbons, or alkanes, with the general formula $C_{p}H_{2P+2}$, which belong to the class of acyclic organic compounds. Homologous series of hydrocarbons similar to methane hydrocarbons, for example, a series of ethylene ($C_{p}H_{2p}$) and other open chain hydrocarbons , are rare.

Methane (CH_{4}) is the simplest main component of natural and anthropogenic hydrocarbon gases. As the first member of a series of saturated hydrocarbons - alkanes, it is the most stable component of carbon and hydrogen compounds and the main component of gases formed in the organomineral layer, where the oxidation of over 99% of the biomass annually formed by living organisms during photosynthesis occurs. The vast majority of this methane enters the Earth's atmosphere, where a significant proportion undergoes oxidation. The share of fossil methane in the atmosphere is only about 20%, i.e. over 80% of atmospheric methane is a product of the destruction of organic matter in the organomineral layer.

Methane is characterized only by the C–H bond, the energy of which is 87 kcal/mol, and the absence of the C–C carbon bond inherent in all other hydrocarbons. The ratio of hydrogen to carbon is 4 in methane, 3 in ethane, 2.66 in propane, approaches 2 in high molecular weight paraffinic hydrocarbons and 1 in aromatic hydrocarbons. Consequently, methane is the most reduced of all hydrocarbons. The exceptional position of methane in the earth's crust and its widespread distribution is also explained by the fact that methane has a minimum level of free energy (-12.14 kcal/mol), minimum values of enthalpy - heat content (-17.89 kcal/mol) and heat capacity at constant pressure (8.536 kcal/mol-deg), as well as the maximum entropy (44.5 entropy units). These properties of methane, combined with very low critical temperatures (-82.4°C) and high critical pressures (4.58 MPa), mean its low reactivity.

Under atmospheric conditions, methane can be oxidized by ozone (Oe), especially under the influence of a small electrical discharge. Nitrogen oxides can also contribute to the oxidation of methane.

The main volumes of methane on Earth are confined to sedimentary rocks of the earth's crust, and in addition to the rocks themselves, methane is also found in underground waters. Methane is an indispensable companion of coal and oil fields. The average methane content in the rocks of the sedimentary cover, whose weight is 2-10 $^{!8}$ tons, does not exceed 48.5 g/t (67 cm ^{3} /kg), and its relative content in the crystalline shell of the Earth is approximately 0.09 g/t (0.12 cm ^{3} /kg).

The widespread distribution of methane has also been noted in the earth's crust. The lithosphere contains about 1,800,000-10 ^{9} tons of methane in sands and 97,000-10 ^{9} tons in sedimentary rocks, of which 68,000-10 ^{9} tons, or 70%, are in coal deposits.

In the interior of the Earth, the oxidation of methane is difficult due to thermodynamic - conditions, but at great depths, during volcanic activity accompanied by high temperatures, the process of complete oxidation of methane to water and carbon dioxide is possible:

Lecture No. 9, (2 hours).

Protection of water resources.

Fresh water reserves are a single resource. Long-term development of the world's freshwater resources requires a holistic approach to the use of these resources and recognition of the interdependence between the elements that make up freshwater supplies and determine its quality. There are few regions in the world that are not affected by the loss of potential fresh water supplies, deterioration of water quality and contamination of surface and underground sources. The main problems that negatively affect the water quality of rivers and lakes arise, depending on the circumstances, with varying degrees of severity as a result of inappropriate treatment of domestic wastewater, weak control over the discharge of industrial wastewater, loss and destruction of catchment areas, irrational location of industrial enterprises, deforestation, uncontrolled fallow farming system and unsustainable agricultural practices. This leads to leaching of nutrients and pesticides. The natural balance of aquatic ecosystems is disrupted and living freshwater resources are threatened. Water development projects for agricultural development, such as dams, river transfer schemes, water management structures and irrigation projects, also affect aquatic ecosystems in various circumstances. Erosion, siltation, deforestation and desertification lead to increasing land degradation, and the creation of reservoirs in some cases has a negative impact on ecosystems. Many of these problems arise from environmentally destructive development patterns and a lack of public understanding and knowledge about the conservation of surface and groundwater resources. The extent of impacts on the environment and human health can be measured, although in many countries the methods for implementing such controls are very inadequate or have not been developed at all. There is widespread misunderstanding of the relationships between water resource development, management, management and treatment and aquatic ecosystems. Where possible, it is critical to implement preventive measures to avoid costly restoration, treatment and development of new water resources later on.

Goals

The complex and interconnected nature of freshwater systems requires a holistic approach to freshwater resource management (involving management activities within the watershed) that balances the needs of people and the environment. Even in the Action Plan adopted in Mar del Plata, the internal connection between water management projects and the serious consequences of their implementation, which are of a physical, chemical, biological and socio-economic nature, was pointed out. In the area of environmental health, the overall goal was to "assess the environmental impacts of different water uses, support measures to combat water-borne diseases, and protect ecosystems" [1].

The extent and extent of contamination of vadose zones and aquifers has always been underestimated due to the relative inaccessibility of aquifers and the lack of information about aquifer systems. In this regard, the protection of groundwater is one of the most important elements of the rational use of water resources.

18.38. To include elements of water quality regulation in water management activities, it is necessary to simultaneously strive to achieve the following three goals:

a) maintaining the integrity of the ecosystem through management based on the principle that aquatic ecosystems, including living resources, are protected and effectively protected from any type of degradation within the catchment area;

b) protection of public health, which includes not only the supply of drinking water that does not contain pathogenic microorganisms, but also the control of vectors of infection in the aquatic environment;

c) human resource development, which is the key to capacity building and a prerequisite for establishing water quality management activities.

18.39. All States, depending on their capabilities and available resources and through bilateral or multilateral cooperation, including with the United Nations and, if necessary, with other relevant organizations, could establish the following goals:

(a) Identify those surface and groundwater resources that could be developed for sustainable use

and other major water-dependent resources that can be developed, and simultaneously initiate programs to protect, conserve and manage these resources in a sustainable manner basis;

b) identify all potential sources of water supply and prepare projects for their protection, conservation and rational use;

(c) initiate water pollution control programs that are effective and commensurate with their level of socio-economic development, appropriately combining the implementation of pollution reduction strategies at source with environmental assessments and the application of feasible standards for emissions from large point sources and non-point sources with high degree of risk;

d) participate, to the extent possible, in international programs for monitoring and regulating water quality, such as the Global Water Quality Monitoring Program (GEMS-WATER), UNEP Environmentally Sound Management of Inland Water Resources (EMINWA), FAO Program on Regional Inland Fisheries and the Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR Convention);

(e) Reduce the prevalence of water-borne diseases, starting with the elimination of Guinea worm (guinea worm) and onchocerciasis (river blindness) by the year 2000;

f) establish, according to their capabilities and needs, biological, sanitary-hygienic, physical and chemical criteria for water quality in relation to all types of water bodies (surface and groundwater) with a view to continuously improving water quality;

g) implement an integrated approach to environmentally sound water management, including the protection of aquatic ecosystems and living freshwater resources;

h) develop strategies for the environmentally sound management of freshwater resources and associated coastal ecosystems, including consideration of issues related to fisheries, aquaculture, pastoralism, agricultural activities and biological diversity.

Activity

All States, depending on their capabilities and available resources and through bilateral and multilateral cooperation, including with the United Nations and, if necessary, with other relevant organizations, could undertake the following activities:

a) protection and conservation of water resources:

i) creating and strengthening technical and institutional capacities to identify and protect potential water supplies across all sectors of society;

ii) identification of potential water supply sources and preparation of national water inventories;

iii) development of national plans for the protection and conservation of water resources;

iv) restoration of important but degraded catchment areas, especially on small islands;

v) strengthening administrative and legislative measures to prevent encroachment on existing and potentially usable watersheds;

b) water pollution prevention and control measures:

i) application, where appropriate, of the "polluter pays" principle to all types of pollution sources, including sanitation measures on and off industrial sites;

ii) encouraging the construction of treatment plants for domestic and industrial wastewater, as well as the development of appropriate technologies, taking into account traditional local practices;

iii) establishing standards regarding the discharge of wastewater and the waters into which it is discharged;

iv) applying precautionary water quality controls where necessary, with an emphasis on minimizing and preventing pollution through the use of new technologies, changes in products and production processes, reduction of pollution at source and reuse of wastewater, recycling and reclamation, treatment and environmental safe disposal of wastewater;

(v) Mandatory environmental reviews of all major water projects that have the potential to cause damage to water quality and aquatic ecosystems, while developing appropriate measures to eliminate such damage and strengthening controls on new industrial installations, solid waste disposal sites and infrastructure development projects;

vi) making decisions in this area based on risk assessment and risk management and ensuring the implementation of decisions made;

vii) identification and application of the most environmentally sound and relatively inexpensive methods to prevent the spread of pollution, namely through the limited, rational and systematic use of nitrogen fertilizers and other agrochemicals (pesticides, herbicides) in agricultural practice;

viii) promoting and stimulating the use of properly treated and treated wastewater in agriculture, aquaculture, industry and other sectors;

c) development and application of environmentally friendly technology:

(i) Control of industrial waste discharges, including the use of low-waste production technologies and water recycling, in an integrated manner and through precautionary measures taking into account a comprehensive life cycle analysis;

ii) treatment and safe reuse of municipal wastewater in agriculture and aquaculture;

iii) development of biotechnology, in particular for waste treatment, production of biofertilizers, etc.;

iv) development of appropriate methods for controlling water pollution, taking into account sound traditional and local practices;

d) groundwater protection:

i) developing agricultural practices that do not degrade groundwater;

(ii) taking the necessary measures to reduce the effects of saltwater intrusion into small island and coastal plain aquifers as a result of rising sea levels or overexploitation of coastal aquifers;

iii) preventing contamination of aquifers by regulating toxic substances entering the soil and creating water protection zones in areas of groundwater recharge and intake;

iv) design and operate landfills based on reliable hydrogeological information and environmental assessments using the most appropriate and best available technology;

v) promoting measures to improve the safety and security of well sites and wellheads to reduce the amount of biological pathogens and harmful chemicals entering aquifers in these areas;

vi) Conduct, as necessary, monitoring the quality of surface and ground waters that may be adversely affected by toxic and hazardous material disposal sites;

e) protection of aquatic ecosystems:

i) remediation of polluted and degraded water bodies in order to restore the aquatic environment and ecosystems;

(ii) restoration programs for agricultural lands and for other users, taking into account equivalent measures for the protection and use of groundwater resources important for agricultural productivity and tropical biodiversity;

iii) conservation and protection, taking into account socio-economic factors, of wetlands (because of their ecological importance for many species as their habitat);

iv) control of harmful aquatic species that can destroy some other aquatic species;

f) protection of living freshwater resources:

i) control and monitoring of water quality to ensure sustainable development of inland fisheries;

ii) protecting ecosystems from pollution and degradation to enable the development of freshwater aquaculture projects;

g) control and surveillance of water resources and waters into which waste is discharged:

i) establishing networks for monitoring and continuous control of waste waters, as well as point and non-point sources of pollution;

ii) encouragement and wider implementation of environmental assessments of geographic information systems;

(iii) Monitoring sources of pollution to ensure greater compliance with the rules and regulations in this area, as well as to regulate the issuance of permits for waste dumping;

iv) control over the use of chemicals in agriculture that may have harmful effects on the environment;

v) rational land use to prevent land degradation, erosion and siltation of lakes and other bodies of water;

h) development of national and international legal instruments that may be required to preserve the quality of water resources, primarily for the following purposes:

i) monitoring and control of pollution of national and transboundary waters and its consequences;

(ii) control of long-range transport of pollutants through the atmosphere;

iii) control of accidental and/or arbitrary discharges into national and/or transboundary water bodies;

iv) conducting environmental assessments.

Means of implementation

a) Financing and cost estimation

The Conference secretariat estimates that the average total annual cost (1993-2000) of implementing activities under this program will be approximately US$1 billion, including approximately US$340 million provided by the international community in the form of grants or concessional incentives. conditions. These cost estimates are indicative and approximate only and have not yet been considered by governments. Actual costs and financing terms, including any non-concessional terms, will depend, among other things, on the specific policies and programs that governments decide to implement.

b) Scientific and technical means

States should undertake joint research projects to develop solutions to technical problems unique to each watershed or country. States should consider strengthening and developing national and research centers networked and supported by regional water research institutions. Collaborative work between North and South research centers, as well as field research by international research institutes on water issues, should be actively encouraged. It is essential that a minimum portion of funds earmarked for the development of water projects, especially externally financed projects, be allocated to research and development.

Monitoring and assessment of complex water systems often requires multidisciplinary research involving a number of institutions and scientists in a collaborative program. International programs in the field of water quality control, such as GSMO-WATER, should be focused on the quality of water resources in developing countries. To process, analyze and interpret monitoring data, as well as to prepare management strategies, user-friendly software products and methods for operating the Geographic Information System (GIS) and the World Resources Database (GRID) must be developed.

c) Human resource development

The training of managers and specialists requires the use of new methods to meet changing requirements and solve emerging problems. Flexibility and the ability to adapt to emerging water pollution problems must be developed. Training activities should be carried out periodically at all levels in those organizations that have responsibility for water quality management, and best practices should be applied in training on specific aspects of water quality monitoring and control, including the development of specialized skills, on-the-job training, problem-based seminars and advanced training courses.

Appropriate approaches include strengthening and improving the human resource capacity of local governments to manage the conservation, treatment and use of water resources, especially in urban areas, and organizing, within existing educational institutions, regional technical and engineering courses on water quality protection and control. him, as well as educational and preparatory courses on the protection and conservation of water resources for laboratory technicians, practitioners, women and other water user groups.

d) Capacity building

Effectively protecting water resources and ecosystems from pollution requires a significant increase in the capabilities currently available in a significant number of countries. Water quality management programs require a certain minimum amount of infrastructure and personnel to find and implement technical solutions and carry out regulatory actions. One of the key challenges of our time and future is the continued operation and maintenance of these facilities. There are a number of areas where immediate action is needed to prevent further damage to resources generated by previous investments .

The existence of the biosphere and humans has always been based on the use of water. At the current stage of development of the technosphere, when water consumption is increasing, and, accordingly, its pollution and natural resources have largely lost their protective properties, **new approaches are needed, greening thinking** in relation to such a terrible evil as *water pollution and depletion* .

Major water pollutants.

Chemical pollutants Biological pollutants Physical pollutants

Acids Viruses Radioact

Alkalis Bacteria Susp.

Soli Dr. disease.organ Warm

Oil and petroleum industry

Algae Organolept (color, zap)

Pesticides Lignins Sludge

Dioxins Yeast. and reach. fungi

Sand

Heavy metals Silt

Phenols, Ammonium, Clay

nitrous nitrogen

Surfactants (synthetic surfactants)

- **Freshwater resources.**

World ocean - 1,138,500 thousand km $_3$. – 96.53%.

Glaciers and snow (mountains, pole) -- 24064 --//-- -- 1.74%.

Groundwater -- 23400 --//-- -- 1.69%.

Underground ice (permafrost) -- 300 --//-- -- 0.023%.

Lakes -- 176 --//-- -- 0.014%.

Soil moisture -- 16.5 --//-- -- 0.001%.

Atmospheric vapor -- 12.9 --//-- -- 0.0008%. *Swamps* -- 11.4 --//-- -- 0.0007%.

River waters -- 2.1 --//-- -- 0.0002%.

Water consumption in the world is **5000 km** ^{3} per year, incl. - **800 km** ^{3} per year for technical needs, 1t. steel - **150 m** ^{3}, 1 ton. copper – **500 m** ^{3}**,** 1 ton. plastics - **500-1000 m** ^{3}, synthetic rubber and artificial rubber. fabrics – **2000-3000** m^3.

Standardization of water quality.

It is prohibited to discharge wastewater containing valuable waste, industrial raw materials, radioactive substances and substances for which MPCs have not been established into water bodies.

When **1 m** ^{3} of untreated wastewater is discharged **, 40-60 m** ^{3} of naturally clean water spoils. To make treated wastewater suitable for reuse, it requires **7-14** fold dilution.

substance is taken to be the maximum permissible concentration at which the normal course of biological processes in the most sensitive organisms is ensured.

For each drain, **the MDS is established** = the sum of various harmful substances.

Emission **limit - for a certain period of time - VSS** (temporarily agreed discharges of harmful substances). **VSS** is greater than PDS.

Bacterial self-purification of rivers in the autumn-summer period - after **24 hours** no more than 50% of their maximum number remains, after **48 hours** - 10-25%, after **96 hours** - 5%. Indirect indicators - COD (chemical oxygen demand) - oxidation, - BOD (biochemical oxygen demand) - organ decomposition. in-in.

■ Wastewater from mining enterprises.

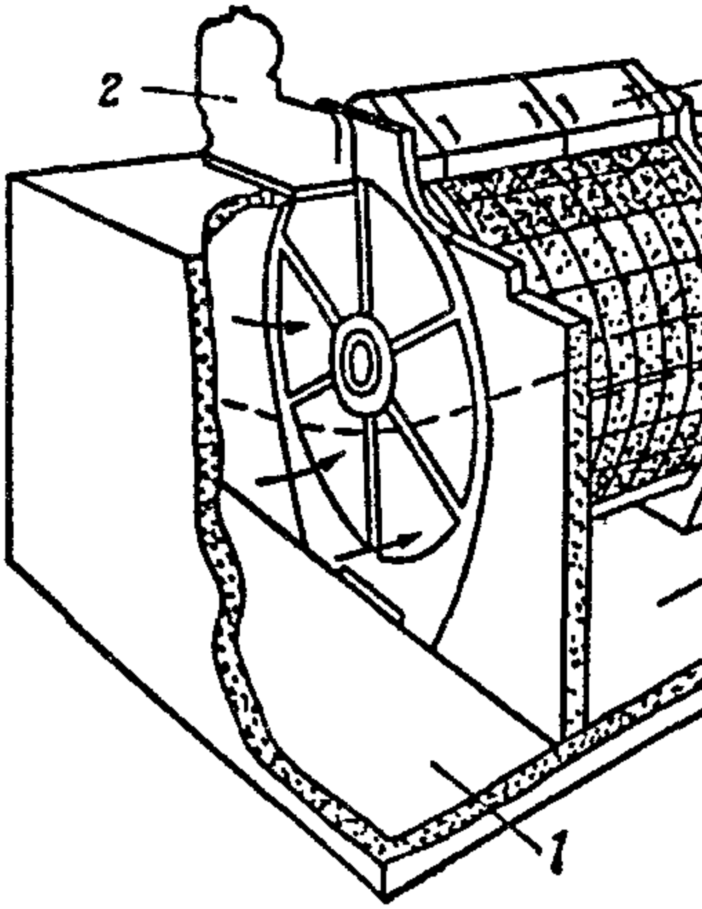
By degree of contamination - *Coarse suspensions* - (large particles), *Colloidal solutions* - (small particles), *True solutions* - (soluble particles).

Mining industry - discharge **is 3 times** higher than consumption, mines - **7 times** , open pits - **4.5 times** , so that this is not necessary - drainage, drainage, barrage (fencing), water protection (plugging, backfilling).

Lecture No. 10, (2 hours). Technology for purifying mine water from harmful impurities.

Mechanical-

- straining - sieves, grates,
- upholding,
- filtration,

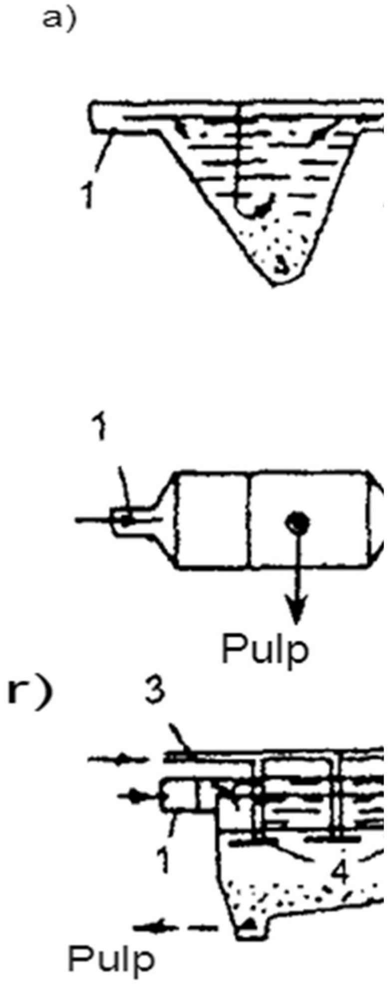


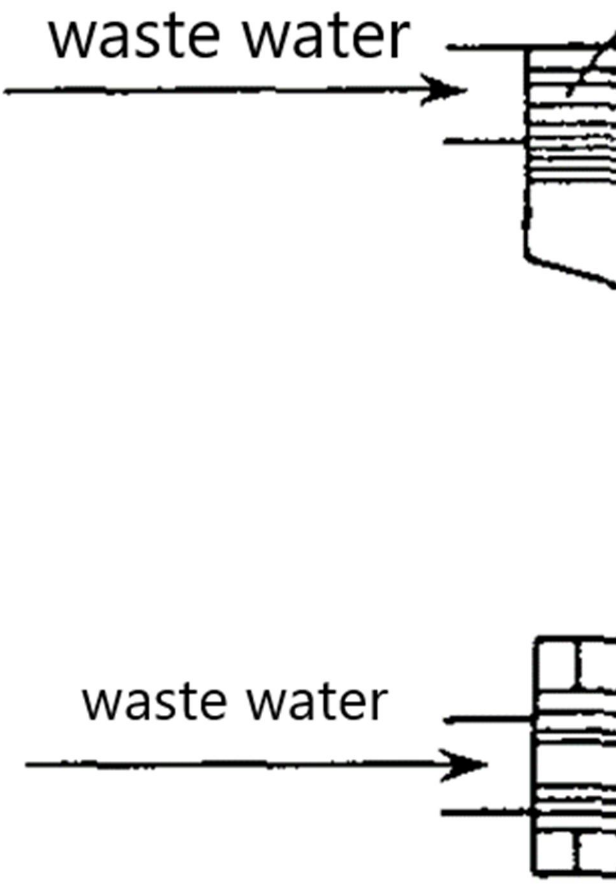
Scheme industrial microfilter :

1 - entrance section ; 2 — motor ; 3 — node flushing injectors ; 4 - drum ; 5 —fabric from steel wire ; 6 — frame ; 7 — day off section

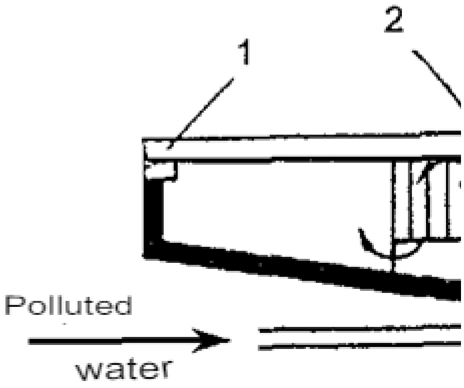
- separation of suspended solids using centrifuges and hydrocyclones.

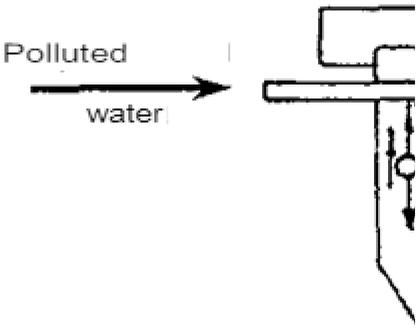
Rice . Vertical (a); horizontal With circular movement water (b , c) and aerated (g) schemes sand traps :
1 - innings sewage water ; 2 — issuance purified water ; 3 — air vent ;
4 - air distributor ; 5 - collection pop-up substances ;
6 — retraction pop-up substances



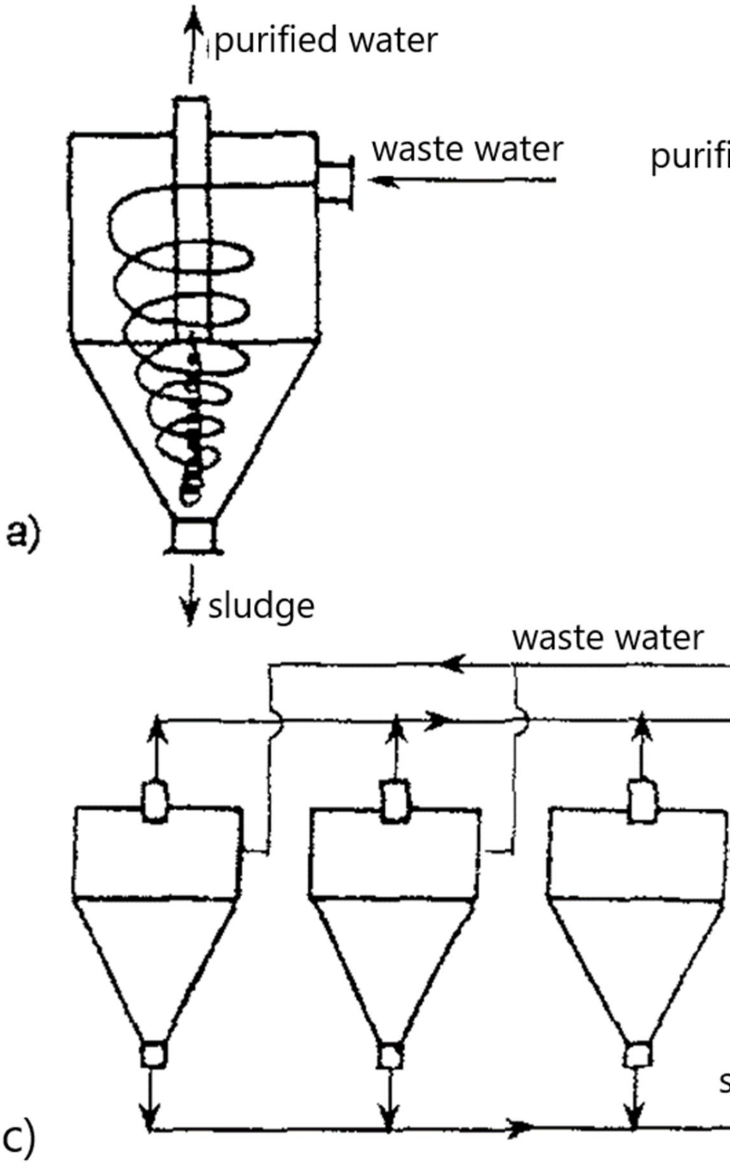


Scheme horizontal settling tank : 1 - chamber flocculation ; 2 — drainage gutter ; 3 — camera savings draft





Scheme radial (a) and vertical (b) settling tanks : 1 - drainage channel ; 2 — damper ; 3 — rotating metal rowing farm with scrapers ; 4 - pipe For removal draft

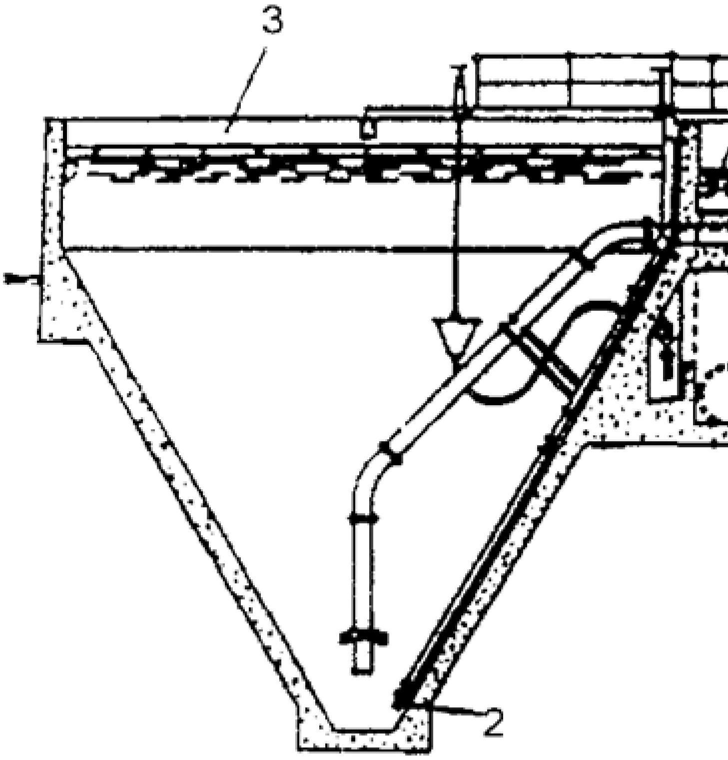


Scheme hydrocyclones pressure (a) and With internal cylinder

And conical aperture (b): 1 - frame ; 2 — interior cylinder ; 3 — annular tray ; 4 - aperture , and Also block pressure hydrocyclones (in)
And multi-tiered hydrocyclone With inclined pipes For withdrawal
purified water (g): 1 - conical aperture ; 2 — tray ; 3 — weir ; 4 - oil collection funnel ; 5 - distribution trays ;
6 — sludge disposal gap

Physico-chemical –

- **coagulation** – sticking together of fine particles under the influence of a coagulant (ammonium salts, iron, magnesium, lime, sludge waste, etc.),
- **flocculation** - a type of coagulation, coagulant - natural organic and synthetic substances (polyacrylamide, proteins, polyethylnamine, etc.)



Scheme vertical separator For flocculation thin precipitation :
1 - collector sludge ; 2 — pipe For plum sludge ; 3 — filtering trays ;
4 - tanks For exit spent liquids

- **flotation** (vacuum, pressure) - adhesion of two phases - air and water - to the surface of the surface - surfactants are used (oil, fuel oil, resins, kerosene, etc.) + foaming agent (heavy pyridine, cresol, phenols, etc.) ,

- **sorption** - absorption of harmful substances by a solid or liquid - sorbent (ash, coke breeze, peat, clay, etc.),
- **absorption** - the transition of an absorbed substance from the surface of the absorbent into its volume with the formation of a solution,
- **adsorption** - absorption of a substance in a gaseous or solid state by the surface of adsorbents (solid or liquid) - activated carbon, sawdust, peat, slag, etc.
- **chemisorption** - chemical interaction of dissolved substances with a solid body,
- **dialysis** is a method of separating colloidal particles and macromolecules in solution from salts and other low-molecular substances,
- **osmosis** is the diffusion of a substance (solvent) through an impermeable partition (membrane) that separates the solution and is permeable to the solvent.
- **ion exchange** – used to extract metals from solutions, etc.
- **evaporation** - distillation with water vapor of water pollutants.

Chemical cleaning.

- **neutralization** - a chemical reaction between substances with acidic and alkaline substances (solutions of acids, alkalis, soda ash, ammonia, lime, marble, dolomite, etc.).

- **oxidation** - water is neutralized with chlorine, calcium or sodium hypochloride, bleach, ozone, oxygen, etc. ***Ozonation*** – redox potential – ozone – 1.8, and chlorine – 1.36. **Ozone** is produced in ozonizers, in which air is passed between two electrically conductive surfaces. To mix liquid with ozonized air, they use: *bubbling of* the ozone-air mixture through filters, - *ejection* into the water flow, - *dispersing* bubbles of the ozone-air mixture in water with impellers (mixers). Expensive, high energy consumption .

Electrochemical cleaning

–

- **electrolysis** is a chemical process that occurs when electric current is passed through an electrolyte solution or molten electrolyte,

- **electrochemical oxidation** - the process of the presence of an inorganic electrolyte in the treated liquid, which, as a result of electrolysis and side reactions, forms a strong oxidizing agent,

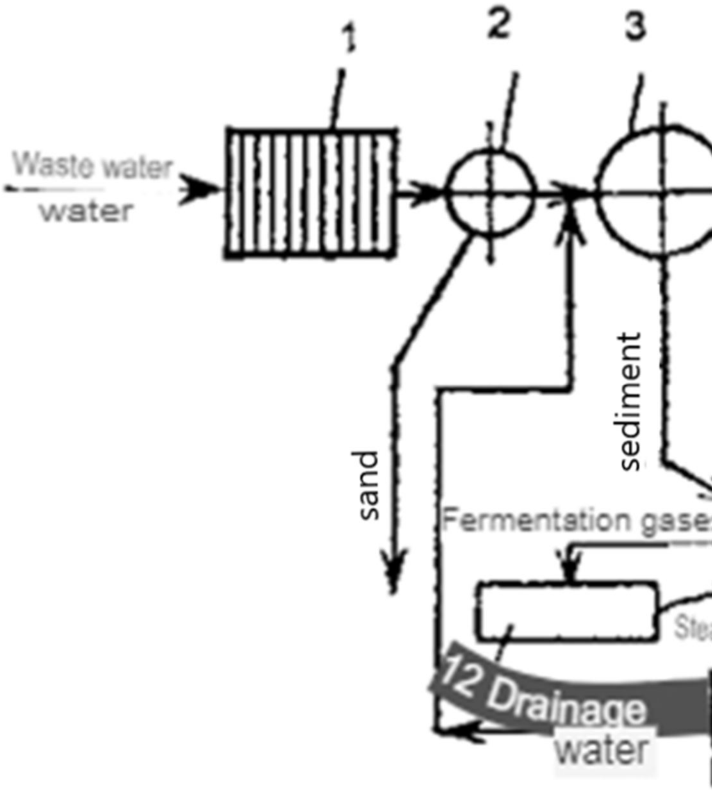
- **electrodialysis** is the process of separating ionized substances using an electromotive force created in a solution on both sides of a porous partition (membrane) separating it.

An undoubted advantage is that simultaneously with cleaning, a lot of valuable substances are extracted - during the electrolysis of waste solutions after pickling carbon steels, you can regenerate 90% of the sulfuric acid used in pickling and several tens of grams of powdered iron from 1 cubic meter. m. wastewater.

Biochemical purification

–

Biochemical purification consists of the oxidation of organic impurities in waters with the help of microorganisms capable of decomposing them into mineral components in the course of their life activity. The fermentation process releases **methane,** which can be used as fuel.



Scheme full biochemical cleaning sewage water :
1 - lattice ; 2 — sand trap ; 3 — settling tank ;
4 - storage tank With partitions ;
5 - settling tank ; 6 — chlorination ;

7 — capacity With purified water ; 8 - sludge collector ; 9 - sludge tank ;
10 - camera fermentation ; eleven - camera collection And drainage draft ;
12 - gas rotter

Thermal cleaning –

- **distillation** (evaporation) – concentrated solutions are obtained, from which the dry residue is isolated for combustion, burial or reuse,
- **crystallization** (freezing) - pure water at low temperatures forms crystals and the remaining brine with salts dissolved in it is placed in the cells between these crystals.

■ Devices and structures for wastewater treatment from mining enterprises.

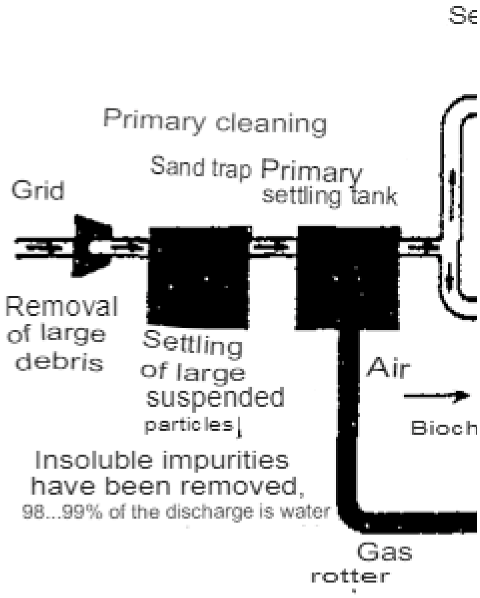
Composition and properties of mine water **–** five groups –

- *main* (*ions* - chloride, sulfate, hydrocarbonate, carbonate, sodium, potassium, magnesium, calcium),
- *dissolved gases* – oxygen, nitrogen, carbon dioxide, hydrogen sulfide, etc.,
- *biogenic elements* – compounds of phosphorus, nitrogen, silicon,
- *microelements* – compounds of all other chemical elements,
- *organic substances.*

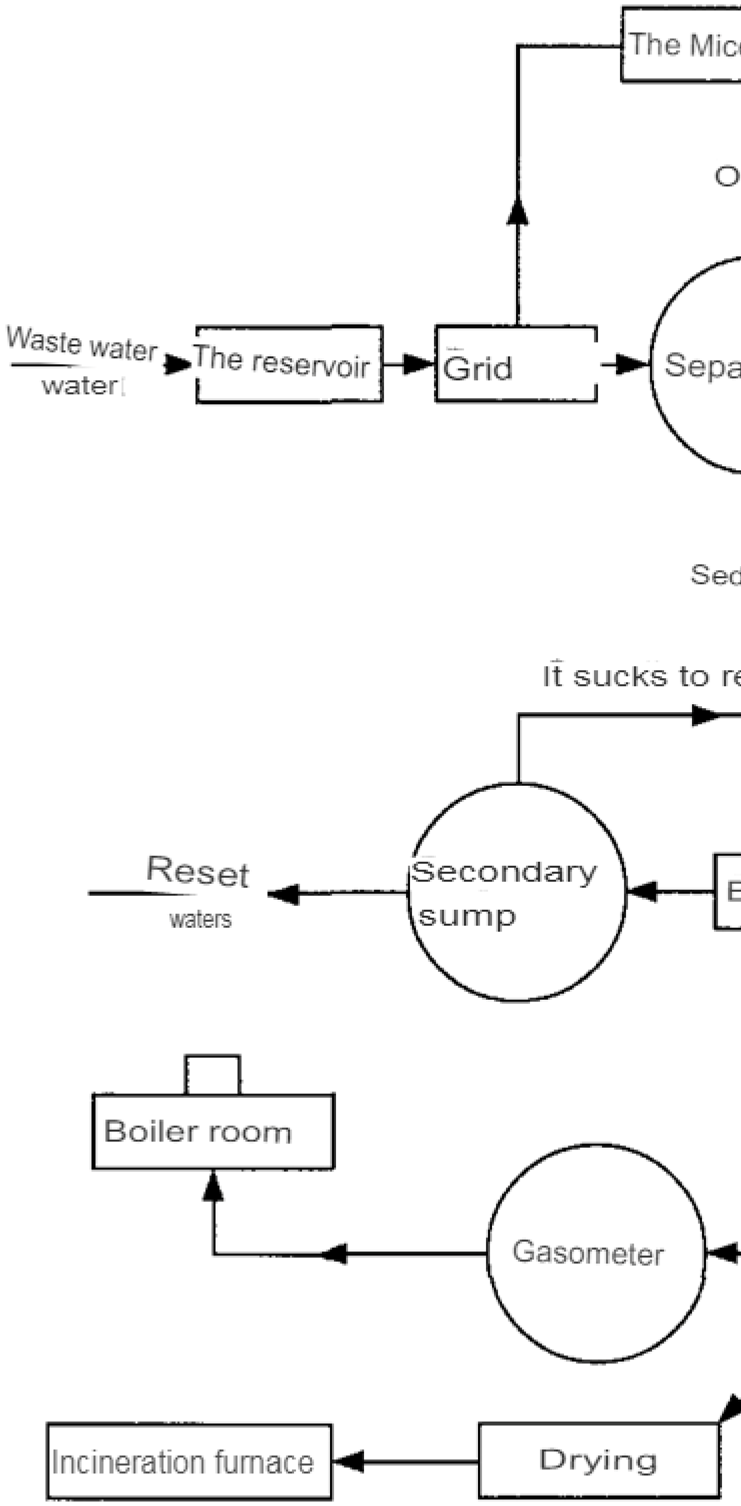
Primary purification - water enters a system of grates and meshes (filtering, retaining large objects), then into a sand trap and then into a settling tank.

Secondary purification is the removal of substances in solution.

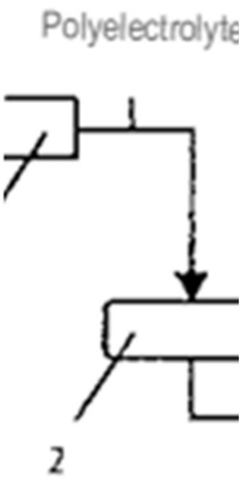
Tertiary purification - plant nutrients are removed - compounds containing *nitrogen and phosphorus* - their content leads to rapid growth of algae. Phosphorus is removed using lime, iron and ammonium salts. Additional purification with activated carbon.



General scheme cleaning sewage water



Scheme plant By recycling sewage water



Scheme plant tertiary cleaning water :
1 - mixer ; 2 — first separator ; 3 — liner ; 4 - second separator ;
5 - coal column (two parallel);
6 —chlorinators ;
7 — bunker For coal suspensions ; 8 - storage tank For spent coal ;
9 - oven For recovery coal ; 10 - storage tank quenching ;
eleven - storage regenerated coal

The Baydayevskaya mine closed about ten years ago. The project for the liquidation of the - enterprise provided for the construction of a drainage complex using submersible pumps, as well as treatment facilities for mine water. In 2004, according to official data, the Russian Government stopped funding the work. After the flooding of the stopped mine exceeded a critical level, the management of Yuzhkuzbassugol became concerned, since water began to flow from the flooded spaces of Baydayevskaya into the Yubileiny mine (the volume ranged from one hundred to two hundred cubic meters per hour). In addition, there was a threat of an emergency water breakthrough, the safety of the

Yubileiny and Abashevskaya miners.

After a stern warning from Rostechnadzor about bringing to responsibility the bankruptcy manager of the State Enterprise "Baydayevskaya Mine" entered into an agreement with OJSC "OUK Yuzhkuzbassugol" for the maintenance and operation of the drainage complex. In mid-2007, the drainage system was put into operation and the flooding level of the mine began to decrease - with insufficient water languid and therefore inactive wastewater treatment.

Today, submersible pumps release 500-600 tons of water from a liquidated mine to the earth’s surface every hour. These are hundreds of thousands of cubic meters of inert dust, which were once used to “shale” mine workings, and are now being gradually washed away. These are the remains of explosives and other chemicals remaining in the depths, not to mention the coal pulp that is thrown out into the Baidaevka stream and flows by gravity into the Tom River. Meanwhile, Baydayevka itself is a river only in the spring, during intense snowmelt: at another time it would dry up naturally, if not for the mine... That is, one hundred percent industrial waste flows along its bed. It turns out to be an open sewer, going directly to the water intake.

The water intake of the Kuznetskaya CHPP is located several hundred meters downstream, and the lion's share of the wastewater flowing from Baidaevka to Tom is simply sucked into the water treatment system and, after purification, goes to replenish the hot water supply system and ends up in the taps of the townspeople.

“We felt that the quality of the water had sharply deteriorated - last summer,” said Olesya Kolesnikova, deputy head of operation of the chemical shop of the Kuznetsk Thermal Power Plant. “Analyzes showed the - alkaline content was twice as high as the level allowed by the design documentation (the construction of the combined heat and power plant was completed in 1944). For example: in the water intake of the West Siberian Thermal Power Plant, this figure is five times lower than ours, due to the fact that the pollutant is washed away. Today, chemical water treatment at the Kuznetskaya CHPP is operating at its maximum capacity. But if the process worsens, in summer the water level in the Tom River will decrease, and the concentration of chemical pollutants will increase. I don’t even know how we can ensure standard water quality . ”

Chemical analysis data of the Baydayevskaya mine wastewater entering Tom indicate a significant excess of maximum permissible concentrations for a number of indicators. Thus, mineralization is 2.2 times higher than the maximum permissible concentration, the aluminum content exceeds the maximum permissible concentration by 9 times, iron by 6 times, sodium by 7 times, copper by 3.5 times. In general, the dry residue is 2.24 times more than permissible.

The discharge of wastewater into the Tom threatens the main artery of our region and may even cause a change in its regime, reduce the oxygen concentration to a level at which fish may die, change the pH to such an extent that aquatic flora and fauna will suffer, and the watercourse will become unsuitable for use. calling.

Today, at thermal power plants, - a double rate of sulfuric acid is introduced into the treated water to destroy carbonate hardness. During acidification, the content of sulfate ion increases significantly, which increases the aggressiveness of make-up and network water and, naturally, intensifies corrosion processes - both of thermal power plant equipment and network - pipelines. As a result, the amount of iron increases and color increases in the water with which we wash ourselves, wash clothes and wash dishes.

In addition, if the situation with increased alkalinity is not prevented , then the appearance and development of sulfate-reducing bacteria in urban networks is inevitable (sulfate ions for these microorganisms are a nutrient medium). The result is a musty, swampy smell, which was also observed in previous years, when the situation with the quality of the water source was not as bad as it is today...

Lecture No. 11, (2 hours).

Extraction of useful components from technogenic deposits

Technogenic deposits represent a significant part of the national wealth, so they must be used through the development of complex technologies for the development of raw materials, which requires their preliminary careful and comprehensive study.

1. Dumps and tailings ponds, which are technogenic deposits, are increasing in volume faster than the increase in mineral extraction. This is due to the fact that the extraction of useful components from mineral raw materials reaches a maximum of 30-40%, and the average in Russia is 4-7%. The second important reason is the growing share of open-pit mining and the increasing stripping ratio. The third most important reason is the steady depletion of mineral resources as the depth of development increases. All this leads to an approaching environmental catastrophe if we do not seriously engage in the comprehensive development of mineral deposits and the use of technogenic raw materials.

2. The development of man-made deposits requires a more strict assessment and compliance with technological regimes than the development of natural deposits.

3. According to the existing accumulated experience, which is not yet sufficient for a qualitative generalization , technogenic deposits can be divided into three groups:

1) Deposits of coal sludge ;
2) Deposits of iron ores and other magnetic minerals;
3) Deposits of polymetals and precious metals.

4. Deposits of coal slurry have a pronounced specificity of origin and the resulting features of extraction and processing. Coal slurries, which are very small particles of coal that are drained along with the water that carries them, are placed in earthen pits. As one hole fills, the drain is transferred to another location. At the same time, the composition of the earth mass is not controlled, and coal sludge can be highly saturated with water.

Determining the location of such pits is not difficult. However, the volume of sludge makes up 20-40% of the mined coal, which greatly affects the efficiency of using the coal deposit.

Work has been carried out in Kuzbass with positive results, which allow:

- reduce the cost of sludge processing by 2-3 times;
- collect and process sludge;
- stop the discharge of sludge into earth sumps and flotation tailings into tailings ponds and thereby improve the environmental situation in the

area where the enterprise is located;

- reduce coal losses through production waste and water discharges into mine workings and reservoirs;
- increase the profitability of enterprises by improving the quality of commercial coal, increasing yield and reducing production costs;
- prepare coal-water fuel - (CWF) from fine sludge with a particle size of 0-0.1 mm at enterprises where there are no other means of processing them.

It should be said that the combination of these measures is not suitable for all grades of coal, especially brown ones.

At one of the Kuzbass mines, an installation for extracting sludge from pits was tested, which consists of a congestion polarizer for reagent-free sludge treatment, a thickener-clarifier, a filter centrifuge, a scraper conveyor and a loading hopper. Similar installations, which are modifications of the one described in relation to specific conditions, exist in a number of mines.

The sludge is used to produce briquettes and smokeless coal. Installations for their production are characterized by low capital and operating costs, are located in close proximity to sludge fields and require relatively small production areas.

The payback period for capital investments in such installations is less than 2 years.

5. Deposits of ores with magnetic properties, as a rule, are slurry deposits such as alluvial maps. The thickness of the alluvial layer varies from the center of the map to the places of pulp discharge from 1 to 7-8 m.

Reserves are assessed by - scanning the walls of pits, furrows and slopes of tailings dumps with geophysical equipment, and by scanning the surface with separators with magnetic devices. Further, instruments and techniques commonly used in geological - exploration are also used.

More than half of the materials from dumps and tailings are potential raw materials for opening magnetite of subcentimeter structures of the outlet slot of a 7-8 mm cone crusher. In the 10-0 mm class and especially in the 5-0 mm class, a mixture of grains of magnetite pieces and rock minerals is visible, ready for SMS operations after screening. However, in the rocky part of the rock mass there are pieces up to 200 mm in size.

The pattern of distribution of

jelly for the total in the 5-0^-mm class is common for ore concentrate and waste tailings. If the lower part of the tailings pond is heavily watered, it is advisable to use hydromechanization means to develop it and supply it to the plant. In conditions of a dry bottom, a mechanized shovel and dump trucks are used to supply the dump mass to the receiving hopper. When the tailings bed is dry, which usually happens, the following production process scheme is used:

Input processes: 1) excavation and loading of dump trucks with a shovel; 2) delivery of technogenic material to the receiving bunker.

Internal processes: 1) allocation of oversized items; 2) accumulation of waste in a bunker; 3) scrap metal separation; 4) screening class (8 10) - 0 mm; 5) crushing of the over-screening part to fineness (6-0 mm); 6) screening with division into classes 8 (10) - 0 mm and +8 (10) mm; 7) removal of enrichment products.

Output processes: 1) accumulation of industrial products in bunkers or storage of industrial products in storage stacks according to fraction classes; 2) additional fractionation and preparation of commercial crushed stone and sand.

In the USSR, the Union reserves of cobalt were located in the iron ores of the Sokolovsko-Sarbayskoye deposit as inclusions, which were not extracted and were sent to the dump. A similar situation is developing in Russia in the Sheregesh group of mines in Altai. As the experience of SSGOK has shown, to process this part of the technogenic deposit, it is advisable to build a separate factory using a shortened scheme without crushing and grinding. The further part of the technology differs significantly from iron ore and requires a new technological scheme and new equipment.

Technogenic deposits of base metals and precious metals are the most complex in terms of their assessment and development technology. It is even argued that each of them requires an individual approach.

Exploration is complicated by the fact that the rock deposits are composed of finely disaggregated rock masses. Therefore, when drilling exploration wells, core extraction is a difficult task.

In some cases, it is advisable to thicken the pattern of wells , since as a result of interaction with flotation reagent discharges, in some places lenses of water-impregnable mineral about 1 m in size were formed, in which the content of the useful component is 2-3 times higher than in the rest of the tailings. Many deposits, especially polymetals, are located in mountainous areas. In this regard, dumps and tailings dumps are placed in gorges, along the bottom of which streams flow. When dumps are placed on slopes, their inspection and assessment of reserves is simplified. However, the overall difficulty remains the task of identifying and assessing reserves of many metals, including noble ones with inclusions of ordinary ones.

As a rule, ores are roasted in rotating tube kilns, which helps reduce coke consumption and increases the content of useful components in the ores by reducing their moisture content, and the content of the useful component reaches 6-9%.

Most often, the collective concentrate is sent for processing

, often also agglomerate, briquettes and pellets containing several components. After dissolving the technogenic raw material, it is subjected to complex selective leaching and a number of commercial products are obtained.

For platinoids, the mineral form of occurrence is the mineral merenskite, containing 27% palladium, 200 g/t rhodium, 300 g/t iridium, 0.7 g/t platinum.

To obtain a more homogeneous product, many mines set up homogenization warehouses, which reduces the influence of ore of different quality in near-mountain operations.

Significant amounts of gold and silver are found in malachite, chalcozine , limonite and chrysocol.

The washing complex makes it possible to obtain a collective concentrate, the amount of noble metals in which is 12-18 kg/m3 ^{of} processed ephels. When the content of free gold in the sands is about 90 mg/t, its recovery is 90-95%. In addition, up to 20-30% of bound gold is recovered into the collective gravity concentrate (relative to the amount of free gold recovered gold). Other minerals with increased density also pass into the collective concentrate : platinoids, cassiterite, zircon, scheelite, tantalniobates, wolframite, etc. In general, the cadastral value of gold-bearing tailings increases many times or significantly due to other useful components.

In the Russian Federation, the processing of waste dumps from mining and metallurgical enterprises is practically not carried out. Tailings and sludge from mining and processing plants or processing plants are processed. The economic efficiency of this direction is determined by the fact that, despite the low cost of useful components in raw materials from tailings (due to low contents), the cost of processing is 2-3 times lower than from primary ores, due to the fact that:

- this raw material has already been mined and lies on the surface;
- a significant part of it does not require crushing and grinding;
- a number of highly efficient technologies for processing such raw materials have been developed (new flotation reagents, hydraulic units for sludge, hydrometallurgy in dumps and heaps, autoclave opening of low-grade concentrates, electrochemistry, etc.);
- The current state of sorption-desorption technologies can provide - selective extraction of metals from gold heap leaching solutions. On average, processing sludge and extracting valuable components from it costs 2-3 times less than from primary ores. Cost of 1 ton of alloy steel, smelted from agglomerated raw materials. The loss of metals from ores of technogenic deposits is 20% less than from ores of primary deposits.

Unfortunately, there are no known cases of biological extraction of gold from ores of other minerals, although there are precedents for successful application. Thus, under the leadership of corresponding member. RAS G.I. Karavaiko extracted gold from refractory gold-antimony ores of the Argun region. The development of the Olimpiadninskoye gold-antimony-arsenic ore deposit in the Arctic region of the Krasnoyarsk Territory took place under the leadership of the current President of the Republic of Adygea D.Kh. Sovmen, who built a factory in Nalchik for growing various microbiological strains capable of extracting other mineral components.

The environmental situation in the area - where the deposit is located improves noticeably if traditional and newly created materials begin to be used.

Traditional materials include: slag, crushed stone, sand, clay, expanded clay.

Among the non-traditional ones we will name: mullite and mullite-silicon carbide, cement-free binders and concrete based on them , heat-resistant and fire-resistant materials, etc.

In all cases, this does not require the use of additional natural raw materials.

However, cases of development of technogenic deposits are still few, the volumes of dumps and tailings continue to increase, as well as the area of land they occupy. Along with them, negative environmental consequences are growing, in particular the consequences of the leakage of harmful liquid substances into underground water bodies. Thus, despite the fact that all the coal mines of the Kizelovsky basin are closed due to their unprofitability, their dumps have been preserved. These dumps, containing pieces of pyrite, as a result of the oxidation and decomposition of the latter, are saturated with acids that penetrate into the water and underground sources, harming the health of the population drinking such water.

To completely process the ores of the Tyrnauz tungsten-molybdenum deposit, it was necessary to carry out four times autoclaving. It turned out to be too expensive, and we settled on double. A lot of heavy metals remained in the leaching discharges, and the placement of sludge storage facilities in gorges with streams flowing through them contributed to the accumulation of heavy metals in the river. Baksan. This affected the composition of the water not only near the field, but also downstream of the river, where many settlements are located.

The presence of dumps and sludge storage facilities affects not only the condition of water intake sources, but also, due to dust, the composition of air and soil.

6. The favorable economic and environmental consequences of processing technogenic deposits are still very far from the results that we can and should get.

From the examples given, it is clear that the equipment used was assembled from the same set of equipment that is included in the usual list of mining and processing equipment.

Meanwhile, from the laws of technological transformations and their economic consequences , substantiated by prof. V.S. Muchnik, it is known that high-tech technologies, starting from the eighth stage of these transformations (a total of eleven stages are known today), should be characterized by continuity, flow and low operational efficiency, as a result of high efficiency. The examples given indicate that the technology and equipment used do not have such properties. Hence. If it is possible to obtain new solutions, especially those combining mining and processing processes, we can count on a significant increase in the efficiency of development of technogenic deposits. The available reserves are obvious.

Lecture No. 12, (2 hours).

Environmental pollution during accidents, environmental risk, low-waste and resource-saving technologies

The conceptual basis of environmental economics is the concept of sustainable development development). It was adopted at the UN Conference on Development and Environment in Rio de Janeiro in June 1992. This Conference adopted the following 376 definition: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs [1].

It includes two key concepts:

- the concept of needs, in particular the subsistence needs of the poorest sections of the population, which should be given the highest priority;
- the concept of limitations imposed by the state of technology and the organization of society on the ability of the environment to meet present and future needs."

The above definition of sustainable development examines it through the prism of economic relations between generations: within the modern generation (in particular, the social aspect - the problem of poverty) and between generations (ecological and economic aspect).

The main criteria for sustainable development for the long term, based on the classification of natural resources and the dynamics of their reproduction, are:

- ensuring at least a regime of simple reproduction of natural resources - the amount of renewable natural resources;
- the maximum possible slowdown in the rate of depletion of reserves of non-renewable natural resources with the prospect of their replacement with other unlimited types of resources in the future;
- the possibility of minimizing waste based on the introduction of low-waste, resource-saving technologies, the best available technologies;
- the possibility of minimizing pollution to a socially and economically acceptable level - environmental pollution (both total and by type) in the future should not exceed its current level.

Approaches to constructing a system of indicators of sustainable development are:

1. Construction of a system of indicators, each of which reflects individual aspects of sustainable - development based on the corresponding system of indicators: economic, environmental, social, institutional.
2. Construction of an integral, aggregated indicator, on the basis of which one can judge the degree of sustainability of socio-economic development. Aggregation is usually carried out on the basis of three groups of indicators: environmental-economic, socio-ecological-economic, and environmental itself.

As you know, the environment provides three functions:

- provision of natural resources;
- assimilation of waste and pollution;
- providing people with natural services, such as recreation, aesthetic pleasure, etc.

The inability to assess the real value of a clean environment and natural resources can cause an understatement of the price of an environmental good and can lead to an understatement of environmental damage and external costs in the price. With adequate economic consideration of the environmental factor, the efficiency of resource saving turns out to be much higher than increasing the environmental intensity of the economy, as has been proven by the economic development of developed countries in the last two decades.

It is advisable to include the assessment of natural resources in the national wealth of the country377 This has not yet been done, which once again indicates an underestimation of the environmental factor. National wealth is the totality of a country's resources that constitute the necessary conditions for the production of goods, the provision of services and the provision of people's lives. The volume of national wealth includes non-financial production assets (fixed assets, inventories, valuables), non-produced assets, including tangible (land, subsoil wealth, natural biological and underwater water resources) and intangible (licenses for the use of inventions, transferred contracts etc.), as well as financial assets (currency, securities, etc.).

We can distinguish at least three limitations , “dead ends” of the technogenic type of development: environmental, economic (investment) and social.

Environmental restrictions include:

- land degradation;
- for water resources - accumulation of pollutants , further exhaustion of their assimilation potential;
- the problem of waste, the amount of which is rapidly accumulating despite the economic crisis;
- Many types of natural resources are close to exhaustion from the standpoint of the economic efficiency of their development. This is due to the enormous wear and tear of industrial, transport and treatment equipment.

To support technogenic and natural - development, every year it is necessary to allocate more and more funds to nature-exploiting complexes and industries. The degradation and depletion of natural resources requires huge capital investments to develop new resources or intensify the exploitation of existing ones. Almost two thirds of all investments in the economy are concentrated in the two largest environmental exploitation complexes in the economy - fuel and energy and agro-industrial. And every year these costs grow (directly or relative to other investments in the economy), but their effectiveness decreases. With this type of economic development, more and more funds are required even to maintain the same level of exploitation and extraction of natural resources and the finished products obtained from them. Other, resource-saving ways of forming a transition economy are needed, which should be based on taking into account environmental factors.

About 85% of all diseases of modern man are associated with unfavorable environmental conditions that arise through his own fault. Not only is people’s health catastrophically deteriorating: previously unknown diseases have appeared, the causes of which can be very difficult to establish. Many diseases have become more difficult to cure than before. The poor state of the environment determines up to 20% of morbidity and 50% of cancer. Unfavorable environmental conditions lead to an unprecedented reduction in life expectancy of the population.

In modern conditions of economic development, the following sequence and priority in greening the economy and solving environmental problems is advisable:

- alternative solutions to environmental problems (structural restructuring of the economy, changes in export policy, conversion, environmentally balanced macroeconomic measures);
- development of low-waste and resource-saving technologies, technological changes;
- direct environmental measures (construction of various types of treatment facilities , filters, creation of protected areas, reclamation, etc.).[379]

Nowadays, an environmentally and economically effective direction for solving environmental problems is the development of “non-natural” industries and activities. And first of all, it is necessary to implement alternative options for solving environmental problems, that is, those options that are not directly related to environmental exploitation and environmental activities.

Among economic indicators, “structural ” criteria for sustainable development can be:

- reduction of the environmental intensity indicator, measured as the costs of primary natural resources (resources) or the volume of pollution per unit of final product;
- a change in the structural indicator, reflecting a decrease in the share of products and investments in environmentally exploitative sectors.

The environmental safety policy of the Republic of Uzbekistan is based on the vital interests of the individual, society and the state. At the same time, environmental threats are natural and man-made phenomena that can directly or indirectly cause damage to the environment and human livelihoods. Environmental threats can be classified according to levels: global, regional, national:

- global environmental threats: climate change, ozone factor, Aral problem;
- regional environmental threats: problems of the Aral Sea region, natural and man-made disasters, transboundary environmental pollution, desertification of landscapes, the spread of infectious and other particularly dangerous diseases;
- national environmental risks: shortage and pollution of water resources, degradation and pollution of land resources, landslides and mudflows, air pollution, conservation of biodiversity, disasters and accidents, industrial and household waste, irrational use of natural resources.

In order to ensure environmental safety , develop social infrastructure that improves the living conditions of the population and solve other tasks provided for in the Strategy of Actions in the five priority areas of development of the Republic of Uzbekistan in 2017-2021, the following were adopted: Decree of the President of the Republic of Uzbekistan “On improving the public administration system in in the field of ecology and environmental protection” , resolutions of the President of the Republic of - Uzbekistan “On measures to ensure the organization of activities of the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection” and “On measures to radically improve and develop the waste management system for 2017-2021” . According to the adopted documents, it is necessary to introduce a mechanism to encourage legal entities and individuals involved in the collection, recycling or recycling of unused plastic, polyethylene and other packaging materials. Thus, the Action Strategy notes that “preventing environmental problems that damage the environment, health and gene pool of the population is a priority in the field of security.”[380]

The combination of the listed environmental threats and problems requires the identification of priority areas for ensuring environmental safety and the development of specific priority measures to prevent, localize, stabilize and eliminate environmental threats:

- rational and integrated use of natural resources, including water, land , minerals, and biological;
- reducing the level of environmental pollution throughout the republic to environmental standards;
- taking comprehensive measures to restore and improve the ecological state in the zone of environmental disaster - the Aral Sea region, as well as in other environmentally stressed regions of the country;
- providing the population of the republic with high- quality drinking water;
- introduction of environmentally friendly and resource- saving technologies;
- development of scientific and technical potential and use of scientific and technological achievements in the field of ecology;
- improvement and further implementation of the economic mechanism for regulating the interaction of government bodies at various levels and users of natural resources, inclusion of environmental requirements in the procedure for assessing the socio-economic efficiency of management decisions;
- creation of experimental ecological zones for sustainable development;
- creation of a unified system of environmental monitoring , forecast and information;
- improvement of services for control and protection of the territory of the republic from transboundary - environmental pollution;
- prevention and mitigation of the consequences of environmental disasters, disasters, emergencies and accidents;
- formation of a Central Asian regional system of environmental safety;
- development and improvement of the system of environmental education, culture and education of the population, for this it is recommended to create, for example: a national television channel or an interactive portal “Man and Nature”;
- deepening cooperation with the world community in solving environmental problems. Thus, environmentally oriented structural restructuring should include large-scale redistribution, the transfer of resources from primary (primarily agriculture and mining) to secondary sectors of the economy (manufacturing, construction, transport, communications) , and then into tertiary ones (spheres of predominantly intellectual activity and services). Along with the construction of new enterprises and the closure of environmentally and economically inefficient production, structural restructuring measures also include the repurposing of production. Environmental legislation and its inconsistency with international principles and trends. The Government of the Russian Federation has formulated the tasks of reforming Russian legislation, based on the principles adopted in the EU countries, based on the use of the best available technologies. In this regard, changes have been made to the basic law “On Environmental Protection”.

According to the changes, the system of environmental quality standards is subject to revision, taking into account international experience and national characteristics, towards less stringent but controlled standards, ensuring a balance between levels that are desirable from an environmental point of view and reasonably achievable from a technical and economic point of view.

As foreign experience shows, reasonable standards for the quality of environmental components (air, water, soil) for different territories should be established on the basis of risk management. The principle of reducing environmental risk should also be reflected in the statistical expression of environmental quality standards, which is common practice in the European environmental management system.

Currently, the concept of risk assessment in almost all countries of the world and international organizations is considered as the main mechanism for developing and making management decisions both at the international, state or regional levels, and at the level of individual production or other potential sources of environmental pollution.

Under the conditions of new programs, the negative consequences of the impact of enterprises on the environment should be limited to a certain minimum level, for example, a socially acceptable acceptable level. Economic mechanisms must operate that implement a compromise between the quality of the living environment and the socio-economic living conditions of the population, especially in conditions of intensification of production. In this regard, it is very important to take into account both environmental and production risks of organized and operating enterprises.

Man has been familiar with risk from the first days of his conscious existence and identified it with the concept of danger. The science of risk - riskology - was formed only in the last quarter of the 20th century. thanks, first of all, to the practical needs of a person to ensure his own safety. In 1980, the world's largest Society for Risk Analysis was founded - The Society for Risk Analysis and the first professional journal on risk analysis began to be published - “ Risk” Analysis ".

Risk, as a quantitative measure of danger, is already widely used abroad for a reasonable comparison of the safety of various sectors of the economy, types of work, argumentation of social benefits, assessment of the likelihood of a particular undesirable consequence occurring, and other purposes.

Russia turned to risk theory only in the late 90s of the last century , but the risk management strategy is already part of the overall strategy for managing the country’s development, which is embedded in the concept of the country’s transition to sustainable development (Decree of the President of the Russian Federation dated April 1, 1996 No. 440), the concept of national security of the Russian Federation (Decree of the President of the Russian Federation dated December 17, 1997 No. 1330), the concept of demographic policy of the Russian Federation for the period until 2015 (Decree of the Government of the

Russian Federation dated September 24, 2001 No. 1270-R) and changes in the law “On Environmental Protection” dated 07/21/2014 No. 219-FZ and a number of other regulatory documents .

The Russian journal “Risk Management” began to be published only in 1996. However, despite a significant number of worldwide - publications, the systematics and analysis of which in the field of risk assessment are presented in domestic works, a unified methodology for assessing risk and environmental risk in In particular, many of the fundamental principles of this science remain controversial.

The purpose of the work was to analyze existing approaches, technologies and methodological capabilities for determining a quantitative assessment of environmental risks.

Among the numerous definitions of the concept of “risk,” the approach to defining risk as an unfavorable event that takes into account not only the probability of the event, but also its possible consequences, has recently become increasingly widespread.

The term is used when there is a possibility of negative consequences. Risk acts as a probable measure of the danger of harm to humans and the natural environment in the form of possible losses over a certain time. From a safety point of view, this means that the more often a dangerous situation occurs and the greater the severity of the consequences, the higher the risk associated with this danger, i.e. risk acts as a measure of the danger of a particular event.

Probability, in this case, determines the measure that an event will occur; gives a mathematical definition of probability - “a real number in the range from 0 to 1, relating to a random event.” The number may reflect the relative frequency in a series of observations or the degree of confidence that some event will occur. For a high degree of confidence, the probability is close to 1.

A consequence is the result of an event. Results can be ranked from positive to negative and expressed qualitatively or quantitatively.

Risks are conventionally divided into two large subgroups: professional and environmental. Conventionally, because very often the risks associated with a threat to the - state of the environment are at the same time risks to human life and health, and the assessment of environmental risks often ensures the safety of the population from various, including man-made, sources.

Environmental risk

This risk is qualified as an assessment at all levels (from point to global) of the likelihood of negative changes in the environment caused by various situations (factors) of a natural and anthropogenic (technogenic) nature. This is a probabilistic measure of the danger of harm to the natural environment in the form of possible losses over a certain time.

However, there is no strict definition of the concept of “ecological risk” yet. Discussions on this issue are fully presented in various works. This is due, first of all, to the fact that environmental risk has a number of features.

This is a multifactorial system in terms of the causes that cause it and the consequences they cause.

The manifestation of environmental risks causes negative processes of changes in the quality of the environment both in the chain of interacting components and at various hierarchical levels of its organization ; the consequences of the implementation of environmental risks “live” in space-time coordinates.

In order to assess and predict - environmental risks, it is necessary to know the complex of factors affecting the system or causes that cause negative consequences.

A fairly complete and substantiated classification of environmental hazard factors is given in the work, which is based on the division of negative factors into two types - natural and anthropogenic - with their subsequent division into separate classes and subclasses.

As the author himself notes: “The problem of assessing environmental risks seems far from trivial, given *the variety of factors* environmental hazards and the uniqueness of their *spatial and temporal relationship with environmental components.* In addition, the overwhelming number of environmental hazard factors given in Table. 1, today is not considered as an environmental risk and it is impossible to find more or less systematic information on them to assess the likelihood of their manifestation.”

single completed classification of environmental risks yet. It is proposed to classify environmental risks according to various criteria, for example:

1. By *sources of exposure* into natural classes (including cosmic ones); technogenic (anthropogenic); social (society - biosphere); political (state, world community); economic (economics, business).
2. According to *the degree of distribution,* into global and local.
3. According to *the nature of the manifestation,* for permanent and emergency.
4. On *the impact of technogenic systems on the environment and public health,* into individual, population , environmental, professional, etc.

5. According to *the degree of influence on human life,* to negligible (the impact is insignificant, no measures should be taken); acceptable (the impact is significant, control and protection measures should be applied); excessive (the impact is catastrophic, the activity is not allowed).

6. Based on *exposi* are identified: for hu ecosystems; risk of loss potential; the risk of degrad of landscapes in general.

In reality, environ appear in a wide variety single to multiple, realizing which creates significa assessing the likelihood of

The division of risks and health risks is conditio In 1994, several internatio the United Nations Envir UNEP), the United Development Organizatio International Atomic Energ and the World Health Orga developed recommendatio and management risks ass to human health and environment as a result of and industrial co recommendations included environmental risks associ human health and life ar environment; they are listed

These tables indicate that e associated with a threat to life, on the one hand, and a the environment , on characterized by both the characteristics. Both risks can occur, for example, from continuous sources (harmful emissions from stationary installations and transport systems), as well as emergency situations at industrial facilities and from one-time sources (accidents and natural disasters).

Type	Class	View
Natural	Space	• Solar activity, cosmic radiation • Impact of cosmic bodies (planets, stars, comets, meteorite • Ethnogenesis
	Geological	• Structure of the geological environment • Properties of rocks • Evolution of the earth's crust • Geomagnetic inversions
	Landscape geographical	• Landscape • Hydrological
	Climatic	• Abnormal precipitation • Air masses with abnormal speed (hurricanes , tornadoes, calm • Extreme temperatures
	Destructive	• Chemical • Physical • Mechanical • Biological
	Unforeseen	• Can be of any type
Anthropogenic	Economic	• Industrial • Resource • Energy • Demographic
	Political	• Weaknesses or absence of environmental policies • Political crises • Conflicts (including conflicts involving weapons) • Terrorism, extremism • Separatism
	Social	• Socio-economic • Social and household • Informational • Research • Religious • Moral and ethical • Environmental illiteracy
	Legal	• Immaturity of environmental law • Incompleteness of environmental law • Legal nihilism

Unforeseen	• Can be of any type

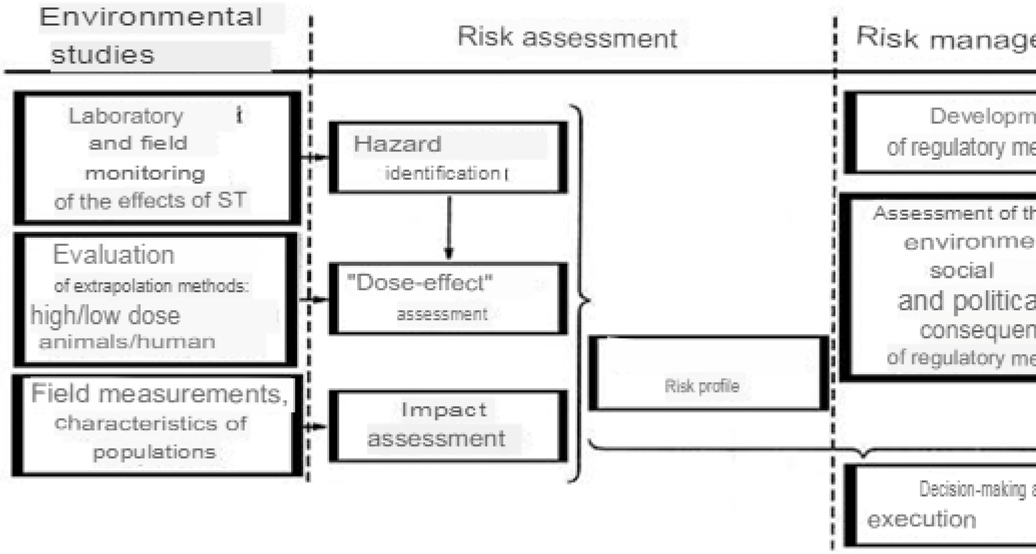
Categories	For people	For habitat
Nature of the risk source	Continuous, one-time (emergency)	Continuous, one-time (emergenc
Contingent (group) at risk	Population of the area Personnel of enterprises	-
Duration actions	Short term Medium duration Long	Short term Medium duration Long
Consequences	By severity: - fatal (risk of death) - non-fatal (risk of injury, illness, etc.). By time of manifestation: - immediate - distant.	By distribution: - local - regional - global. By duration: - short-term - average duration - long-term

Regardless of the nature of the action of the source of danger, the result of the manifestation of the danger is damage that is caused to both people and the environment. In this case, simultaneous consideration of both types of environmental risk is required. However, in many cases, environmental risks associated with threats to human health and life must be considered separately from risks caused by threats to the state of the environment.

Environmental risk assessment and risk management

Environmental risk assessment is a scientific assessment of the likelihood of reversible or irreversible changes in the biogeochemical structure and functions of ecosystems in response to anthropogenic (or natural) impacts (stressors).

Environmental risk assessment is a complex and ongoing scientific and scientific- technical process, including the possibility and necessity of iterative approaches, i.e. improving risk assessment results by repeatedly improving the quality of initial information. Each type of risk requires its own risk assessment methodology, but they are all characterized by general principles and approaches to risk assessment, regardless of where the risk is considered, in the "person-environment" system or in the "social-hygienic monitoring" system. The methodology for risk analysis and management in procedural terms is quite well developed. It is reflected in the guidelines of environmental protection agencies of various countries, including Russia. The risk determination scheme consists of several blocks (stages) :



In this case, various risk identification methods are used:

- statistical, based on the analysis of accumulated statistical data of events that have occurred and their frequency of repetition;
- analytical, based on the study of cause-and-effect relationships;
- expert assessments of events, which involve assessing the probabilities of environmental hazards occurring by processing the results of expert surveys.

Second stage: determining the boundaries of the risk zone. The process of quantitative hazard assessment involves considering the pattern of the maximum possible flow of a harmful substance and establishing the geographical boundaries of its impact, i.e. full product life cycle; for example, for a chemical, this is exposure assessment: obtaining information about what actual dose loads are faced by certain groups of the population .

The third stage: assessing the ways in which the stressor influences. It involves consideration of the general pattern of the impact of a harmful substance on biota, as well as its direct impact on human health, as a result of which a quantitative assessment is made between the influencing dose of a pollutant and cases of harmful effects, and a dose-effect relationship is established.

At these stages, the parameters are selected by which to evaluate:

- degree of toxicity of the harmful substance ; content in various environments;
- changes in the activity of various biochemical parameters in the organisms of animals and plants, primarily enzymes ;
- impairment of reproductive functions and survival of various test objects (daphnia, microorganisms, fish, etc.).

These data are obtained as a result of experimental studies. A mandatory element of the calculation is the analysis *of the uncertainty* of the input data and their influence on the calculation results.

Fourth stage: risk characteristics. Using quantitative indicators obtained at the previous stages of analysis, the probability of environmental risk for an individual, population or ecosystem as a whole is assessed, risk values are calculated for individual routes and pathways of substance entry, and uncertainty analysis is *carried out* risk assessments.

Fifth stage: risk management.

The concept of risk assessment includes two elements: risk assessment and risk management, and the fifth and final stage is risk management.

In turn, risk management consists of four elements: comparative assessment and ranking of risks; determination of risk acceptability levels; choosing a risk reduction and control strategy (for example, controlling the release of chemicals into the environment from pollution sources, monitoring exposures and risks, regulating permissible exposure levels); making management (regulatory) decisions [6].

At this stage, the compatibility of financial benefits with environmental requirements and the likelihood of environmental risk is considered. For example, options for risk reduction measures are proposed:

- the most efficient and relatively cheap;
- prompt and relatively expensive;
- relatively expensive;
- other organizational events .

Risk management is a logical continuation of risk assessment and is aimed at justifying the best decisions in a given situation to eliminate or minimize it. Risk management is based on a set of political,

social and economic assessments of the obtained risk values, comparative characteristics of possible damage to human health and society as a whole, possible costs of implementing various options for management decisions to reduce risk and the benefits that will be received as a result of the implementation of measures (for example, saved human lives, prevented cases of diseases, etc.).

In its most general form, risk management is based on the method of optimizing the ratio of benefit and damage.

The concept of risk management has long been applied, primarily because environmental risk assessment is a necessary component of insuring production units. The standards of the ISO 10 011 and ISO 14 000 series are considered as the methodological basis for such an audit. Environmental risk management is carried out through the development and application of regulations that establish environmental legal responsibility.

Types of Risk Analysis

The mathematical apparatus for calculating risk has been developed quite well, and six types of risk analysis have been identified based on their inherent features.

Analysis of chemical risk caused by non-carcinogenic chemicals (the risk appears only in cases where the dose of the toxicant exceeds a certain value, called the threshold).

Carcinogenic risk analysis (no threshold) stands out among other types due to its importance and the need for frequent use. The analysis is based on the use of probabilistic and statistical concepts.

Epidemiological risk analysis establishes correlation (statistical dependencies) and causal relationships between properties of risk sources and the number of induced diseases. This type of analysis is usually performed in the study of occupational diseases in humans, but due to a lack of data, it allows for extrapolation of results obtained in experiments with animals.

Probabilistic risk analysis designed to ensure the safety of complex and potentially dangerous technological processes. The peculiarity of this type of analysis is the use of the “trees” method, which takes into account all possible failures of equipment, technological units and large units, and each failure is characterized by its own probability. This allows not only to calculate the probabilities of complex events, but also to evaluate specific consequences (for example, the release of a certain toxicant or radionuclide into the atmosphere).

A posteriori risk analysis, the scope of which includes both natural disasters (earthquakes, floods, landslides, etc.) and hazardous human activities (transport accidents, acute pesticide poisoning, cancer due to smoking, etc. .). The term “a posteriori” means that this type of analysis uses the results of statistical processing of manifestations of dangerous events and processes in the past.

Qualitative risk analysis must be used in cases where quantitative consideration of a hazardous event or process is practically impossible. For example, it is very difficult to quantify the risks posed by acid rain or global climate change.

All of the above types of risk analysis are directly related to *environmental* risks, which, as we noted above, should be understood as a set of risks threatening the health and lives of people, risks threatening the state of the environment and possible consequences.

The information basis for assessing environmental risks is statistical data: results of monitoring the state of environmental components, data from environmental impact assessment (EIA), environmental assessment and audit, environmental and sanitary-hygienic certification, information about various processes and phenomena, etc.

The first three types of environmental risk analysis are regulated by a document that is used in the system of social and hygienic monitoring, primarily to assess damage (harm) to human health from the influence of environmental factors, including in emergency situations of a natural and man-made nature.

This methodological document unifies the requirements, principles of methods and criteria for assessing health risks associated with exposure to chemicals that pollute the environment, taking into account the requirements of domestic, foreign and international organizations.

Thus, in the case of non-threshold toxicants - (carcinogenic substances), which have a linear relationship between the carcinogenic risk and the dose of the carcinogenic substance, the risk is expressed by the simple formula where r - individual carcinogenic risk; it should be understood as an additional risk (in addition to the already existing probability of developing cancer) of cancer caused by the entry of a given carcinogen into the body; D - dose of carcinogen entering the human body; Fr _ - proportionality coefficient between risk and dose, called risk factor. Risk factor F_r shows how quickly the probability of cancer increases with increasing doses of carcinogens entering the human body through air, water, and food. Risk factor unit F_r - [mg/kg-day]" ^{1} - the reciprocal of the unit of average daily intake of a carcinogen. The risk factor quantitatively characterizes the increase in the threat to health as a result of the daily intake of this carcinogen in the amount of 1 mg, referred to 1 kg of human body weight.

Individual carcinogenic risk is calculated using the formula

$$r = m\,Fr\,,\,\_$$

where m - average daily intake of a carcinogen with air, water or food, referred to 1 kg of human body weight, in milligrams per kilogram per day (mg/kg-day).

According to the method recommended by the US Environmental Protection Agency, the average daily intake of carcinogen with air, per 1 kg of human body weight, is calculated using the formula

$$C \text{-} V \bullet f \bullet T_p m = \quad ,$$
$$P \bullet T$$

where C - concentration of carcinogen in the air , mg/mg ^{3} ; V - volume of air entering the lungs, m3 $^{/}$ day (it is believed that an adult inhales 20 m3 ^{of} air daily); f - the number of days per year during which exposure to the carcinogen occurs ; Tp _ - the number of years during which the action of the carcinogen occurs; R - the average body weight of an adult, taken to be 70 kg; T - the average time of possible exposure to a carcinogen, which is taken to be the average human life expectancy, considered equal to 70 years (25,550 days).

The values of risk factors are determined, as a rule, as a result of experiments on animals. The US Environmental Protection Agency has compiled an Internet database of risk factors for various carcinogens, which is constantly updated, and the values of these factors are updated as new scientific information is obtained.

If r < 10" ^{6}, the individual carcinogenic risk is considered negligible. The upper limit of the permissible individual carcinogenic risk is assumed to be 10" ^{4}. It is at this level that the majority of foreign and recommended by international organizations hygienic standards for the population as a whole are established (for example, for drinking water the WHO uses the value 10" $^{5\text{ as an acceptable risk}}$, for atmospheric air - 10" ^{4}).

If r > 10" ^{4}, but less than 10" ^{3}, it is considered acceptable only for professional groups, but unacceptable for the general population; the emergence of such a risk requires the development and implementation of planned health measures and risk reduction measures.

If r equal to or more than 10" ^{3}, it is not acceptable either for the population or for professional groups.

In the case of exposure to multiple carcinogens, the total risk is expressed as the sum of the individual risks:

$$r_t = ri + r_2 + \ldots + n .$$

Collective carcinogenic risk R is determined by the formula

$$R = r \cdot N ,$$

where N - the number of people exposed to this risk.

Quantitative assessment of environmental risk. According to the accepted definition , risk is a quantitative measure of danger taking into account its consequences. The consequences of danger always cause damage, which can be economic , social, environmental, etc. Therefore, risk assessment must be linked to damage assessment. It is believed that the greater the expected damage, the greater the risk. In addition, the higher the probability of occurrence of the corresponding danger, the greater the risk .

However, on the one hand, not all risks can be expressed in monetary terms, although a methodology for their accounting is being developed. On the other hand, the unambiguous ranking of risk based on the amount of damage will probably not always be fair, since the expected damage may be the same for rare events (the probability is low) with large losses (the damage is large) and for frequent events (the probability is high) with relatively small losses

(damage is small)

To a first approximation, risk can be defined as the product of the probability of danger of the event or process under consideration and the magnitude of the expected consequences (damage) :

$$R = P\,Q,$$

where R - a quantitative measure of risk (average risk), expressed in the same indicators as damage; P - probability of an adverse event (group of events); Q - the amount of damage in cost terms.

If during a certain period (most often a year) several dangerous events can occur, for example, pollution of atmospheric air, water basin, soil cover, then the risk indicator is the sum of damages from all possible events, often expressed in monetary units.

If damage is assessed in cost terms, then they speak of an environmental and economic risk. The environmental and economic risk during the operation of environmentally hazardous facilities can be determined by the average damage per year. There are *direct* environmental damage, which is associated with damage directly to the native environment; it is caused by a negative impact on the soil, flora and fauna, water bodies, atmosphere, and its assessments are associated with a negative impact on the current generation of people; and *indirect* damage, which includes losses incurred outside the area of direct impact. Indirect environmental damage has a global scale, for example, disruption of the climate balance, deterioration in the quality of natural resources, death and reduction in the number of animals and birds. It follows from the negative impact on the livelihoods of future generations of people. Indirect damage can include, for example, negative social effects that are difficult to quantify.

Damage caused to environmental components is calculated on the basis of approved (current) guidelines, a list of which for the period of 2010 is presented in the work.

The degree of risk from environmental pollution can be assessed depending on the relative frequency of its occurrence and the cost of possible damage.

As a result of ranking the calculated risk factors according to Table. It is possible to identify areas of acceptable, unacceptable risk, and areas where measures need to be taken to reduce risk.

One of the methodological approaches to assessing environmental risk considers it as the risk of disruption of the dynamic balance in ecological systems, which leads to a change in the parameters of the characteristics of their abiotic and biotic components as a result of natural processes or technological activities and the restructuring of the ecosystem into a state corresponding to new properties.

Substances	Options		Norm	Time of action
	Environmental - disaster	Ecological emergency situation		
Critical levels for above-ground vegetation, μg/ ^{m3}				
Dioxide sulfur	> 200	100-200	< 20	average annual
Dioxide nitrogen	> 300	200-300	< 30	average annual
Hydrogen fluoride	> 20	10-20	< 2-3	long-term
Ozone	> 1500	1000-1500	< 150	maximum within 1 hour
Critical loads for forests and waters ecosystems				
Sulfur compounds, g/m2 ^{per} year	> 5	3.0-5.0	<0.32	northern and central regions
Nitrogen compounds, g/m2 ^{per} year	> 4	2.0-4.0	<0.28	northern and central districts
Hydrogen ions, g/m2 ^{per} year	> 300	200-300	< 20	northern and central districts

conclusions

Thus, the modern methodology for assessing environmental risk provides for parallel consideration of risks to human health and environmental risks caused by disruption of ecosystems and harmful effects on environmental components, risks of decreased quality and deterioration of living conditions.

The scientific theory of risk will undoubtedly be improved in creating a conceptual apparatus for risk assessment. The developed mathematical apparatus already makes it possible to quantitatively calculate some environmental risks. For the successful application of risk theory in practice in Russia, it is necessary to create a statistical data base regarding the impacts on risk objects and the corresponding consequences.

In the strategic plan, it is necessary to develop a national environmental policy and create a national environmental safety system as a universal tool for its implementation . One of the objectives of this system is the effective management of environmental risks.

Lecture No. 13, (2 hours).

Mineral resources and problems of their use • Rational use of the earth's interior.

Russia occupies a leading place in the world in proven *reserves of natural gas, zinc, iron ore, nickel, cobalt, diamonds* , and consistently holds second place in *reserves of oil, apatite ores, gold, platinum, potassium salts* and third place in *reserves of coal and copper* .

As a result of mining operations, *geochemical, hydrogeological, chemical, physicochemical, and temperature changes occur in the natural environment* . Also *, work* related to mining, underground construction, and operation of underground structures for various purposes leads to the formation and existence of free underground space, the presence of which *can have catastrophic consequences* .

The bowels of the earth are used; - for the development of mineral resources and geological exploration.

A special feature of mining operations is their ***temporary*** *nature; When the deposit is depleted, their production stops* . In this regard, it is advisable to carry out mining operations in such a way that the new landscapes, excavations, dumps, engineering surface and underground complexes that are formed could subsequently be used for other purposes with maximum effect. *This will reduce the harmful impact on the environment and reduce the costs of its restoration* .

When developing mineral resources, all mineral resources are divided into **three groups**

-- main - those mineral resources, the extraction of which is the main goal.

-- associated - those mineral resources included in the extracted mineral raw materials, the separation of which at the extraction stage is technically impossible or economically unprofitable.

-- incidentally extracted - those mineral resources that are forced to be extracted from the subsoil when performing certain technological operations. *In some cases, after their accumulation, they can become a raw material base for a number of industries in the future* . They can have a significant environmental impact on the environment. Therefore, **their rational use** and protection is an important task.

One of the most important characteristics when assessing the efficiency of using mineral deposits is *the standards for mineral raw materials* , which represent a set of requirements for the quality of minerals in the subsoil (reserves, quality, availability, etc.).

-- Integrated development of mineral deposits.

All mineral deposits are complex: they contain main and associated (accompanying, co-occurring) minerals. *The integrated use of a deposit means the extraction from the subsoil, in a usable state, of the main and together with the underlying minerals* .

Use of mining waste.

Solid - to improve the chemical, physical, biological properties of soils, during reclamation, landscape restoration, road construction production, in construction, as a raw material in industrial production

agriculture, extraction of minerals in the processing of rocks dumps.

Liquid – (limited) for household needs, for agricultural needs,

for industrial water supply.

Gaseous - for generating electricity, for heating.

Geotechnology.

- chemical,
- physic-chemical,
- biological
- and microbiological

methods for extracting minerals in situ.

The global problem of resources is that the natural elements of the planetary ecosystem, components of living and inanimate nature, which act as conditions for the life of the biosphere, including humans and society, are consumed immensely, and their reserves are rapidly being destroyed. At the same time, resources are not unlimited, exhaustible, and with constant, irrational and, at the same time, increasing exploitation, the natural supply of natural resources is sharply reduced and does not have time to reproduce.

People's needs are limited by the resources to provide them: whether we like it or not, such dependence is objective. The real tragedy is that some types of resources are exhaustible, that is, they cannot be restored.

Typically, a resource problem is considered either as an environmental problem or as an economic one. We deliberately highlighted it in a separate position in order to emphasize its planetary dual significance - environmental and economic (social) at the same time.

In the 20th century, the pace of industrial development accelerated unprecedentedly compared to previous periods of history. This became possible thanks to the technological implementation of numerous scientific discoveries of the 19th and 20th centuries, with the conditional alignment of the world's leading economies and market globalization.

During the twentieth century, more minerals were extracted from the bowels of the Earth than in the entire history of civilization. For example, fossil fuel consumption has increased almost 30-fold as global industrial production has increased 50-fold. Moreover, 3/4 of the increase in fuel consumption and 4/5 of the increase in industrial production has occurred since the early 1950s. The main effects have been economic growth, enormous demographic shifts and dramatic changes in the natural environment, some of which are irreversible: the Earth is on the brink of depletion as humanity consumes more resources than the planet can produce.

Currently, the global resource problem is posed in terms of resource availability, exhaustibility (renewability) and the size of remaining reserves.

The resource availability indicator is the ratio between the amount of reserves and the scale of their use. Moreover, the provision of mineral resources is expressed by the number of years for which proven reserves will suffice with their modern use; and the provision of forest, land, and water resources is determined by their reserves per capita.

The property of exhaustibility is decisive in the assessment of a resource and divides all available planetary resources into renewable and non-renewable naturally. Thus, many renewable natural resources, due to anthropogenic impact, have ceased to be renewable: atmospheric air, fresh water and fertile soil covers of land, many species of flora and fauna, and entire ecosystems.

As for the remaining supply of resources, reliable knowledge about them is necessary for planning the further development of resource-dependent industries and scientific development of resource substitutes.

No.	**Resource type**	**Problem**	**Causes**	**Consequences**
1	Oxygen	Catastrophic decrease in oxygen (by 10 billion tons per year - this would be enough for several billion people to breathe)	Harmful emissions into the atmosphere, destruction of marine phytoplankton that produces 80% oxygen, deforestation, other anthropogenic factors	Atmospheric depletion
2	Water	Pollution: negative changes in physical and chemical composition	Natural and anthropogenic factors of biological, physical-mechanical, chemical, noise, radioactive, thermal pollution: settlements,	Loss of natural qualities and functions, cloudiness, oxidation, saturation with poisons, inability to remain a complete environment

			industry, agriculture	for living organisms
		High dynamics of decline in fresh water reserves	Growing industrial and household consumption	Risk of conflicts over ownership, extraction and use of water resources
3	Fertile soils	Soil erosion: the process of excessive removal of the top fertile layer of soil (volume more than 25 million tons per year). In total, more than 23% of the entire vegetation-covered surface of the Earth has already been damaged.	Atmospheric precipitation, weathering, human agricultural activity, deforestation	Soil erosion destroys arable land and agricultural land, fresh water bodies are polluted with phosphorus and other fertilizers washed out from cultivated areas of land
		Trampling of land (10 million km ^{2})	Grazing	Decrease in fertile qualities

4	Wood	Destruction of wood resources: in the last 200 years alone, the area of forests on Earth has been reduced by at least half and continues to decline catastrophically. Tropical rainforests are disappearing the fastest: today only 1/3 of their original area remains.	70% of the total population of underdeveloped countries uses wood for cooking and heating; on average, approximately 700 kg are burned per year for human needs. More than 1/2 of the forests cut down each year are burned for energy.	Forests and vegetation (especially in the tropics) produce 20% oxygen, so reducing their area has a detrimental effect on the quality of the atmosphere. Deforestation also leads to the destruction of entire ecosystems.
5	Natural gas	Reducing reserves of the strategic life-support resource of modern civilization.	Growing demand for energy, low gas prices, high production rates	With the current volumes of proven reserves and production volumes, this type of fuel will last humanity for

				a period of 55 to 60 years.
6	Oil	The energy resource most needed by humanity is rapidly depleting.	Growing demand for energy, low oil prices, high production rates	Current world oil reserves, according to various estimates, are about 1.65 trillion barrels. At current levels of proven reserves and production volumes, humanity will have enough oil for a period of 50 to 54 years.

In the system of international division of labor, economically developed countries act mainly as consumers, and developing countries act as producers and exporters of natural resources (mineral, forestry, etc.). This kind of “specialization” is explained both by the peculiarities of the location of many types of resources on the globe, and by the level of historical and socio-economic development of the countries of the world.

Man’s dependence on nature has not been overcome; on the contrary, it has acquired a qualitatively new, global scale: the 20th century became the era of man’s collision with nature, when, at the level of civilizational capabilities, he was no longer inferior to it in the possession and ability to use destructive forces. At the same time, man’s dependence on nature has decreased only relatively, but in terms of the most important means of his life support, he continues to be fundamentally dependent on the natural environment for his life support.

Problems of the state of the environment, the use of natural resources and the socio-economic development of society should be regarded as global, valuable and vitally important. However, they cannot be considered in isolation: both in isolation from each other and, secondly, locally, that is, within individual countries.

In view of the threat of imminent depletion of the most important raw material resources for social reproduction, industry, the functioning and development of economic systems, innovative solutions are already needed in the areas of rationalization of environmental management, increasing the efficiency of resource use and resource substitution.

About 20 thousand mineral deposits have been discovered and explored in Russia , a third of which have been put into development. Large and unique deposits (about 5% of the total) contain almost 70% of proven reserves and provide up to half of the mineral production. The mineral resources complex of the Russian Federation provides more than 50% of budget revenues, about 60% of industrial production volumes, more than 70% of exports and foreign exchange earnings, 100% of the stabilization, reserve funds and national welfare fund.

The problem of national security at the present stage of state development is largely determined by economic and technological factors, including natural reserves of mineral raw materials, where fuel and energy resources and their rational and integrated use play a dominant role.

The Russian Federation occupies 30% of shelf waters, has 22% of forest resources, 20% of fresh water and 16% of all global mineral resources. Russia's share in world reserves, for example, palladium, is 90%; rare and rare earth elements: tantalum - 80%, yttrium - 50%, niobium - 35%, lithium - 28%, beryllium - 15%, zirconium - 12%; gas - 32%; agrochemical ores: potassium salts - 31%, phosphates - second place in the world; metal from metallurgical production: tin - 21%, iron - 26%, zinc - 16%, lead - 12%; cobalt - 21%. In addition, Russia is in third place in the world in terms of proven gold reserves (the latter's established reserves in absolute terms are about 4,500 tons).

In general, the mineral resource potential of Russia is characterized by such features as large-scale and complexity. No other country in the world has a mineral resource base of such a volume and range: from oil, gas and coal to almost all metallic (with the exception of a sufficient number of proven reserves of manganese and chromium ores, as well as titanium) and non-metallic minerals. .

In accordance with the federal laws of the Russian Federation “On subsoil” and “On environmental protection”, subsoil is part of the earth’s crust located below the soil layer, and if it is absent, below the earth’s surface and the bottom of reservoirs and watercourses, extending to depths accessible to geological study and development.

In addition to legislative provisions, the main requirements for the rational use and protection of subsoil are: conducting advanced geological studies of subsoil; ensuring the most complete extraction from the subsoil of the main and co-occurring minerals and associated components; prevention of subsoil pollution during work related to the use of subsoil; compliance with the established procedure for conservation and liquidation of mining enterprises and underground structures not related to mining. In this case, it should be provided measures to protect the environment, restore the natural environment, and ensure environmental safety.

As is known, mineral resources are all consumable - material components of the lithosphere, used in the economy as mineral raw materials or energy sources (ore and nonmetallic minerals, hydrothermal springs, etc.). Rational use of natural resources, including mineral ones, represents the fullest possible extraction of all useful products from a natural resource. In this case, the least harm is caused to sectors of the economy based on the same resource, and to the state of the natural environment necessary for life and maintaining human health. Subsoil protection is a set of measures that ensure the most complete extraction of minerals, the preservation of geomorphological structures, properties and energy state of the upper layers of the lithosphere.

The strategy for the development of mining as the basis of the economy and national security should be based on a strategy for the rational use of resources, the continuous replenishment of the mineral resource complex with new reserves of mineral raw materials. In a market economy, a complex of geological, mining, technological , environmental and economic research to replenish the mineral resource base must be carried out according to a single scientifically based methodology, uniform scientifically based requirements for assessing the readiness of deposits for their comprehensive industrial development on the basis of advanced mining technologies and processing, in particular heap leaching of mineral raw materials.

It should be noted that the quantitative advance of the growth of reserves over their depletion is a prerequisite for the functioning of the system of expanded reproduction of the mineral resource base. The use of the latest achievements is especially necessary in connection with the complication of natural and geological conditions for geological exploration work, their expansion onto the shelf and into the World Ocean, as well as the need to assess new genetic and geological-industrial types of mineral deposits, identify unconventional types and sources of mineral raw materials and sharply increased requirements for environmental protection. Scientific and technological progress in geology should be considered as a process designed to counter the factors of deterioration of mining conditions for the development of deposits, as a lever in the search for alternative sources, as a means of solving acute environmental problems [8].

In the process of exploration and subsequent development of mineral deposits, cases of irrational use of mineral resources, deterioration of the condition of the subsoil and intense, sometimes catastrophic environmental pollution are observed. As an example of technogenic impact on nature, the area in which the Norilsk Mining and Metallurgical Combine (NMMC) operates is considered. The latter includes three smelters, two processing plants, a quarry near the Medvezhiy stream, the Zapolyarny, Mayak, Komsomolsky, Oktyabrsky, Taimyrsky and Gluboky mines. Mining of ore, its enrichment with division into the finished product for smelting and sludge accumulated in tailings, and, finally, the smelting of copper, nickel, cobalt, platinum, a number of other platinum group metals and metal concentrate - matte - these are the stages of mining and metallurgical production taken together , are the backbone of the region's economy. Pollution of natural environments with heavy metals in the Norilsk region may be associated with geochemical anomalies in places where ore deposits occur on or near the surface. However, to a much greater extent, metal pollutants are delivered by air with smoke from smelters, as well as emissions from other enterprises, vehicle exhaust gases and dust raised from industrial sites, tailings ponds and dumps [3].

Norilsk is the city with the highest industrial emissions of sulfur dioxide on the planet. Emissions of this gas through the pipes of smelters: nickel and copper, as well as the Nadezhda multi-industry plant, have been consistently estimated in the last decade at figures in excess of 2.0 million tons per year. Air pollution from industrial dust is very high, although it makes up no more than 5% of all emissions, followed by nitrogen compounds, phenol, chlorine and heavy metals. In winter, the Norilsk industrial region appears on satellite images as a blurry dark spot on a white snow surface. Pollutants are damaging the fragile Arctic environment. However, other anthropogenic impacts also cause great harm to it. The Mayak and Komsomolsky mines and the adjacent technogenic wastelands are located in the water protection zone of the exploited groundwater deposit, which creates a danger of its pollution and degradation. Information about Norilsk shows that the large-scale impact of mining and metallurgical production on Arctic natural systems leads to severe disruption .

In the process of quarrying, rocks are excavated and accumulated, changing the geological and geomorphological conditions of not only the mining area, but also the adjacent territories. At the same time, a new technogenic relief is created: negative forms of quarries , and in the coal industry - cuts, alternate with positive ones - waste rock dumps. Quarry depths reaching 400-500 m are confined to open-pit mining of coal and ore deposits, as well as diamonds. For example, when developing the Mikhailovsky group of iron ore deposits of the Kursk magnetic anomaly, the depth of the quarries reaches almost 100 m. In this case, external multi-tiered dumps are formed with a service life of 25 to 50 years. The area of the dumps is 75 km ^{2} and increases by 2.5 km

$^{2 \text{ annually}}$. The volume of stored rocks is 500 million ^{m3}. During the development of the Korshunovsky iron ore deposit on the slope of the northern exposure of the river. Korshunikha dumps were created from six tiers with a height of 15 to 30 m, occupying an area of 5 km2. Thus, the open method of extracting minerals leads to the emergence of a new technogenic, highly dissected relief in mining areas. Due to technogenic impacts (opening the pit, washing placers with dredges and laying waste rock in dumps), the intensity and extensiveness of slopes increases, erosion accumulative, karst, suffusion processes, such as loss of land resources and disturbance of the habitat of biota.

Mining using wells, as well as open and closed methods of mining, changes the natural topography, although to a much lesser extent. Due to the pumping of large volumes of fluids, the day surface subsides. In our country, this process is especially relevant for the oil and gas province of Western Siberia. Lowering this territory even by a few centimeters can increase its already severe swampiness and cause irreversible changes in existing eco-geosystems.

A significant part of the oil and gas reserves in Russia is confined to the permafrost zone. Borehole development of oil and gas fields in permafrost conditions causes transformations of geocryological processes with adverse environmental consequences not only for humans, but also for the ecogeosystem as a whole. In existing hydrocarbon fields, as a result of disturbances in the plant and soil layers and thawing of frozen rocks around the wellheads, thermokarst sinkholes up to 1-1.5 m deep or more are formed, which sharply increase when fires occur in the wells. In some fields in Western Siberia, such thermokarst sinkholes have been recorded around almost 50% of wells.

As a result of mining operations, geochemical , hydrogeological, chemical, physicochemical, and temperature changes occur in the natural environment. In addition, work related to mining, underground construction, and operation of underground structures for various purposes lead to the formation and existence of free underground space, the presence of which can lead to catastrophic consequences. An example is the voids with a volume of 330 million m3 $^{\text{under}}$ the cities of Berezniki and Solikamsk, which accumulated as a result of untimely liquidation work and backfilling of the mined-out space of underground mines at the Verkhnekamsk deposit.

At the present time, when human activity has become a powerful geological factor, ignoring modern geodynamic processes leads to the fact that the created engineering systems do not fit into natural systems and therefore cause mutual damage to each other. Even in the earliest stages of mining, miners encountered underground forces of nature in the form of sudden man-made earthquakes. A sharp change in the geodynamic situation at the apatite mines in the Khibiny massif occurred due to an increase in the intensity of mining operations and the total volume of mineral extraction.

A new class of geodynamic phenomena includes man-made tectonic movements. The development of oil and gas fields in some cases provokes man-made earthquakes. With intensive fluid extraction, as well as fluid injection into the reservoir, seismic events can occur. Man-made earthquakes in the productive strata are characterized by a magnitude of up to 3.5, and with sources above and below the formation - up to 4.5 . In Russia, the largest number of man-made earthquakes - were recorded during the development of the Romashkinskoye oil field. Seismic phenomena have also been observed in the fields of Western Siberia, which previously belonged to geodynamically quiet regions. Managing mining technical factors and their combination with mining and geological conditions makes it possible to reduce geodynamic hazards during deposit development.

Forecasting geodynamic phenomena is a necessary component not only of technological process control during the development of hazardous mineral deposits, but also of environmental protection. At present, the prediction of technogenic seismicity is most difficult, since many questions of the nature and mechanism of this phenomenon have not yet been sufficiently studied. Thus, human mining activity significantly affects the subsoil, transforms the geodynamic ecological function of the lithosphere, changing its environmental properties, causing an increase in the intensity heterogeneity of the manifestation of geological processes in time and space, a redistribution of stress in lithospheric blocks, and an increase in synergistic effects that increase negative environmental consequences.

It is advisable to separately consider the issues of rational and comprehensive use of mineral resources during exploration and production of solid minerals and hydrocarbon raw materials. We will pay special attention to the most promising area of geological exploration for oil and gas on the Russian shelf. At the moment, a State program for the study and development of the continental shelf of the Russian Federation has been developed, the implementation of which will make it possible to study and develop the mineral resources potential of the shelf with the simultaneous development of transport infrastructure and the shipbuilding industry while complying with environmental safety requirements

When developing an environmental support system for oil and gas production operations, it is necessary to adhere to the following basic principles:

- priority - work on the shelf will not be carried out at the expense of disturbing the ecological balance in the natural environment; measures to prevent environmental consequences take precedence over measures to eliminate them;
- justified risk - decision-making on environmental activities is based on foreign and domestic experience in field development, on modeling (predictive assessments) of the possible environmental consequences of mining activities, based on monitoring results.

The development of an offshore oil and gas field is carried out in several stages: geological and geophysical surveys to search for promising structures containing oil and gas; carrying out exploration and prospecting drilling operations to open the productive layers of these structures; preparation and development of fields; equipping fields with technological and communication structures; exploitation of deposits and their liquidation.

At each of these stages, especially if environmental - requirements and relevant legislation are not observed, harm may be caused to various components of the marine environment. Negative consequences resulting from environmental pollution can manifest themselves in changes in its quality, degradation of natural ecological systems and depletion of natural resources. Mechanical impact on the seabed and bottom waters leads to changes in petrophysical and engineering-geological properties, thermal regime, geocryological structure and, as a consequence, lowering of the bottom surface level, disruption of rock continuity, permafrost degradation, etc.

The main types of impact of the offshore oil and gas production complex on the environment include: physical, chemical, biological, mechanical. The total impact is complex and manifests itself in the form of physical, chemical and biological disturbances in the water column of the marine environment, on the bottom and partly in the atmosphere. The role of factors and the degree of impact of a particular activity, the consequences of which lead to negative changes in environmental quality, differ for different objects and different stages of development of offshore oil and gas fields.

Environmental consequences during the operation of oil and gas production complexes may be associated with the geocryological structure of the shelf , ice conditions, the nature of the coastal zone, variability of hydrological and other conditions. During the exploitation of fields, ice conditions can cause emergency situations on oil and gas production platforms. When transporting gas over long distances, gas pipelines may have an adverse effect on the geological environment due to a decrease in the temperature of the gas flow to negative values. This entails the formation of cryogenic processes in soils, freezing of gas pipelines and sometimes leads to emergency situations.

The nature of the impact of the offshore oil and gas production complex on the environment indicates that:

- the development and development of offshore oil and gas fields affects all structural and functional formations that have the rank of marine ecosystems, however, the impact and consequences caused by it when using the best existing technology and an accident-free situation lead to a slight change in the quality of the environment, are short-term in nature and limited, as usually at a point, local or local scale;

- the most severe consequences for marine ecosystems are associated with oil spills due to accidents of large tankers, pipeline ruptures and long-term open flowing of wells;
- The main guarantee of environmental safety is the - design, technological and operational reliability of production facilities of the oil and gas production complex and the creation of a system for ensuring environmental safety during the development of offshore oil and gas fields [6].

Issues of environmental safety are particularly acute in the process of developing hydrocarbon resources within the Arctic region, where there are currently no effective methods for eliminating possible significant (more than 100 tons) oil spills. One of the options for preventing possible oil spills would be the introduction of temporary moratoriums on its production during periods of difficult weather conditions [9].

A general criterion for assessing the use of subsoil resources discovered by geologists can be the efficiency of mineral resources in the national economy , which is the ratio of the actual benefit of a mineral or group of minerals extracted from the subsoil to the natural potential of a given mineral raw material. The optimal efficiency value should be close to 100%. However, of the 26 different minerals mined annually per person on average, only 2% is a useful product, the rest is waste returned to the natural cycle.

One of the most serious environmental problems in the Russian oil production industry remains the irrational use of associated petroleum gas: its combustion has a negative impact on the environment. At the same time, the most valuable raw materials for the chemical industry are irreparably destroyed. Significant losses at the initial stage of the resource cycle also occur when using solid mineral raw materials. Billions of tons of coal and ore are buried in abandoned mines and mines. During mining of coal, its minimum losses amount to up to a quarter of industrial reserves; in some mines, about half of the deposits suitable for extraction remain in the depths.

The integrated use of mineral resources of deposits in the process of their development is currently most common in non-ferrous metallurgy mining enterprises, since non-ferrous metal ores are usually complex and multi-component. At the same time, the value of related components often exceeds the value of the main ones. For example, at the Gayskoye field, the total value by-product minerals are higher than the cost of extracted copper .

The possibilities for the integrated use of deposits depend on the effectiveness of solving the issues of processing minerals . The completeness of complex extraction of minerals can be increased in many cases by enriching the extracted rock mass. Organization and improvement of enrichment processes of not only the main but also accompanying components, as well as the removal of harmful impurities from them, is one of the main conditions determining the full integrated use of deposits. Currently, during geological exploration and mining operations, the possibilities of using waste-free technology are very limited. When developing mineral deposits, the amount of waste rock exposed to the surface can be reduced by leaving it in the goaf as backfill material. Overburden rocks are placed in the mined-out space of quarries, which makes it possible to effectively reduce the area of the disturbed surface. In this case, production waste becomes a kind of “filler” for cavities formed on the surface as a result of mining. A significant part of these rocks brought to the surface can be used as raw materials for the production of building materials: crushed stone, sand, lime, brick, etc.

The Russian Federation has almost all types of mineral resources. Their rational and integrated use, as well as environmental protection, require measures, of which the most significant are: further improvement of subsoil legislation; conducting advanced geological study of the subsoil; the use of modern technologies that ensure the most complete and comprehensive extraction of main and associated components from the subsoil; prevention of contamination of subsoil and the environment during mining; implementation of measures for the protection and restoration of the natural environment; conducting environmental monitoring at all stages of prospecting, exploration and development of mineral deposits.

Lecture No. 14, (2 hours)

Losses of minerals in mining and their accounting. Measures to reduce losses .

The importance of accounting for losses and dilution of ores

Losses, or lost reserves, of a mineral mean a part of its balance reserves, either not extracted from the subsoil during the development of a deposit, or taken to dumps with waste rocks, or, finally, lost during transportation.

Dilution is understood as the contamination of standard ores or minerals with waste rocks or substandard (off-balance) ores.

Under normal conditions of underground mining, losses amount to 5-12% of the amount of mineral resources intended for development; under difficult conditions, losses increase, reaching 20% or more.

In open-pit mining, although the loss of minerals is lower than in underground mining, even here they can reach significant values. Thus, in the Bogoslovsky quarries alone in the Northern Urals over the period from 1946 to 1955, more than 6 million tons of coal were lost during mining.

In connection with the enormous growth in mining production in the USSR in recent years and the corresponding increase in irreversible losses, the problem of combating losses is acquiring great national economic importance.

In 1949, the Main Directorate of State Mining Supervision under the Council of Ministers of the USSR was organized; on the basis of the latter, in 1954, the Committee for Supervision of Safe Work in Industry and Mining Supervision under the Council of Ministers of the USSR (Gosgortekhnadzor Committee) was created.

The Committee's task was, first of all, to monitor the technically correct development of deposits while observing the conditions for maximum use of mineral reserves in the subsoil, i.e., supervision over the technically correct conduct of mining operations while observing the conditions for combating unnecessary losses and dilution of mineral resources.

To implement this, the Committee is given the right to monitor the accuracy of losses and dilution planned by mining enterprises: all mining enterprises of the Soviet Union are required to coordinate with the Committee the planned losses and dilution of ores calculated by them and provided for in the annual production plans of mining operations.

Soviet specialists, using highly productive domestic mining equipment, have achieved significant success in rationalizing mining systems and reducing losses and dilution of ores. The struggle for maximum extraction of minerals from the subsoil has become the law of the mining enterprises of our country. In this regard, the establishment of a rational classification of ore losses is of considerable benefit, since without this it is difficult, and sometimes impossible, to correctly account for losses and fight for maximum extraction of ore from the subsoil.

The reasons for the occurrence of losses and dilution of mineral resources during the development of deposits are very diverse. For a long time, their accounting at mining enterprises was not carried out properly, which hindered the development of measures to reduce them. In 1953 The Main Directorate of the State Mining Supervision has developed a “Unified Instruction for Accounting for Losses and Dilution of Solid Minerals in the Development of Ore, Non-metallic and Placer Deposits (during Underground and Opencast Mining)”, mandatory for all mining enterprises extracting solid minerals. In accordance with these instructions, a classification of losses of various types of minerals is given below and measures to eliminate them are outlined.

Classification of mineral losses

To successfully combat losses and dilution and prevent them, a mine geologist, surveyor and other technical personnel of the mine must correctly classify losses and dilution and know the reasons that cause them. According to the “Unified Instructions”, losses are distinguished between design, regulatory, planned and operational losses.

Design losses are part of the balance reserves of a mineral, provided for by the technical design to be irretrievably left in the ground during the development of the entire deposit or part of it. That part of the balance reserves, which is envisaged by the project for extraction from the subsoil, is called industrial reserves. It is obvious that industrial reserves are determined by excluding project losses from balance reserves. Exhausted balance reserves are part of the spent balance reserves (both extracted and not extracted from the subsoil), as well as lost in bulk.

Standard losses are calculated and established losses of mineral resources for each development system used.

Planned losses are losses of mineral resources established when drawing up annual mining plans in accordance with the geological and mining conditions of the deposit and loss standards for certain development systems. Planned losses are annually agreed upon with the territorial departments of Gosgortekhnadzor.

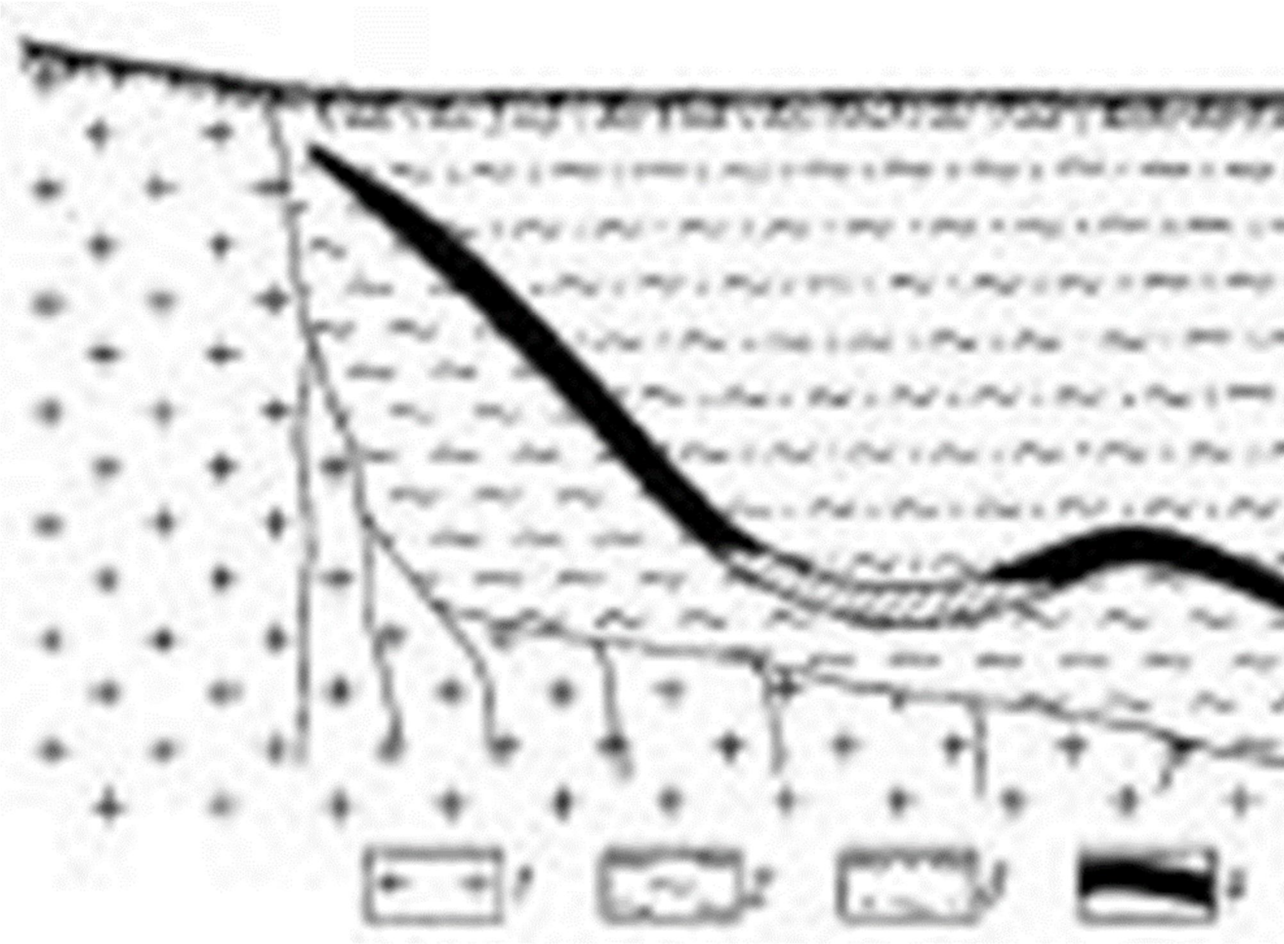
Operational losses are part of the balance reserves of a mineral that are actually left in the ground. These losses are directly dependent on the mining system used and on the correctness of mining operations. Operational losses include part of the balance reserves removed to dumps with waste rocks. These losses are also called actual losses.

Losses, depending on the reasons causing them, are divided into four groups:

- 1) loss of mineral resources due to mining, geological and hydrogeological conditions, inevitable under any rational development system;
- 2) losses of mineral resources, depending on the development system used in this case, but provided that this system complies with the geological, hydrogeological and mining conditions of field development;
- 3) loss of minerals in safety and barrier pillars;
- 4) loss of mineral resources from improper mining operations.

Losses of mineral resources due to mining-geological and hydrogeological conditions include the losses provided for by the project:

- a) in pillars left to protect mine workings from the breakthrough of water from underground reservoirs or quicksand, as well as from the collapse of the weak roof of the workings;
- b) in areas with tectonic disturbances of layers, deposits or veins in zones of faults, shears and shears;
- c) associated with the complexity of the contours of the ore body and, for this reason, the impossibility, during normal operation, of extracting from the subsoil all the reserves in the branches from it.

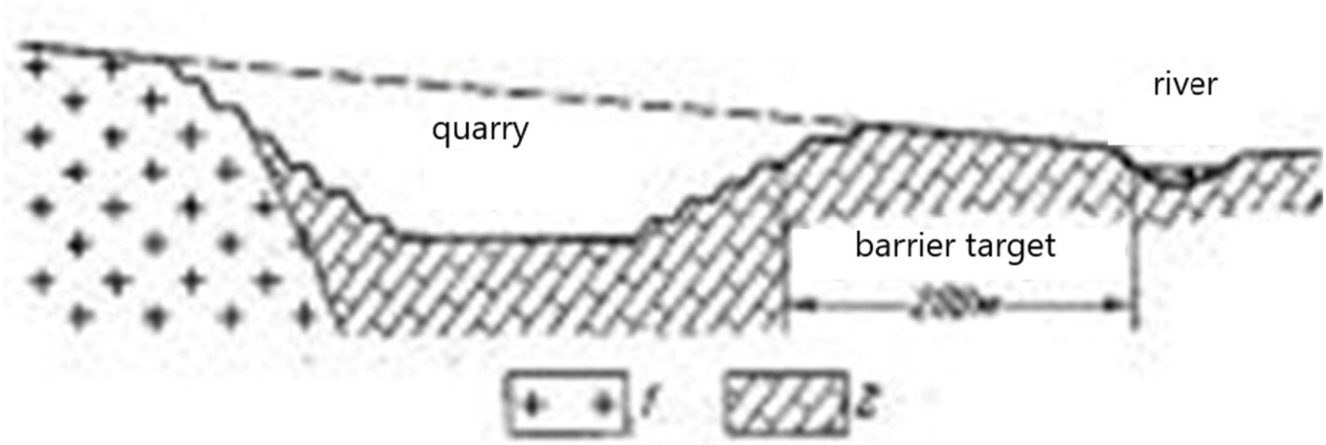


Ore losses in hydrogeological conditions
1,2,3 host rocks, 2 ore body, 3 losses

-

This group also includes losses in pillars not provided for by the project, the need to leave them during operation is caused by additionally established geological conditions, confirmed by relevant documentation.

The figure shows ore losses associated with the possibility of pressure water breaking into mine workings from fractured porphyrites. According to the conclusion of hydrogeologists, a layer of mudstones of at least 10 m should remain between the treatment space and the porphyrites, protecting it from breakthrough; all ores separated from porphyrites by a layer of mudstones less than 10 m are thus subject to losses due to hydrogeological conditions.



Barrier whole between the Tagil riverbed and the opencast mine

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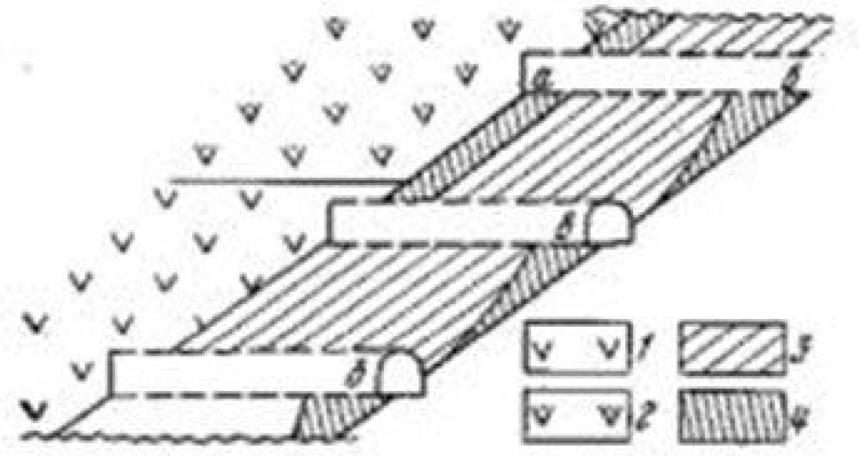
Barrier pillar between the river bed. Tagil and Ivanovsky limestone quarry

An example of a barrier pillar between a river and a quarry, reducing the flow of water into the quarry and preventing the possibility of sudden breakthroughs of large masses of water into the quarry.

In Fig. Figure 120 shows ore losses in pillars that protect the working from the collapse of loose rocks of the hanging wall into it, which can lead to excessive dilution of ores, as well as losses due to incomplete excavation associated with the angle of occurrence less than the angle of repose for ores.



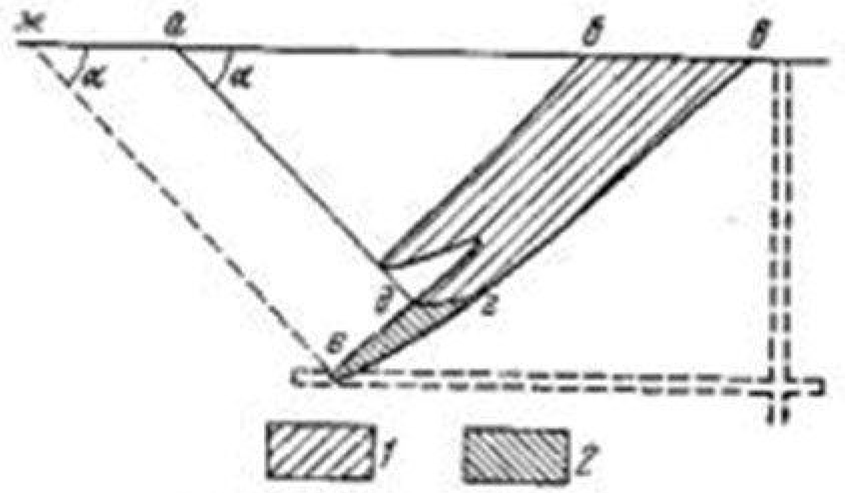
The loss of ore in the pillars gives protection from collapse due to the work of a weak roof (a) and losses from incomplete ore coarsening (b).

1 - pitruzine rocks; 2 - dredging of hard rocks; 3 - collapsible ore; 4 - ore remaining intact

-

Losses of ore in pillars to protect against collapse

The case of losses due to mining and geological conditions is shown in the figure. Here, a quarry is designed within the boundaries of the abcd *with* a completely satisfactory ratio of the volume of overburden to the volume of ore, determined by the resulting angle of repose of the quarry α. In this case, the ore in the circuit *J is lost* . To mine these small volumes of ore, it is necessary to take a very large volume of overburden - *or* go through a shaft and crosscut it, as shown by the dotted line. Neither one nor the other solution is economically feasible and the ore from the lower horizons ends up in losses here.



Ore losses by mining
and geological conditions.
1 - ore extracted by an open method;
2 - ore remaining in buckets during open mining

Ore losses due to mining and geological conditions

Losses of mineral resources, depending on the development system (within the established standards), include losses in various types of pillars (inter-block, inter-chamber, ceiling, etc.) left in accordance with the development system adopted by the project; This also includes losses in filling mined-out space and losses from incomplete release of broken (collapsed) minerals. In open-pit mining, this group includes losses in the roof and soil of the deposit, and in selective excavation - also losses in contact zones. These losses are often the greatest; The magnitude and types of losses are different for different development systems.

Thus, in systems with the collapse of ore and cap rocks, losses occur due to the incomplete collapse of ore layers or blocks, premature collapse of waste rocks, incomplete release of ore from the goaf, etc. In systems with backfilling, losses occur in the backfill material, during bypass along ore passes, in shadshtrsky and subvyrok pillars, etc. In systems with ore storage, losses can be caused by incomplete release of ore from the mined-out space, as well as incomplete excavation of inter-block, above- and under-gate pillars. In open-face systems, losses are caused by incomplete release and removal of ore from the goaf, as well as local collapse of the ore along with the surrounding rocks.

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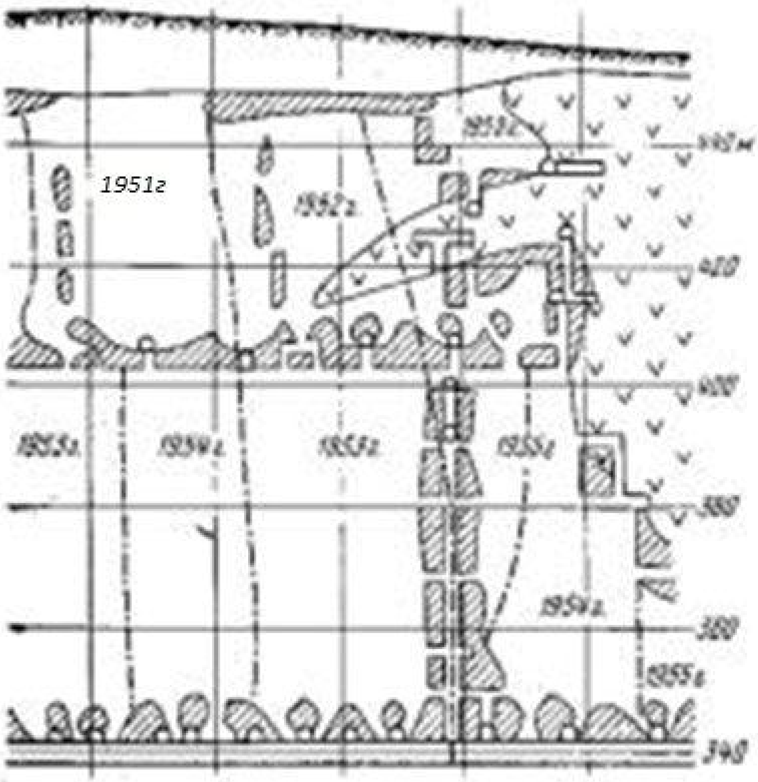
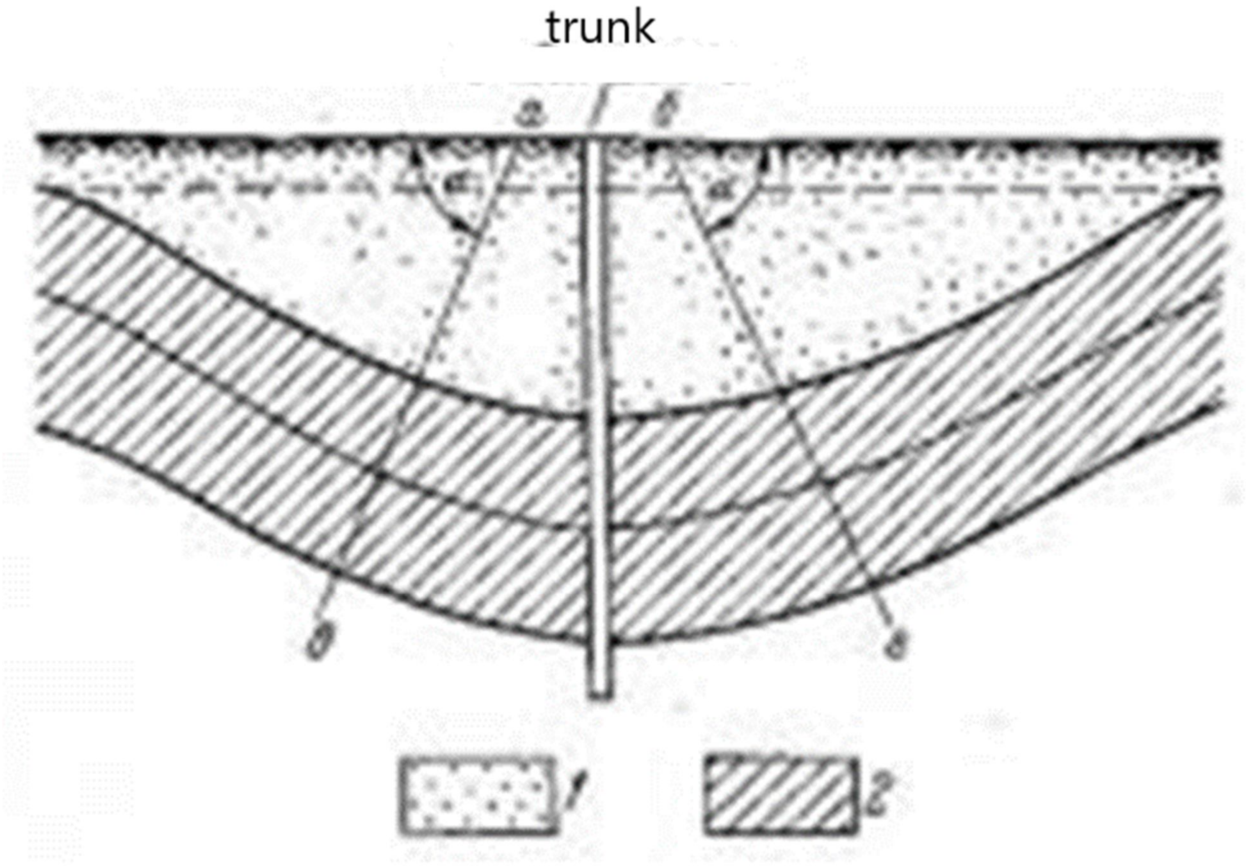


Vertical projection of the spent part of the deposits with interblock and sub-track targets left in the subsurface (shaded). 1951-1965 years. - dates of mining of individual parts of the deposits.

Vertical projection of the mined-out part of the deposit

The picture shows a vertical projection of the spent mouth of the Saranovskoe chromite deposit with the addition of superstructure pillars along two production horizons. It follows from the figure that in some pillars of the first floor the ceilings remained uncollapsed; in the central part, an unremoved interblock pillar was left, the collapse of which turned out to be impossible, since a fault zone runs along it. In addition, a number of pillars were left along the contacts of the ore with the vein rocks. The abandonment of these pillars is due to the desire to avoid excessive dilution of the ore by these rocks, which, naturally, will affect the quality of marketable ore. Losses of minerals in safety pillars include losses in pillars intended to protect mine shafts, ground structures, reservoirs and rivers, cities and towns; This group also includes losses in barrier pillars.



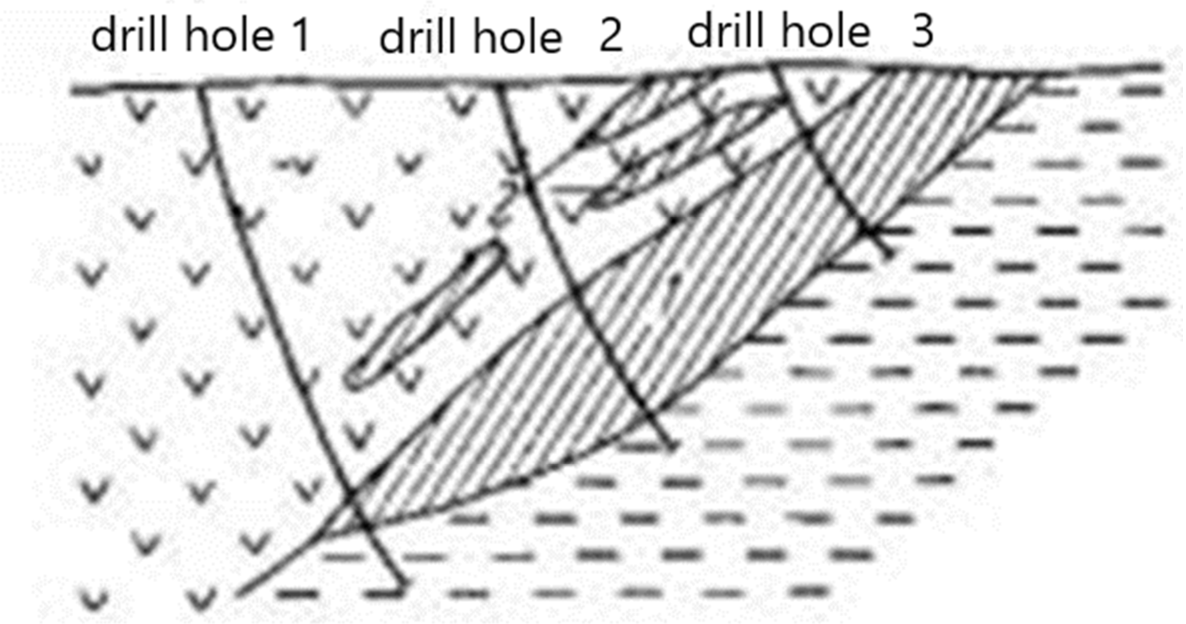
Safety rear sight {abvg) mines

The losses of this group include reserves of only those pillars that are within the boundaries of the worked out contours and will obviously be worked out in the future. Losses in the spent part of the pillars, depending on the reason for their occurrence, are classified into other relevant groups provided for by the classification.

The picture shows a safety rear sight left around the shaft. Repose angles are calculated according to certain rules, depending on the physical properties of the surrounding rocks. Judging by the section, it seems that a very large part of the ore body is lost here. However, such placement of a production mine is permitted only in cases where the mineral deposit is confined to a synclinal fold of

considerable extent and the mineral deposit left in the pillar constitutes an insignificant percentage of the total reserves.
Losses from improper mining operations include:

- a) losses in various kinds of pillars not provided for by the mining project, but left unexcavated in the depths;
- b) losses in safety pillars left to protect sources of underground fires or prevent the breakthrough of groundwater accumulated in mine workings as a result of improper mining operations;
- c) losses associated with the extraction of reserves preserved under underground fires;
- d) losses from undermining of deposits or layers with balance reserves in pillars left in mined-out space when mine workings are blocked, in pillars of unmined areas, in underworked blocks and floors. In open-pit mining, this group includes losses from hardening and losses in unworked areas. This group also includes all excess losses of minerals. It should be noted that excess losses occur when the mining sequence of individual floors and individual sections to a floor is not followed, as well as from premature excavation of pillars, untimely fastening of mine workings and other deviations from generally accepted rules for the exploitation of deposits.



Parallel ore bodies

In addition, losses of this group may occur due to insufficient or untimely exploration of individual floors and individual sections of the floor. Insufficient or untimely exploration of parallel ore bodies and apophysis also leads to excessive ore losses.

Poor quality of geological survey documentation also leads to unnecessary losses and dilution of ore. Large losses of ore due to poor geological documentation most often occur in deposits with unclear or complex boundaries of ore deposits or when the ores are complex in nature and insufficiently sampled. This circumstance must always be taken into account by mining geologists.

Measures to reduce losses and dilution

The fight against losses and depletion of mineral resources is an important event of national importance. The surveying service of the mining enterprise, together with the geological service, keeps records of mined and lost ore, as well as records of losses and dilution, records the write-off of redeemed reserves from the balance sheet of the enterprise, develops and, through the management of the enterprise, submits for approval to the ministry a draft of regulatory and planned losses and dilution.

The mine surveying department conducts systematic instrumental surveys of mine workings and all other mine workings and ore dumps, draws up new and systematically supplements previously drawn up working plans for mine workings.

The Geological Department carries out systematic geological documentation of mine workings and sampling of ores and rocks in the massif, together with the technical control department, it tests the broken-off ore mass. The geological department also takes samples to determine the moisture content and volumetric weight of the ore; based on the sampling results, it calculates the average content of useful components in the ore body, in the broken ore mass and in the host rocks that fall into the ore.

The technical control department (QCD) systematically weighs and tests the ore mass sent to the processing plant or metallurgical plant for processing. This department carries out sampling of low-grade ores stored in dumps, as well as sampling of overburden rocks and rocks used as backfill material. At the end of each month, the quality control department, based on daily recording and sampling of the ore mass, determines the amount of ore mined and processed for the reporting period and its average composition. Sometimes part of the work supervised by the quality control department is carried out by the geological service. The chief geologist of the enterprise must have comprehensive information about the work of the quality control department.

The chemical laboratory of the enterprise provides timely chemical analysis of bottomhole samples, commercial samples of ore mass, low-grade ore and rock, ore processing products at processing plants and metallurgical plants. The chemical laboratory also determines the moisture content and volumetric weight of the ore.

The mining department and the geological and surveying service of the enterprise, together with the mining supervision of the mine, conduct a comprehensive analysis of losses and dilution of ore, identify their causes and outline measures to eliminate them.

Systematic control by mining supervision over the sorting, loading and transportation of ore is important for reducing ore losses. So, when sorting, it is necessary to ensure that the ore does not get into the rock. Mining supervision is also obliged to ensure systematic control over the loading of ore, while avoiding overloading and underloading of trolleys and the presence of cracks in their bodies in order to avoid losses during transportation.

Along with this, the geological and mining supervision of the enterprise must take timely measures to maximize the extraction of ore from the contact parts of the ore body, to the extent possible prevent the abandonment of thin ore bodies in the depths, which are branches from the main ore body, to ensure that when mining gently dipping ore bodies the smallest amount of ore was left in the soil and roof of the workings, in the berms and sides of the pits.

In order to combat losses, it is necessary to constantly improve the technology of ore processing at beneficiation plants and metallurgical plants, to increase the extraction of not only the main, but also associated useful components during the beneficiation and metallurgical processing of ores.

Along with the noted measures, to reduce losses of mineral resources it is necessary:

- organize storage of low-grade ores in special dumps;
- introduce reserve capacities and create new capacities at processing plants in order to enrich diluted ores from contact zones and use poor, and in some cases substandard, ores for the needs of the national economy;
- use tailings from processing plants and dust from metallurgical plants to extract both main and associated components from them;
- constantly rationalize field development systems and the organization of mining operations, mechanizing these works as much as possible.

To reduce the amount of ore dilution it is necessary:

- during open-pit mining, conduct careful selection;
- do not allow ore to be mixed with the rock delivered to fill the treatment space, prevent possible damage to the flooring in the treatment chambers and blocks;
- carry out hole-testing of the near-contact parts of the ore body in deposits with unclear contacts of the latter in order to prevent possible breaking of the rock along with the ore;
- carry out selective extraction of thin ore veins (for example, deposits of rare metals) and barren areas in thick ore bodies;
- but allow the surrounding rocks to fall out from the sides of the ore body and mix them with the ore.

The implementation of these measures will reduce losses and dilution of ore, increase the production of ferrous, non-ferrous and rare metals, and improve the technical and economic performance of the mining enterprise.

Lecture No. 15, (2 hours).

Integrated use of mineral resources

The problem of integrated use of mineral resources is considered in three aspects: 1) integrated use of mineral deposits; 2) integrated use of mined mineral raw materials, 3) use of production waste. The level of complexity of the use of mineral raw materials is assessed by the complexity coefficient Kk

Integrated use of natural resources is the satisfaction of society's needs for certain types of natural resources, based on the economically and environmentally justified use of all their beneficial properties. This principle forms the basis for the rational use of natural resources and maximum limitation of possible negative consequences of anthropogenic impact on the environment.

The essence of complex use lies in the sequential processing of raw materials of complex composition into various valuable products in order to make the most complete use of all components of the raw material. This is extremely important for preserving the environment.

An example of the integrated use of organic raw materials is the thermal processing of fuels - coal, oil, shale. Thus, when coking coal, in addition to the target product - metallurgical coke - coke oven gas and tar are obtained, processing which releases hundreds of valuable substances; aromatic hydrocarbons, phenols, pyridine, ammonia, hydrogen, ethylene, etc.

The level of complexity in the use of mineral raw materials can be assessed by the complexity coefficient Kk, which is the ratio of the total cost of useful components extracted into commercial products to the total cost of components in raw materials. The level of complexity of the use of deposits is assessed by the number of minerals and useful components extracted from the deposit, as well as the degree of completeness of their extraction and sale.

Almost all deposits of solid minerals are complex; they contain, as a rule, several different minerals and chemical elements, some of which are considered basic, others - associated (accompanying, or co-occurring) minerals. The problem of integrated use of mineral resources is considered in three aspects: 1) integrated use of mineral deposits; 2) integrated use of mined mineral raw materials, 3) use of production waste.

The economic efficiency of the integrated use of deposits lies mainly in the fact that one-time costs for geological exploration, stripping and, to a large extent, for preparatory and treatment work are distributed over a large mass of extracted minerals, while reducing the cost of a unit of production.

The integrated use of deposits in the process of their development is currently most widespread in mining enterprises of non-ferrous metallurgy, due to the fact that non-ferrous metal ores, as a rule, are complex and multi-component. These ores, along with the main ones - copper, lead, nickel and other metals - contain numerous associated useful components: gold, silver, platinoids, tin, tungsten, molybdenum, cobalt, arsenic, sulfur, iron, barium, cadmium, selenium, tellurium, indium, rhenium, etc. At the same time, the value of accompanying useful components often exceeds the value of the main ones.

Mining and metallurgical enterprises of non-ferrous metallurgy, in addition to 12 basic metals, produce raw materials and finished products from 62 elements.

Most iron ore deposits are also characterized by multicomponent minerals. The most important associated elements include: vanadium, copper, cobalt, nickel, germanium, phosphorus, sulfur, boron, tantalum, niobium and zirconium.

The most interesting object for the integrated use of deposits is the Yarega mine in the Ukhta oil basin. This enterprise produces mines of so-called "heavy" oil, which consists of injecting superheated steam through wells into oil-bearing sandstone layers and draining oil that has lost its viscosity through production wells into underground mine workings. Between the developed oil deposits there are some reserves of valuable titanium ores. Currently, a semi-industrial beneficiation plant has been built and is operating, where ore beneficiation technology is being developed.

One of the most striking examples of the use of industrial waste is metallurgy.

In a blast furnace, slags are formed due to waste ore and coke ash. Depending on the ratio of components, slags can be basic, neutral or acidic. Slag is a valuable raw material for the construction and road construction industries. Slag crushed stone is 1.5 - 2 times cheaper than natural stone, slag pumice is three times cheaper than expanded clay and requires less unit costs. The use of granulated slag in the cement industry increases the yield of cement, reduces the cost and unit costs of its production compared to the natural raw material cement clinker. The use of slag in the recycling of metals to deoxidize steel reduces the consumption of scarce ferrosilicon. It is even permissible to use metallurgical slag as an abrasive material for cleaning the bottoms of ships. Converter slag can be used in hydraulic engineering for filling dams instead of soil.

Mine rocks often contain a large number of microelements necessary for plant nutrition, and therefore can be used as soil fertilizers, the imbalance of which occurs as a result of the intensification and chemicalization of agriculture.

Coal enrichment waste containing a large amount of combustible mass can be subjected to additional enrichment to produce solid fuel of standard ash content or directly used for combustion and gasification. It is possible to burn high-ash coal enrichment waste in a dusty state at power plants.

Using biological methods, it is possible to extract pyrite and organic sulfur, various metals (Mn, Nl, Co, Zn, Ca, Al, Cd), ash, oxygen- and nitrogen-containing compounds from coals and part of coal waste. Coal purification can be carried out in 6 days by 93% when using thermophilic bacteria and 18 days with mesophilic bacteria.

From oil refining waste it is possible to use acid tars, which can be used together with oil slags in road and municipal construction.

The sustainable development of mining enterprises is determined by the comprehensive use of extracted raw materials. The complete use of natural resources makes it possible to increase production efficiency, rationally develop subsoil resources, and ensure full use of labor resources. At the same time, the problem of recycling mining waste and, accordingly, preserving the ecology of the environment is resolved. Solving these problems for mining enterprises is possible with their complete technological, economic and economic independence.

Sustainable development of mining companies is determined by the multipurpose utilization of mineral resources. Multipurpose utilization of natural resources helps to increase production ef ficiency, develop minerals in the most efficient way and secure full use of the labor force. At the same time it solves the task of mining waste utilization thus saving the environment. Solution of these tasks for mining companies is possible only in conditions of their total technological, business and economic independence.

The economic and social development of Russia should take place in conditions of concentration of forces and resources in the main production sectors of the country, intensification of production, improvement of management systems and the entire economic mechanism in relation to market relations. Primary attention should be paid to the development of basic industries, improving the location of productive forces, the complexity and specialization of the economy of regions and economic regions in order to strengthen and accelerate the development of a single economic complex.

The historical feature of Russian industry lies in its complexity, i.e. in the interdependence and consistency of individual industries, expressed in the creation of diversified regional units - territorial production complexes (TPC), formed around the corresponding natural resource core (Center, Urals, North-West, Volga region, etc.).

An analysis of the current state of - Russian industry shows that, despite undoubted successes and achievements, solving the problem of further development faces a number of objective difficulties.

First of all, these are problems - associated with the ever-increasing scarcity of natural resources in the most developed economic regions of the European part of the country, where natural sources of raw materials are being depleted, the relative mass of the potential labor force is decreasing, and the area of free development territory for accommodating new productive forces is decreasing. In addition, as a result of the collapse of the USSR, part of the natural resources moved from Russia to the former Soviet republics, which led to the need to develop northern and remote, industrially undeveloped regions.

Secondly, the transport problem is worsening, expressed in the growth of oncoming traffic, the complication of transport networks, and the reduction in the capacity of the busiest highways.

Thirdly, problems arise in the management of territories in cases where national interests are closely intertwined with the narrow departmental interests of each economic region. Objectively, these difficulties should increase in the future, and overcoming them using traditional methods of organizing industrial production, as practice has shown, is ineffective.

In this regard, there is an urgent need to create territorial production complexes with fundamentally new organizational and economic content, which would combine a number of properties characterizing a qualitatively new level of a market economy, namely:

- the complexity and compactness of the organization of diversified industrial and production enterprises, in which they are united on the basis of common goals of operation and development;
- the fullest and most efficient use of natural, energy, material and labor resources;
- maintaining environmental balance , waste-free production, reproduction of consumed natural resources.

Currently, Russian industry has all the necessary prerequisites for the transition to a new level of economic development, since there are vast territories underdeveloped by industry on which TPK of the most diverse profile can be located.

An analysis of the structure of the existing economic regions of the country and special literature on this issue shows that there are practically no industries that do not participate at all in the processes of complex formation. It would seem that with such a variety of industries that form the economic region, the issue of the integrated use of natural resources should not even be discussed, but should be decided automatically, taking into account national interests. However, in practice, one often has to deal with amazing mismanagement, causing irreparable harm to both individual regions and the state as a whole.

Insufficient attention to the issues of complete extraction of minerals from the bowels of the earth and their deeper processing ultimately leads not only to a decrease in the efficiency of use of mineral resources, but also in the long term creates many additional problems associated with the reconstruction of enterprises and the organization of recycling waste, infrastructure rationing and environmental restoration. The desire of each industry, whose enterprises are located within the territory of the developed area, to save on capital investments and production costs in the initial period of construction results in excessive material and labor losses in the future.

In recent years, in the economic literature devoted to the problem of territorial organization of industrial production, the objects of research, as a rule, are represented either by a group of enterprises of the same industry, or by a group of specialized enterprises of various industries, focused on the production of homogeneous products in both in the case of those located in the same economic region, or a set of intersectoral enterprises within a specific administrative-territorial unit. Although the study of objects was carried out using different methods of grouping enterprises, their final conclusions about the irrational use of natural resources are quite clear.

In our opinion, the reasons for this situation are mainly as follows:

- ambiguous representation and interpretation by researchers of the concept of TPK, which arose during the analysis of the already established territorial organization of production. The concept of TPK in the most aggregated form, although it makes it possible to determine the prospects for the development of the territorial organization of production, is not so deep and unambiguous that on its basis it is possible to clearly imagine in advance the internal structure and composition of the complex and what the economic relations should be between the enterprises of the complex in this economic region;
- the complexity or impossibility of practical implementation of large complex programs;
- disunity of representatives of small and medium-sized businesses in solving the problems of developing large economic regions.

Along with these reasons , one should also take into account such constant factors as a decrease in the share of some scarce natural raw materials, deterioration of mining and geological conditions for mining, a decrease in the content of useful components in ore and other reasons that objectively reduce production efficiency.

In order to eliminate the initial - negative impact of individual industries on the formation of a complex of enterprises in a newly developed area, when private interests most clearly come into conflict with state interests, and issues of integrated use of subsoil are not sufficiently worked out, it is necessary already at the pre-design stage, and subsequently at the design stage, adhere to a uniform methodology for the development of natural resources and, in particular, mineral deposits for all industries, namely, adherence to the following principles:

- complete use of natural resources and extraction of minerals from the subsoil;
- integrated extraction and use of minerals from mined ore;
- environmental safety, waste-free production;
- technological, economic and economic independence of all industries included in the TPK.

The complete use of natural resources in the extraction of minerals for any type of TPC is always or almost always effective. This is explained by the fact that the construction of mining enterprises is very expensive. With existing methods for assessing the magnitude of losses of mineral resources and their standardization, losses are considered justified in the case when the damage caused by them is less than the compensation received. However, this does not take into account the irreplaceability of minerals and the fact that all rationing of losses is based on the existing, and not the future, level of technology for extracting and processing raw materials.

When solving such issues, *the principle of complete extraction of all components from the mined ore* is of great importance , even those that at this stage of technical progress there is no particular need to extract or it is quite expensive. The completeness of extraction of useful components from mined ore is closely related to the principle of environmental safety and waste-free production. The functioning of all enterprises of the complex, focused on the finished or final product, to one degree or another, suitable for the needs of industry and the disposal of waste from each enterprise, makes it possible to balance the costs of monetary, material, labor and energy resources per unit of the finished or final product and processed products at all stages production.

The principle of technological, economic and economic independence of the TPK follows from the very nature of the market economy and the laws of functioning of each enterprise included in the complex. Here, the TPK acts as an independent production unit in the state system.

Lecture No. 16, (2 hours).

Structure and objects of control in the system of industrial technological monitoring, justification of design decisions when locating mining facilities, environmental impact assessment (EIA).

In the process of prospecting, exploration, operation, transportation, storage and processing of oil and gas, a number of environmental problems arise, which are caused by both the technogenic influence of oil and gas industry facilities on the environment [1] and unfavorable natural processes at these facilities. Technological processes of oil production influence the components of the environment in different ways - they pollute them, disrupt the natural balance, change landscapes, contribute to the development of specific diseases, worsen the aesthetic perception of the natural environment, etc.

In order to assess the impact, prevention and elimination of environmental emergencies, it is necessary to apply an integrated approach to solving emerging environmental problems. This is greatly facilitated by environmental monitoring, the fundamental points of which are set out in the Regulations on state environmental monitoring (state environmental monitoring) and the state data fund of state environmental monitoring (state environmental monitoring) approved by Decree of the Government of the Russian Federation of August 9, 2013 No. 681) [2]. Environmental monitoring is designed to provide environmental authorities with reliable, timely and representative information at reasonable economic costs spent on obtaining it.

The purpose of environmental monitoring is subsequently:

- preservation, restoration and (or) improvement of the environment;
- reduction (prevention) of harmful effects on the environment;
- application of low-waste, energy- and resource- saving technologies;
- rational use of natural resources ;
- prevention of accidents and other emergency situations.

Industrial environmental monitoring is intended to solve the problems of operational monitoring and control of the level of environmental pollution in the territory of sanitary protection and residential zones, assessing the environmental situation and providing information support when making business decisions, locating production complexes, informing the public about the state of the environment and the consequences of man-made accidents.

Articles [3,4] consider the impact of - oil production facilities on the atmospheric air, and indicate measures to protect it and reduce suspended substances in the air. It also provides information on the impact of oil production facilities on surface and groundwater, on soil vegetation and land use conditions.

When assessing the impact of the oil production process on the environment, it is necessary to consider all the components of the natural-anthropogenic system that was formed in the process of its historical development, and it is necessary, if possible, to separate the adverse effects of natural and technogenic types. The experience of conducting various environmental assessments of the impact of oil production on the environment shows that the main negative impact is experienced by: geological, air, soil and water environments.

During the process *, the geological environment* is usually disturbed by the construction of wells. In addition to man-made disturbances, the geological environment in the process of oil production also experiences pollution that is associated with the filtration of drilling and grouting fluids, the formation of technogenic deposits, changes in the filtration and capacitance parameters of formations, changes in the chemistry of formation waters, etc. However, such phenomena are of a local injection nature and in relation to the total volume of the geological environment of the oil field are insignificant.

In addition to the above-mentioned factors of negative influence on the geological environment, natural unfavorable phenomena are also possible, such as earthquakes, landslides, relief subsidence, river erosion, etc., which lead to adverse, often extreme, consequences.

Assessment of the impact of oil production *on the air environment* is primarily related to natural climatic factors, parameters of emissions of polluting technological gas-air mixtures and the level of natural hydrocarbon gas contamination of the territory. The main source of air pollution in the South-Eastern region of the Republic of Tatarstan is the enterprises of oil companies. This is technological equipment for collecting and preparing for transportation of oil (reservoirs, separators, oil heaters, pumps, oil storage tanks). Thus, in the Nurlat region of the Republic of Tatarstan in 2014, there were 1,667 stationary sources of pollutant emissions into the atmosphere, which emitted 11,482 thousand tons of pollutants [5]. The main polluting ingredients are petroleum hydrocarbons, but practice shows their complete dispersion within the sanitary protection zones of industrial facilities. The same picture is observed for the air basin around the wells.

The aquatic environment is assessed by the level of natural and technogenic state of surface, underground and industrial waters.

Peculiarities of oil fields include , for example, the presence of natural sources of mineral waters, which cause an increased content of dissolved organic substances in surface waters. Physic-chemical analysis of surface waters according to various calculations shows that the maximum permissible concentrations of petroleum products are exceeded by 1.1-8.5 times. The process water that is used to maintain reservoir pressure has a calcium chloride composition with a mineralization of up to 35 g/l and an oil product content of up to 600 mg/l. Groundwater is generally characterized by a chlorine-calcium composition with a mineralization of up to 300 g/l; isotopes of radioactive elements are often found in groundwater.

The assessment of the impact of the process of oil field exploitation *on the soil cover* is carried out in the areas of disturbance and contamination of the soil cover, based on its natural state. In the process of developing oil fields, soil destruction is carried out by: removing soil during the construction of wells and oil collection structures; laying underground pipeline communications; gryphon formations near wells (occur around drilling rigs when the integrity of the casing string is damaged, the pipe wall ruptures or its upper part is worn out).

The group of surface forms of soil pollution within oil fields most often includes: pollution with solid insoluble substances, dusting with fine dusty substances; oiling and contamination with petroleum products; changes in the acidity of soil sediments; soil air pollution. When near-surface soils are contaminated, the most harmful are oil products and liquid drilling waste. The latter, entering the soil, deoxidize it due to high concentrations of water ions and favor the intensive displacement of oxygen. This causes irreversible changes in the agrochemical properties of soils and reduces their agronomic value. The area of possible distribution of surface forms of soil pollution in an oil field is limited, as a rule, by the contour of the drilling site.

The basis for monitoring at an oil field will be the issuance of a task, which will indicate the purpose of the work , the spatial boundaries of the object, the main assessment parameters (pollutants) in the components of the natural environment, geoecological tasks, the main methods used, the sequence of decisions, expected results, deadlines performance of work. The organization of environmental monitoring and the stage of operation, indicating the negative impact on the geological, air, soil and water environment are indicated below (Fig. 1).

The sequence of actions for collecting data about an object and analyzing the collected information during industrial - environmental monitoring involves:

1. studying the environmental documentation of the enterprise, stock and published materials, drawing up requests to regulatory authorities;
2. collection and systematization of available information on previously conducted studies (including environmental and geochemical);
3. analysis of technogenic load on the environment;
4. identification of priority sources of pollution and zones of their influence, types of pollutants;
5. drawing up maps of the territory's exploration;
6. justification of the need to organize environmental monitoring of the environment.

Next, the methodology and organization of the designed work is worked out. We are aware that this process is long and complex, however, when implementing the program, we consider it appropriate to highlight the following stages:

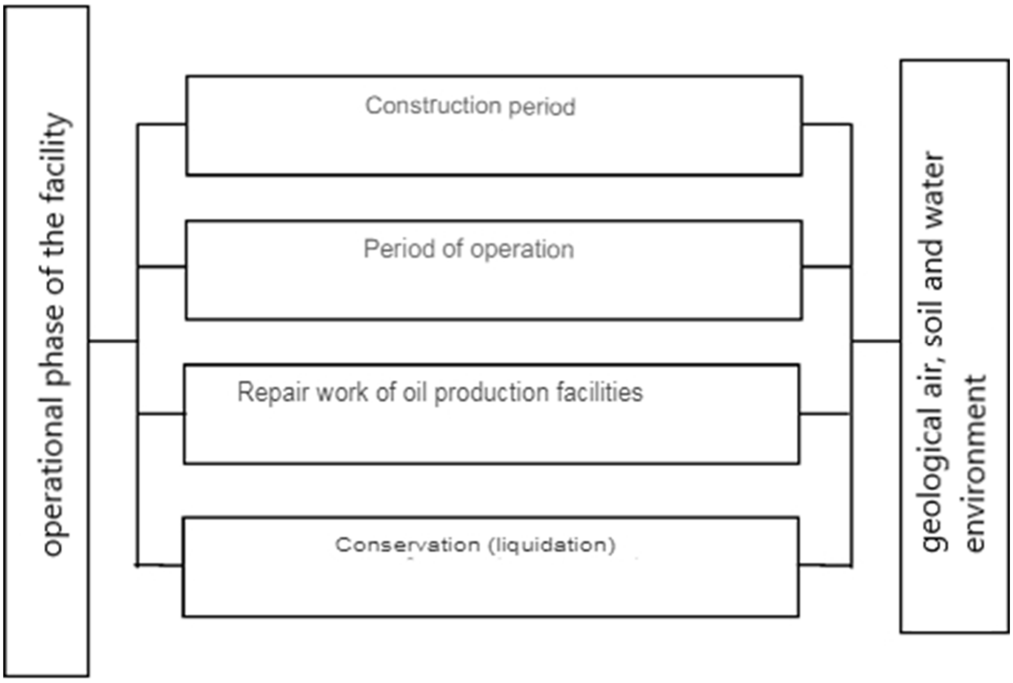
- selection of observation methods and ground-based monitoring methods;
- justification and breakdown of the observation network for the components of the natural environment;
- drawing up maps of the organization of territory monitoring;
- methodology for selection,

preparation, frequency of samples of components of the natural environment;

- selection of assessment indicators in the components of the natural environment;
- selection of analytical support for -monitoring.

The main thing in monitoring is the systematicity, duration and uniformity of control using a relatively small set of methods. The classification of environmental monitoring systems can be based on various observation methods (monitoring by physical, chemical and biological indicators, remote monitoring).

The application of various criteria for assessing environmental quality should be based on the superiority of the requirements of the method whose criteria are more stringent.



Organization of environmental monitoring

Край шельфового ледника и айсберг

As a result of all the activities carried out, a map of the organization of environmental monitoring points on the territory of the facility should be constructed .

The selection of assessment indicators (pollutants) in the components of the natural environment is carried out taking into account the specifics of production, regulatory and methodological documents, data from previously conducted studies, statistical reports, and industry standards. The list of macro and micro components should be as identical as possible in the components of the natural environment being studied.

Thus, in order to prevent and timely identify environmental deviations of various directions and degrees, it is necessary to conduct detailed environmental monitoring in oil fields. Compliance with the current rules and regulations for maintaining technologies and operating equipment, protecting subsoil, atmospheric air, ground and surface water, soil cover, and labor protection leads to ensuring an accident-free process of field development and its further environmental safety.

Measuring the anthropological impact on the ecosphere is an important condition for maintaining an acceptable level of the environment. Many of today's human activities have an impact on the environment.
To prevent disasters and deterioration of the state of nature, special methods have been developed to determine the level of impact of a particular activity on the environment. Based on this assessment, a plan can be developed to reduce the impact, as well as measures to prevent excesses.

In our company you can order an environmental impact assessment, abbreviated as an EIA project, on favorable terms. We guarantee affordable prices and optimal deadlines.

What is an EIA and who needs it?

Environmental impact assessment is a set of measurement, analytical and research processes carried out to identify, study, describe and evaluate the levels of environmental impact during the implementation of activities.

An environmental impact assessment is developed for the working documentation and revised in the event of changes in the design decisions of this design documentation.

The term was invented by the International Association for Environmental Impact Assessment. The Association was founded in 1980 and is a leading international organization that specializes in improving impact assessment practices as a tool for making political decisions, programs, plans and projects. Members of the organization include company managers, strategic planners, analysts and political scientists, and university professors. A forum is held regularly to promote innovations and practices that have proven to be effective. The first International Conference on the Application of Social Impact Assessment (SIA) was held in Canada in 1982. Since then, SIA has acquired the status of a scientific method. In 1994, the United States Committee on the Application of SIA Methods and Principles adopted the “Guidelines, Principles and Recommendations for SIA in the United States.”

Environmental impact assessment is carried out with the aim of preventing environmental degradation, restoring natural systems disturbed as a result of economic activities, to ensure the balance of planned economic activities, creating favorable conditions for people’s lives, developing measures that reduce the level of environmental hazard of the planned activities, and serves as the basis for making decisions on the implementation of a particular project.

As a result of the development of an EIA, the degree of environmental risk of the planned economic activity is determined. Establishing the level of environmental risk is based on identifying the resistance of the natural environment to impacts (for individual components and the ecosystem as a whole) during periods of normal operation of the implementation facility and emergency situations.

Environmental impact assessment includes several stages of development:

- **Stage I** - drawing up and consideration by the authorized body of a statement of planned activity (APA) in order to determine the scope of the environmental impact assessment;

- **Stage II** - preparation of a report on possible impacts (POI), taking into account the scope of the environmental impact assessment, coordination of this report with all authorized bodies specified in the conclusion on the statement of the planned activity;

- **Stage III** - obtaining an impact permit for objects of categories I and II, which includes: development of draft environmental emission standards, development of a waste management program (WMP), industrial environmental control program (IEC), technical action plan.

Public hearings are required for stages II and III

In simple words, these documents indicate how this or that type of activity will affect the environment in the location of the described object. In addition, if an enterprise emits GHGs or particularly heavy chemicals, it can have an impact on the environmental situation not only in the country, but also in the world.

The total environmental impact is taken into account, including the impact on the atmosphere, water resources and soil. The level of noise exposure is also taken into

16 account. Environmental impact assessment materials must be scientifically substantiated, reliable and reflect the results of comprehensive studies of predicted environmental impacts and their consequences, carried out taking into account the relationship of various environmental, social and economic factors.

It is worth noting that according to the current legislation of the Republic of Kazakhstan, this documentation is required for registration for a number of areas of activity.

This list is quite extensive, so we will give examples by industry. To find out whether you need to order an EIA project, you can contact our specialists for a free consultation.

Impact assessment is necessary for individuals and legal entities involved in:

1. Energy;
2. Subsoil use;
3. Metal production and processing;
4. Processing of non-metallic minerals;
5. Chemical industry;
6. Waste management;
7. Pulp and paper production;
8. Road, rail and air transport;
9. Water transport;
10. Water Resources Management;
11. Intensive rearing of poultry or pigs;

Documents are developed by facilities that have a negative impact on the environment, namely before the start of planned activities, construction, reconstruction of facilities, modernization of production facilities as part of project documentation.

Stages of registration :

The environmental impact assessment is carried out as follows:

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- processing an application, drawing up a contract, collecting information about the characteristics of the enterprise being evaluated;
- inventory of emission sources, territory survey, screening and other activities to identify assessments;
- Based on the activities carried out, a conclusion on impact assessment is made.
- documentation for confirmation by the authorized bodies, then the entire package of documents is transferred to the customer.

Lecture No. 17, (2 hours).

Environmental audit, environmental assessment, environmental damage assessment.

By its internal essence, the commodity producer today is not interested in environmental protection, because Economically and technically, it can produce more products and at lower costs if it does not spend money on environmental protection.

Pollution control costs are expensive. In developed countries they account for **up to 3% of GDP** . This is mainly government spending.

Economic mechanisms can solve two problems :

- **influence** the source of pollution by creating positive and negative incentives;
- **create** funds that can be used to finance environmental policy.

The best way to achieve environmental quality requirements is through the combined **use of coercive** and **economic** methods of environmental regulation.

Economic methods of influence **.**

- Resource pricing.
- Subsidies (waste minimization, installation of treatment equipment, resource conservation (land, water, soil, etc.), reuse of resources, protection of landscapes and animal habitats, low-waste technologies, etc. are encouraged.

- Government grants, subsidies,

17 - *special funds (oil spill relief fund in the USA, Japan, in Russia in 1991 -* ***the Federal Environmental Fund was created*** *- the sources of funding are payments for environmental pollution + fines + claims for violation of environmental protection laws).* The Foundation finances work on the creation of industries with waste disposal, the creation of nature reserves and their improvement, environmental education and public education.

- *preferential, low-interest loans* ,
  - *tax credits,*
  - *accelerated depreciation of treatment, resource-saving equipment.*

- Payments and taxes:

- *administrative payments* - fees for licenses, for example, for the use of landfill sites, for control of chemicals, etc. Used for the maintenance of control bodies.
  - *user payments* - in Russia, payments are established for any pollution. For those pollutions that exceed established limits, fees are charged at **increased** rates.
  - *fees for effluents and emissions* or payments for pollution - are charged taking into account the value of the relevant emission standards.
  - *payments for products* with a high degree of environmental risk (use of pesticides in agriculture, environmentally “dirty” products, products produced in environmentally “dirty” production).
  - *differentiation of taxes* - application of different levels of taxes on products and substances depending on their environmental friendliness (stimulation of production and use of unleaded gasoline).
  - *energy tax with carbon content* – apply mainly to fuels used in transport engines.

Fee refund system (tax-deposit) - users pay an inflated fee, which is reimbursed to them after the product is returned to the collection and recycling system (return of bottles, cans, tires, batteries, etc.), 17 Creation of a new market:

- *sale of emission licenses* (pollution rights), the principle is to limit the total permissible emissions within a geographic area. Licenses are granted to a business or company, which is allowed to sell them to other companies or offset higher emissions from its facilities. *Markets* for emission permits (rights) form a competitive system for the distribution of emission rights, created through *the purchase and sale* of rights after their initial distribution among market participants. *The price is determined by supply and demand.*
- *water markets* (can stimulate reduction of water consumption and preserve its depleting sources). Privatization of water supply and introduction of prices for water use reduces water losses.

Economic coercion:

- fines for failure to comply with environmental legislation,
- bonds redeemable during the operation of enterprises.

Civil liability insurance, compensation funds:

- strict liability,
- civil liability insurance for environmental damage,
- creation of compensation funds.

Economic methods of stimulation are ***coercive*** *and* ***incentive*** *in nature.*

One of the ways **to stimulate** environmental activities is taxes. **Tax** is a part of an enterprise's income (known in advance) withdrawn for the benefit of the state. *This encourages people to reduce pollution levels as much as possible in order to avoid paying taxes* . However, at the same time, enterprises with high costs of pollution control **prefer to pay taxes** rather than engage in environmental protection.

One form **of the tax** system includes **direct payments** , which represent monetary payments from pollution sources to the state. Unlike taxes , ***payments*** *are set for any source of emissions and are levied only if emissions exceed a certain, predetermined level* .

Economic methods of OS are cheaper and better when chosen correctly.

Lecture No. 18, (2 hours).

- Use of the underground space of the earth's bowels.

1. Areas of activity.

1.1 Industrial sphere.

Types and uses of cavities:

- for the extraction of host rocks (limestone, chalk, rock and potassium salts, sandstone, etc.);
- mining of fulfilling deposits (flint, copper, gold, iron, lead, silver, arsenic, uranium, precious stones, marble onyx, etc.);
- placement of factories and engineering equipment facilities (iron smelters, concentrating factories, precision instrumentation factories, hydroelectric power stations, nuclear power plants, water treatment plants, wine production plants, etc.);
- storage of various substances, materials, production products (refrigeration units, petroleum products, industrial waste, etc.).

1.2 Agricultural sector.

Types and uses of cavities:

- growing mushrooms (champignons);
- ripening of cheeses (Roquefort, etc.);
- vegetable growing (cucumbers, tomatoes, onions, tomatoes);
- floriculture (lilies of the valley, jasmines, carnations, callas, etc.);
- beekeeping (storage of hives, bee materials, etc.);
- extraction of bird nests (for food and treatment);
- pens for livestock (small and large livestock, poultry);
- cattle burial grounds.

In addition, water, bat and bird guano, bone breccia, gypsum are used as cavity fillers of various types.

1.3 Communal sphere.

Types and uses of cavities:

- communication routes (pedestrian, bicycle, railway, water);
- stations, depots, car parks;
- collectors (water pipelines, gas pipelines, water-carrying and drainage communications, electrical and telephone cables).

1.4 Military sphere.

Types and uses of cavities:

- shelters and shelters (civilians, military, criminal elements);
- communication structures (communication routes, communication centers, printing houses, etc.);
- fortifications (fortified areas, bunkers, etc.);
- factories (for the production of weapons, ammunition, etc.);
- proving grounds (weapon testing, shooting ranges, training sites).

17 Saltpeter (for the production of gunpowder) and stalactites (arrowheads) are used as cavity fillers.

1.5 Social sphere.

Types and uses of cavities:

- housing (cities, shelters, prisons);
- water supply (tanks for collecting and storing water, wells);
- warehouses (wine, fruit, medicines, gold reserves, treasures, messages to descendants and aliens, garbage, etc.);
- commercial premises (shops, restaurants, buffets, workshops, post office, telegraph office, etc.);
- medicinal purposes (hospitals of various profiles, as well as deposits: gypsum, mirabilite, swift nests, water);
- sports and excursion purposes (gyms, hockey fields, swimming pools, training grounds, caving tourism, excursions, dance and concert halls, music schools, caving competitions, New Year trees, photography, etc.);
- cultural and educational purposes (mountain, archaeological, biological, pharmacological, speleological museums; libraries, archives, etc.).

1.6 Cult sphere.

Types and uses of cavities:

- places of worship (primitive shrines, pagan temples, Vedic, Hindu, Islamic, Jewish, Shinto, Christian temples, chapels, churches, mosques, monasteries);
- ceremonies (initiation, marriage, funeral, etc.).

1.7 Scientific field.

Types and uses of cavities:

- clarification of the conditions for the formation and existence of cavities (route and stationary geological, hydrogeological, microclimatic, engineering-geological, biological and other studies);
- study of processes occurring in the earth's crust and in space (geophysical observations - tilt meters, deformation, seismic, electromagnetic, etc.; astrophysical observations - study of cosmic radiation, high-energy particles, etc.);
- study of life underground (biological observations - the life of animals in conditions of eternal darkness, constant temperature and humidity; medical - the study of human biorhythms during a long stay underground in a calm and stressful environment, the behavior of humans and groups of people in conditions of confined space and information isolation and etc.).

The study of cave spaces gives important results not only in the listed, but also in many other scientific areas of geology (mineralogy, sedimentology, etc.), hydrogeology (study of condensation, features of the movement of groundwater and the formation of their hydrochemistry, mathematics (problems of topology, etc.) .

Thus, the use of underground spaces is multifunctional. It began with the Paleolithic and continues throughout human history. By the end of the 20th century. There has been a sharp increase in the types and types of use of cave spaces, as well as an increase in the number of objects used for different purposes. Therefore, the problem of assessing them as resources arises. V.N. Andreychuk and G.A.

[17]Bachinsky consider cave spaces to be natural resources of a special type; V.P. Korzhik considers their individual components (rock, atmosphere, water, biota) as specific types of natural resources. The data presented indicate that they cannot be fully correlated with any of the types of resources identified by N. F. Reimers. Cave spaces are integral resources. Their individual types (capacitive, gaseous, liquid, solid) in different combinations are part of the general resources: natural (spatial, energy, lithosphere, hydrosphere, atmosphere, biosphere), labor (medicinal, cognitive-informational, cultural, recreational-aesthetic) and material (construction, communication). A resource approach to cave spaces requires the development of proposals and standards for their assessment, rational use and protection.

The presence of underground spaces complicates the engineering and construction development of the territory. If in the 50s. XX century It was believed that natural and artificial cavities affect the stability of the territory at a depth of up to 20 m, then this limit began to increase rapidly. Currently, cases of their negative influence are known at depths of 100-400 (Moscow region, the Urals, certain states of the USA), and in some places (Germany, China) - even up to 800-1000 m. This forces us to take a new approach to geological and economic assessment of territories where there are caves and artificial workings.

■ Location - nuclear power plant,

- oil and gas storage facilities,
- radioactive waste repositories,
- Wastewater.

Lecture No. 18, (2 hours).

Payment for environmental pollution and use of natural resources.

Formation of an effective mechanism for interaction between enterprises and authorities in solving environmental problems. An analysis of the ways of using environmental payments received by the budget made it possible to identify its features, significant shortcomings and draw a conclusion about the need for changes in the system of rational environmental management. One of the functions of the economic mechanism is identified and analyzed, which is stimulating in nature and is aimed at ensuring the interest of both enterprises that have a negative impact on the environment and environmental legislation. The place and role of environmental payments in the system of economic opportunities to stimulate rational environmental management are determined. Environmental payments are considered as a tool for increasing the efficiency of environmental management. The need to improve this tool through the development of a number of economic and organizational measures is substantiated, with the help of which it will be possible to achieve specific results in solving the problem of environmental management.

Human development is determined by a significant impact on the environment, 17 its pollution and depletion of natural resources in the process of continuous human activity. Irrational use will lead to disruption of the natural system, which will have a detrimental effect on current and future generations. To prevent deterioration of the environmental situation, it is necessary to develop new management methods that would ensure balanced socio-ecological and economic development of society and rational use of natural resources.

One of the important conditions for limiting damage to the environment is payment for the use of natural resources, the main implementation mechanism of which is a system of environmental payments aimed at stimulating environmentally appropriate behavior of participants in economic relations and ensuring that the environmental component is taken into account in the economy.

The current payment system does not ensure the interest of entities in payments , and this leads to the need for authorities to develop a strategy in order to ensure increased interest in economic conditions and to conduct business activities taking into account the norms of rational environmental management.

In this regard, research in the field of improving the system of environmental payments aimed at stimulating rational environmental management is important and relevant.

The purpose of the study is to develop methods for increasing the efficiency of using funds received from environmental payments aimed at solving environmental problems; justification of the need for changes in the system of rational environmental management.

To achieve the goal, it is necessary to solve a number of main tasks:

- 17 analyze the existing mechanism for stimulating rational use of natural resources, identify its features and the most significant shortcomings;
- determine the place and role of environmental payments in the system of economic opportunities to stimulate rational environmental management;
- to specify the economic basis of environmental payments as a tool for increasing the efficiency of spending funds on environmental needs.

The object of study to solve the problems highlighted above is the system of environmental payments. The subject of the research is tools for increasing the efficiency of environmental management.

The predominant place in the system of economic instruments for rational environmental management is occupied by the economic assessment of environmental damage. This indicator is involved in the area of making, preparing and developing management decisions.

The existence of the natural resource potential of a country or region plays a significant role in socio-economic development. Often this influence is negative. To avoid undesirable consequences and achieve growth in economic development, it is necessary to create an environmental management policy that will be based on the principles of sustainable development.

The concept of the economic mechanism, its role in stimulating rational environmental management and the main components

The main condition for sustainable development should be the formation of a new economic mechanism for rational environmental management, which will not have a negative impact on the use of natural resources and will ensure sustainable socio-economic development.

The economic mechanism is a system of economic measures to ensure the reasonable use of resources and environmental protection, provided for by regulatory legal acts.

The main elements of the economic mechanism for stimulating rational environmental management can be identified:

- economic incentive measures (subsidies and government subsidies, tax credits and preferential loans, accelerated depreciation of energy-saving and treatment equipment, strengthening the environmental insurance system and the creation of compensation funds, the introduction of market regulators, such as the sale of rights to trade resources);
- planning for rational use of natural resources and environmental protection (assessing the sustainability of natural resource potential, combining into a single set of natural and economic interaction criteria for a more balanced use of the natural resource potential of the regions);
- financing of environmental organizations;
- environmental insurance.

The main task of the economic mechanism in environmental law is to perform all functions in this area. One of these functions is economic support for rational use

17 of natural resources and environmental protection, the implementation of which is possible subject to a consistent series of all economic measures included in the economic mechanism. This function of the economic mechanism should be stimulating in nature and be implemented in such a way as to ensure the interest of both enterprises and environmental legislation.

There are many economic measures in environmental legislation, but only some of them are considered - those that play a stimulating role. They include: 1) payments for causing a negative impact on the environment and for the use of subsoil, lands , waters, and other natural resources; 2) credit and tax benefits, incentive measures in the field of environmental protection.

Due to the lack of a coordinated incentive system to increase the total development of natural resources, the efficiency of the economic mechanism for using resources in many industries is reduced.

The command-administrative method of managing the national economy, used for a long time, was aimed at increasing production, which was of an exploitative nature, the use of areas for agricultural activities, and mining.

The system of fines for environmental pollution did not stimulate measures to protect nature, and the levers for optimizing the use of natural resources were also ineffective. Thus, the responsibility of enterprises for the results of their activities and economic levers were not included to the required extent in the sphere of environmental management.

Analysis of a tool for improving environmental management efficiency

General instruments of economic regulation and methods in the field of rational environmental management are contained in the Law “On Environmental Protection”.

The instruments of economic regulation, according to the Law “On Environmental Protection”, in the field of rational environmental management include:

- planning for rational use of natural resources and environmental protection;
- carrying out and developing environmental protection measures;
- establishing payments for negative environmental impact;
- establishing restrictions on the disposal of production waste, as well as on emissions and discharges of pollutants;
- conducting an economic assessment of the impact of economic and other activities on the environment;
- provision of tax and other benefits for the implementation of modernized treatment facilities ;
- compensation in accordance with the established procedure for environmental damage and other methods of economic regulation for efficient use of natural resources.

In order to truly understand and identify the role of economic tools for increasing the efficiency of environmental management, it is necessary to analyze one of its components.

17 In this article, preference was given to the analysis of an instrument - environmental payments , or the establishment of fees for negative impacts on the environment.

Payment for environmental pollution is a way of compensating for the harm that occurs during economic activity due to the negative impact on the environment.

Environmental payments are collected from natural resource users who carry out the following types of negative impact on the environment:

- waste disposal;
- discharge of pollutants into surface and ground waters;
- release of pollutants into the atmosphere from stationary and mobile sources;
- pollution of subsoil and soil;
- environmental pollution by heat, noise and other types of physical influences.

This tool for increasing the efficiency of environmental management cannot be called perfect , and enterprises will not use it if it is not profitable for them. After all, the system of payments for negative impact on the environment does not provide profit to enterprises, except for the disposal of waste that was obtained in the process of treating wastewater and gases released into the atmosphere .

Therefore, it is necessary to eliminate shortcomings in order to change the economic mechanism of environmental protection and strengthen the influence of environmental law on the economic activities of enterprises. What exactly should be done to eliminate the shortcomings of this tool for increasing the efficiency of environmental management:

1. To fully develop a system of state and non-state environmental control, which will make it possible to determine the real volume of negative impact on the environment of a particular business entity.
2. Develop basic legal standards for payments for certain types of impacts from - physical factors (vibration, electromagnetic and radiation impacts, noise) and biological impacts.
3. Increase the number of chemicals for which basic payment standards will be established.
4. Introduce accounting of the integral impact of pollutants, including those emitted by various enterprises.
5. Bring into compliance existing payment standards and the necessary costs for protecting the environment from various types of pollution, taking into account changes in macro- and microeconomic development indicators.

In other words, all tools for effective environmental management will have a positive effect when they are economically beneficial to an economic entity. To do this, it is necessary to fully utilize one of the main instruments of the system of economic incentives for rational environmental management - a reasonable and mandatory payment for negative impacts on the environment. The introduction of quite significant and affordable fees for the use of natural resources, which will stimulate not only the rational use of natural resources, but will also level out the socio-ecological and economic conditions of management, rationally allocate productive forces, and form funds for financing environmental protection measures.

Conclusion

Despite the importance and relevance of the study, today there are many unresolved problems and issues that require further development and research. At the present stage, the development of the legislative framework lags significantly behind the development of market and economic relations , which has an impact on the stimulation of rational environmental management.

But one should not make hasty negative conclusions, since over the course of several years a legislative framework has been being developed that will comply with economic measures to ensure the wise use of resources and environmental protection provided for by regulatory legal acts. People's consciousness and attitude towards the need to protect the environment is also changing.

Theoretical and practical approaches to the mechanism of environmental regulation of activities are analyzed. It was revealed that the main role in this mechanism belongs to environmental legislation, economic instruments for the protection of the environment and environmental regulation.

The areas of application of economic assessment of environmental damage in the development, adoption and preparation of business decisions are outlined.

The system of existing environmental payments for environmental pollution is analyzed . Its shortcomings are identified and ways of improvement are indicated.

A system of environmental payments is presented, which is aimed at stimulating the reduction of negative impacts on the environment, reducing emissions, and creating environmental funds for enterprises and territories.

Analyzing the practical application of the existing mechanism for managing rational environmental management, we can conclude that it is necessary to improve it through the development of a number of economic and organizational measures with the help of which it will be possible to achieve specific results in solving the problem of environmental management.

The essence of economic incentives for environmental protection activities lies in the emergence of interest among enterprises that have a negative impact on the environment in implementing environmental protection measures.

Drawing final conclusions, it should be noted that economic incentives for rational environmental management should be aimed at eliminating
causes of environmental pollution, rather than eliminating their consequences.
Economic
the costs associated with solving this problem are increasing.

RESOLUTION
CABINET OF MINISTERS OF THE REPUBLIC OF UZBEKISTAN
ON MEASURES TO FURTHER IMPROVE ECONOMIC MECHANISMS FOR ENSURING ENVIRONMENTAL PROTECTION

In accordance with the laws of the Republic of Uzbekistan “ On Nature Protection ”, “ On Atmospheric Air Protection ”, “ On Waste ”, as well as in order to further improve the economic mechanisms for ensuring environmental protection in the Republic of Uzbekistan, the Cabinet of Ministers decides:

1. Approve the Regulations on the procedure for applying compensation payments for environmental pollution and waste disposal on the territory of the Republic of Uzbekistan in accordance with Appendix No. 1 .

2. Establish that:

a) base rates of compensation payments for environmental pollution and waste disposal are accepted in coefficients of the established minimum wage;

b) compensation payments for environmental pollution and waste disposal on the territory of the Republic of Uzbekistan are collected by the bodies of the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection, with the exception of compensation payments for excess discharges of pollutants into municipal sewer networks and are distributed as follows:

74 percent - to the Fund for Ecology, Environmental Protection and Waste Management under the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection;

26 percent goes to the republican budget of the Republic of Uzbekistan.

c) compensation payments for environmental pollution and waste disposal on the territory of the Republic of Uzbekistan in terms of sewer discharges are collected by the Ministry of Housing and Communal Services of the Republic of Uzbekistan and distributed as follows:

74 percent - to the Housing and Communal Services Development Fund of the Ministry of Housing and Communal Services of the Republic of Uzbekistan;

26 percent goes to the republican budget of the Republic of Uzbekistan.

5. This resolution comes into force on January 1, 2019.

Prime Minister of the Republic of Uzbekistan A. ARIPOV

Tashkent,
October 11, 2018
No. 820

“STANDARDS
for maximum permissible concentrations of pollutants in discharges of industrial wastewater into municipal sewer networks

No.	Name of pollutants	Concentration (mg/l)
1.	Ammonia nitrogen	1
2.	Nitrate nitrogen	9.1
3.	Nitrite nitrogen	0.2
4.	Acetone	17.16
5.	Acetonitrile	1.5
6.	Beryllium	0.002
7.	BOD total, BOD 5	15
8.	Suspended solids	150.0
9.	Diethyl ether	2.0
10.	Fats	1.0
eleven.	Potassium	50.0
12.	Calcium	180.0
13.	Caprolactam	10.73
14.	Dye black	1.0

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15.	Xylene	1.0
16.	Magnesium	40.0
17.	Light tall oil	1.0
18.	Solar oil	1.0
19.	Methanol	1.0
20.	Molybdenum	1.0
21.	Urea (urea)	80.0
22.	Sodium	120.0
23.	Sodium thiosulfate	16
24.	Ammonium nitrate	10
25.	OFA (oxylated fatty acids)	3.9
26.	Rodanids	1.0
27.	Sulfur	10.0
28.	Carbon disulfide	2.0
29.	Turpentine	0.5
thirty.	surfactant	20.0
31.	Styrene	0.56
32.	Sulfates	100.0
33.	Corrosive sublimate	0.0001
34.	Antimony	0.2
35.	Dry residue (mineralization)	2000.0
36.	Tellurium (to background)	0.05
37.	Titanium	0.1
38.	Toluene	2.8
39.	Phosphates	2.5
40.	General phosphorus	3.0
41.	Fluorides (fluoride ion)	1.5
42.	Chlorides	350.0
43.	Cyclohexane	0.1

"

“LIST of particularly toxic pollutants

No.	Name of pollutants	Concentration (mg/l)
1.	Acrylic acid	0.05
2.	Aluminum	0.75
3.	Aniline	0.001
4.	Antio (toxic chemical)	0.05
5.	Benzene	1.0
6.	Butanol (normal)	1
7.	Butifos	0.0015
8.	Vanadium	0.1
9.	Bismuth (+3)	15.0
10.	Bismuth (+5)	15.0
eleven.	Tungsten	0.016
12.	DDT (technical)	0.02
13.	Dimethylformamide	0.5
14.	Iron (total)	0.03
15.	Cadmium	0.1
16.	Karbofos	0.02

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17.	Cobalt	0.1
18.	Silicon	0.1
19.	Copper	1.0
20.	Arsenic	0.1
21.	Oil and petroleum products	1.0
22.	Nickel	0.5
23.	Nitrobenzene	0.05
24.	Mercury	0.001
25.	Lead	0.1
26.	Selenium	0.01
27.	Strontium	18.0
28.	Acetic acid	0.01
29.	Phenol	0.05
thirty.	Fozalon	0.05
31.	Formaldehyde	0.6
32.	Furfural	2.0
33.	Chlorine (residual)	1.0
34.	Sodium chlorate	0.1
35.	Chlorobenzene	0.1
36.	Chrome (+3)	0.5
37.	Chrome (+6)	0.1
38.	Cyanide	0.64
39.	Zinc	1.0
40.	Ethylbenzene	0.5
41.	Ethylene	0.1

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2.	Fund for Ecology, Environmental Protection and Waste Management (State Committee of the Republic of Uzbekistan on Ecology and Environmental Protection)	Amounts of fines and funds collected for violation of environmental legislation, with the exception of fines and amounts of money collected for violations related to the use of objects of flora and fauna	74
		Compensation payments for environmental pollution	74

"

"3. The Fund's resources are generated from the following sources:

74 percent of the amount of compensation payments for environmental pollution and waste disposal;

74 percent of the amount of compensation payments for excess discharges of pollutants into municipal sewer networks of cities and towns;

74 percent of the amount of fines and funds collected from natural resource users for damage caused to the environment by emergency burst emissions (discharges, waste disposal) of pollutants;

40 percent of the amount of payments by natural resources users for excess and non-integrated use (losses) of natural resources and raw materials obtained from them;

18 40 percent of funds collected from natural resource users for compensation for damage caused to environmental objects as a result of economic and other activities;

74 percent of the amount of fines and sums of money collected in administrative and judicial proceedings from individuals and legal entities guilty of violating environmental legislation, with the exception of fines and sums of money collected for violations related to the use of objects of flora and fauna;

74 percent of the amount of fines and money collected in administrative and judicial proceedings for violations of environmental legislation and in order to compensate for damage caused to environmental objects from foreign citizens, as well as from legal entities of other states, with the exception of fines and money collected for violations related to the use of objects of flora and fauna;

74 percent of the amount of payments for cutting trees and shrubs outside the state forest fund;

funds for the equity participation of legal entities in the financing of joint environmental activities;

charitable donations from individuals and legal entities, including charitable organizations;

funds from environmental events and actions;

receipts from income from placement of temporarily free funds of the Fund on deposits of commercial banks of the Republic of Uzbekistan;

other sources not prohibited by law."

Topics of practical classes.

1. Legislation in the field of mining ecology
2.Calculation of a wellpoint installation for draining loose mineral waste dumps
3. Determination of the concentration of metals in rainwater infiltrating through dumps of substandard ores.
4. Calculation of the required degree of wastewater treatment before its discharge into natural reservoirs
5. Calculation of the dimensions of equipment for mechanical cleaning of waste water
6. Calculation of equipment for physical and chemical treatment of waste water
7.Calculation of equipment for disinfection of waste water
8.Assessment of environmental risks of mining production. Insurance of environmental risk of a mining enterprise.

18 9. Structure and objects of control in the system of industrial technological monitoring, justification of design decisions when locating mining facilities, environmental impact assessment (EIA).

Topics of laboratory classes.

1.Technical analysis of wastewater. Sedimentation of suspended particles in sand traps and settling tanks

2. Study of the effects of coagulants on wastewater and determination of their doses. Determination of the optimal operating mode of a mechanical aerator.

3. Study of the process of ion exchange purification of mineralized waters and determination of the exchange capacity of the ion exchanger.

4. Study of the desalination process by reverse osmosis.

5. Determination of the distribution coefficient during extraction wastewater treatment.

6.Determination of free and total chlorine in water using a calorimeter

7. Determination of the basic properties of sorbents. Study of the basic properties of sewage sludge

8. Determination of the plasticity of clays of clayey technogenic deposits and the magnitude of air and fire shrinkage of clays.

9. Study of the process of obtaining construction lime from carbonate mineral waste

Terminological dictionary

A

ABRASIA (from Latin abrasio - scraping) - process of destruction wave us surf surface and underwater (no deeper than 200 m, where wind waves are still active) shores reservoirs. Abrasion lowers and levels the coastline of seas, lakes, and reservoirs . The faster the winds and the more frequent the waves, or the weaker the rocks shores. As a result, abrasion banks are created : platforms or terraces inclined towards the water; underwater inclined bedrock surfaces - benches; surface ledges in hard rocks - cliffs ; niches; sometimes bays, caves and arches, for example, in Karadag (Crimea). The products of coastal destruction are carried

18 into the depths, where they are formed into talus rocks. terraces leaning against the lower part of the bench. In the surf zone on the surface of abrasive platforms Bulk beaches made of sand and pebbles are common, used in warm areas for recreation (recreational areas) .

ABRASIONAL (coastal) PLATFORM - a part of the coast that gently descends towards the ocean, sea or lake and gradually goes below their level. Formed during the process of abrasion. Areas of the abrasion platform devoid of sediment are called benches.

ABRASION TERRACE - a coastal area of abrasion origin gently inclined towards the sea or lake .

ABRASIONAL SHORE - the coast of oceans, seas, lakes and reservoirs, which is destroyed under the influence of waves or surf. The main forms of abrasion relief: an abrasion underwater slope or bench, a coastal ledge or cliff limiting the coastal terrace on the land side, and a wave-cut niche.

ABRIS (from German - adriv) - a schematic plan of the area, sketched when shooting in the field, indicating the measured distances and other data necessary for drawing up a plan or profile of the area.

ABSOLUTE HUMIDITY - the amount of water vapor contained in a unit volume of air, expressed in g/ ^{m3} .

ABSOLUTE AIR HUMIDITY (from the Latin absolutus - full) - the amount of water vapor, its density in the air, in g/ ^{m3} . It depends on the temperature regime and the transfer (advection) of moisture with oceanic by the masses air _ If in polar latitudes in winter the air contains from 0.1 to 1.0 g/m3 ^{of} water vapor, then in equatorial belt - often up to 30 g/ ^{m3} . In winter in Batumi, absolute humidity is 6.3 g/m3 , in Verkhoyansk - 0.1 g/ ^{m3} .

18**ABSOLUTE OR ISOTOPIC AGE OF ROCKS** (from Latin absolutus - complete) - the number of thousands and millions of years (geological age) from formation rock to the present day. It is determined by the accumulation of decay products of radioactive elements in rocks. Age of young people - quaternary - rocks are calculated by the decay of the 14th carbon isotope (C_{14}) in organic remains in loose strata (coal, wood, bones). The age of lake sediments is determined by simply counting annual pairs of layers: dark (summer) and light (winter) tones.

ABSORPTION (from Latin absorbeo - absorb) - volumetric absorption of gases or vapors by a liquid (absorbent) with the formation of a solution. In industry, it is carried out in devices called absorbers. The separation of gas mixtures and gas purification are based on absorption.

AVANDELTA - the underwater part of the delta, formed on the pre-estuary shoreline due to the accumulation of sedimentary material during the interaction of river waters and sea waves.

ACCIDENTAL RELEASE - the release of pollutants into the environment as a result of accidents or disruptions in the technological process.

ACCIDENT - a dangerous man-made incident that creates a threat to the life and health of people at an object, a certain territory or water area and leads to the destruction of buildings, structures, equipment and vehicles, disruption of the production or transport process, as well as damage to the natural environment.

AULACOGEN is an intraplatform linearly elongated depression of increased mobility, bounded by deep faults cutting through the foundation of the platform. Represents ancient flexural rifts. During development, the aulacogen is transformed either into syneclises or into intraplatform gently folded zones.

AUTOCATALYSIS is a change in the rate of a chemical reaction by one of the substances (catalyst) participating in this reaction.

AUTO-REGULATION IN NATURE - interaction in a natural system based on direct and feedback functional connections leading to dynamic equilibrium or self-development of the entire system. It is carried out on the principles of system management (Reimers, 1990).

AUTOTROPH (HELIOTROPH) - an organism that synthesizes organic substances from inorganic compounds using the energy of the Sun (heliotroph) or energy released during chemical reactions (chemotroph).

AUTOTROPHIC LAKE - a lake whose water provides the organisms living in it with nutrients formed in the reservoir itself.

AUTOCHON (from the Greek autochon - local, indigenous) - in geology: part of a folded structure that has not experienced significant horizontal movements under the tectonic covers thrust over it - allochthons.

AUTOCHORS - plants or fungi that spread without the influence of external factors: self-dispersal of seeds from a bursting fruit, simple falling under the influence of gravity, as well as when fruits and seeds ripen in the soil at some distance from the mother plant.

AUTOCHTONUS ORGANISM - an organism that arose and initially evolved in a given place (biotope); original, native, aborigine. Usually these organisms form the ancient core of any flora or fauna; they include mainly endemics. Examples: Australia (platypus, echidna, marsupials) and others.

AGGLOMERATION is the process of the actual merging of many cities and towns into a single urban settlement. This is a spatial, functionally unified grouping of urban-type settlements, constituting a general socio-economic and ecological system. According to the latest French census, Greater Paris is one of the largest agglomeration areas in Europe. Its

18area reaches 1200 km ^{2} , and the population in 2001 exceeded 11 million people. In Russia, about 40% of the urban population lives in 33 largest agglomerations. As a rule, it has negative environmental significance.

AGGLOMERATION OF SETTLEMENTS - (urban agglomeration) - a compact grouping of settlements united by intensive economic , labor and cultural ties. There are monocentric agglomerations of settlements formed around a large core city (suburbs, satellite cities, etc.: for example, the Moscow agglomeration), and polycentric agglomerations of settlements with several interconnected core cities and their suburban areas (for example , a cluster of cities in the Ruhr Basin of Germany).

AGGREGATE STATES OF MATTER - states of the same substance in different temperature and pressure ranges. Traditionally, states of aggregation are considered to be gaseous, liquid, and solid states, transitions between which are usually accompanied by abrupt changes in density, entropy, and other physical properties. As the temperature increases, the gas transforms into an ionized state - plasma, which is sometimes called the 4th state of aggregation. In physics, instead of the aggregate state of a substance, the concepts of liquid, gaseous and solid phases are more often used.

AGGRESSIVE WATER - water that has the ability to dissolve or destroy solid materials (metals, concrete) upon contact with them. The aggressiveness of waters containing sulfuric and nitric acids (acid rain) is especially high . All this causes great damage to various structures, vehicles, architectural monuments, and also has a negative impact on agricultural land, forests and aquatic ecosystems.

AGGRESSIVENESS is a set of ecological elements that characterize the relationship between competing individuals, between parasite and host, predator and prey. It is one of the most important natural mechanisms for the settlement of organisms, the formation of new communities, population regulation, etc. Intraspecific aggressiveness contributes to the formation of an ecological hierarchy and often manifests itself in the early phases of ontogenesis. For example, aggression of older chicks in many species of birds of prey (skuas, owls) leads to the death of younger ones.

AGROBIOGEOCENOSIS (agrobiogeocenosis) is an unstable ecosystem with an artificially created or depleted natural biotic community that produces agricultural products. Agrobiocenosis is not able to exist for a long time without human support.

AGROLANDSCAPE - a landscape, most of which is occupied by lands for agricultural use (arable land, hayfields, pastures, etc.).

AGROFORESTRY - a set of forestry measures aimed at improving the soil, hydrological and climatic conditions of the area, making it more favorable for farming. The main directions are steppe afforestation, cultivation of soil protection forest belts, sand consolidation, improvement of pastures, afforestation of heavily degraded lands.

AGROSPHERE is a part of the biosphere involved in agricultural use (i.e., occupied by agroecosystems). The agrosphere accounts for approximately 30% of the land, including about 10% occupied by arable land, and the rest by natural forage lands. This ratio varies in different areas of the world. The reserves for expanding the agrosphere have been exhausted; a further increase in the share of the agrosphere, especially through the destruction of forests, will inevitably aggravate the crisis situation on the planet. The agrosphere is also being destroyed under the influence of industry, especially energy and metallurgical complexes.

AGROCENOSIS (agrocenosis) - a biotic created for the purpose of obtaining agricultural products and regularly maintained by humans. community with low ecological reliability, but high yield (productivity) of one or more selected species (varieties, breeds, plants and animals).

AGROECOLOGY is a complex of sciences that studies the possibilities of agricultural use of land to obtain crop and livestock products while simultaneously preserving agricultural resources (soils, natural forage lands, hydrological characteristics of agricultural landscapes), biological diversity and protecting the ecological human environment and manufactured products from agricultural pollution. Agroecology emerged as a branch of ecology in the second half of the twentieth century. Agroecology has been developing especially rapidly in the last two decades due to the sharp deterioration of the environmental situation in the agricultural sector. Agroecology focuses on the agroecosystem - an autotrophic ecosystem, the main source of energy for which is the Sun. Solar energy is absorbed by producer plants and fixed in the crop yield or transmitted through food chains to consumers, the main of which are livestock, and to decomposers, primarily detritivorous animals living in the soil. By processing organic residues, they promote the activity of decomposer microorganisms, which replenish the supply of nutrients available to plant roots. Nitrogen-fixing bacteria play a major role in agroecosystems, of which the most important are species symbiotically associated with legumes, since when the soil is tilled with a plow, biological nitrogen fixation due to free-living bacteria is reduced by 4-5 times.

AGROECOSYSTEM is an ecological system that unites a site - territory (geographical landscape) occupied by an economy producing agricultural products. The agroecosystem includes: soils with their populations (animals, algae, fungi, bacteria); agrocenose fields; livestock; fragments of natural and semi-natural ecosystems (forests, natural feeding grounds, swamps, reservoirs); Human. Agroecosystems are very diverse and can differ in specialization (crop, livestock, complex) and in the amount of input of anthropogenic energy (extensive, compromise, intensive). There are both small aboriginal farms, where only manual labor and less often the muscular power of animals are used, as well as highly mechanized farms and cattle feeding complexes that consume a lot of anthropogenic energy.

ADAPTATION - 1) an evolutionary adaptation of organisms to environmental conditions, expressed in changes in their external and internal characteristics (biological adaptation); 2) any adaptation of an organ, function or organism to changing environmental conditions (physiological adaptation); 3) a set of reactions of a (living) system that maintain its functional stability when environmental conditions surrounding this system change (Reimers, 1990); 4) social adaptation of a person in a new environment for him (for example, migrants from a village to a city) (HES). We can also talk about adaptation of the geomorphological system.

ADVECTION - 1. In meteorology - horizontal movements of air masses from one region of the Earth to another; in oceanology - the transfer of water mass in the horizontal direction. Due to the rotation of the Earth, the dominant advection in the middle latitudes flows from west to east (in the northern hemisphere) and from east to west (in the southern hemisphere).

ADYRY - hilly and ridged foothills in the Fergana depression. These are merged and superimposed on each other alluvial cones, strongly dissected by potholes of temporary watercourses to a depth of 100-400 m. Adyrs are folded loess and clastic material carried down from mountain slopes proluvium . On the steep slopes they are bare, and on the flat and convex tops they are covered with semi-desert vegetation . _Elsewhere in Central Asia there are desert, eroded lands used for pastures.

ADSORBENTS - solid or liquid substances that have a large specific microporous surface (up to several hundred m ^{2}/g), on which accumulation (adsorption) of harmful components

19 of industrial gases, waste water, etc. occurs. Solid adsorbents are activated carbon, alumina, zeolites , aluminosilicates, silica gel. Along with active carbons, coconut shells, fruit seeds and other substances of natural origin are used to produce carbon sorbents.

ATMOSPHERIC INVERSION (TEMPERATURE, GAS) -the displacement of cooled layers of air (gases) downwards and their accumulation under layers of warm air (this is facilitated by basins, valleys and other negative forms of relief), which leads to a decrease in the dispersion of pollutants and an increase in their concentration in the surface part of the atmosphere.

ADSORPTION - absorption of a substance from a gaseous or liquid medium by the surface of a solid or liquid, occurring under the influence of molecular forces. A distinction is made between physical adsorption, when molecules retain their individuality, and chemisorption, where the formation of new chemical compounds. The method is used in industry to capture hazardous production waste, to purify gases from organic vapors, volatile solvents, sulfur dioxide, etc.

AZIMUT - the angle between the plane of the geographic meridian of a given area and a line drawn from the observer to a certain point. It is counted clockwise and defined in degrees.

AZONAL VEGETATION - vegetation that does not form an independent zone, occurring as an inclusion in the environment of zonal vegetation. The concept of azonal vegetation is close to the concept of intrazonal vegetation.

AZONALITY - the distribution of any natural phenomenon without connection with the zonal features of a given territory. Azonality is one of the most important formations of regional natural complexes, including ecosystems . Azonality is associated with the geological structure, tectonic regime, lithological features, the nature of the relief and other factors. A type of azonality is intrazonality.

ACARICIDES are chemical substances from the group of pesticides used to kill harmful mites.

AQUACULTURE (from Latin agua - water and culture - cultivation, care) - purposeful breeding of beneficial organisms in the aquatic environment to obtain biological products. Aquacultures are divided into limnoculture (in fresh water bodies) and mariculture (in seas and oceans).

AQUATORIA - a body of water limited by natural, artificial or conditional boundaries (Water Code of the Russian Federation).

ACCLIMATIZATION is the adaptation of organisms to new conditions of existence, to new biocenoses. Acclimatization can be natural (as a result of migration of animals, transfer of plant seeds, etc.) and artificial (after the introduction of animals and plants). In relation to humans, acclimatization is adaptation to new climatic conditions.

ACCRETION (from Latin assretio - increment, entrainment) - the formation of the Solar system from a cloud of rarefied gas and dust. The globe arose from cold scattered matter (protoplanetary cloud) through condensation.

ACCUMULATIVE SHORE - the advancing shore of reservoirs, lakes, seas and oceans, formed as a result of the accumulation of sedimentary material above their level.

ACCUMULATION is the general name for the processes of accumulation on the earth's surface of terrigenous, volcanic, chemogenic and biogenic materials, from which sedimentary rocks are formed through diagenesis and catogenesis. Depending on the predominance of a particular geological factor, the following types of accumulation are distinguished: water, wind (ash), glacial, biogenic, anthropogenic, etc. Together with denudation, accumulation contributes to the growth of relief.

19**AXIOMATICS ECOLOGICAL** - a set of fundamental principles of ecology and environmental management. A figurative expression, since these are not axioms that do not require proof, but theorems that can be proven based on modern scientific data (Reimers, 1990).

ACTIVE TEMPERATURES (from Latin activus - active) - air temperatures exceeding +10°C on average per day. The sum of average annual active temperatures determines the possibility of growth of various cultivated and wild plants. For example, oranges cannot bear fruit if the sum of active temperatures is less than 7000° C , and larch grows at 800°C.

ACTIVATED SLUDGE is sludge formed during the biological treatment of wastewater in aeration plants and containing a huge number of microorganisms that intensively oxidize organic substances. All this significantly accelerates the processes of oxidation and wastewater treatment. Activated sludge (industrial waste) containing nutrients (nitrogen, phosphorus, potassium, magnesium) is sometimes used in agriculture as organic fertilizers. However, it is necessary to take into account a negative factor: sludge contains heavy metals (mercury, zinc, chromium, nickel, copper and others) in significant concentrations.

AXIOMATICS ECOLOGICAL - a set of fundamental principles of ecology and environmental management. A figurative expression, since these are not axioms that do not require proof, but theorems that can be proven based on modern scientific data. See Theorems of Ecology. Laws. Rules. Principles . (Reimers, 1990).

ACCESSORY MINERALS , accessory (from Latin assessorius - additional) - minerals included in the composition of rocks in small quantities (less than 1%). By origin, accessory minerals can be allogeneic or autogenous.

ALARMISM (from English alarmism - anxiety, fear) is a trend in Western science, whose representatives focus on the catastrophic consequences of human impact on nature, the lack of natural resources for the further development of humanity, the need to take immediate decisive measures to optimize the "nature-society" system. A distinction is made between environmental and economic alarmism (Reimers, 1990), i.e. ideas about the inevitability of a global environmental crisis due to unregulated growth of the planet's population, resource depletion, destruction of biological diversity and environmental pollution. The first consistent environmentalist-alarmist was J.B. Lamarck. At the beginning of the twentieth century, he warned humanity that it would die by destroying its own habitat. Modern alarmism is not so pessimistic; forecasts are not considered fatal: the crisis can be avoided if society's attitude towards nature changes. A striking example of alarmism is the reports of the Club of Rome compiled in the 70s. a group of scientists led by Aurelio Peccei. In the 90s, after the death of Peccei, in the forecasts of the Club of Rome, alarmism was largely overcome, which reflected successes in improving the environmental situation in developed countries (Japan, Germany, etc.).

ALAS (from Yakut - clearing, meadow, small plain in the middle of the taiga) - flat- - bottomed basin - final stage of development thermokarst, when it dries out lake sequentially framed first swamp, then wet and dry meadow. Valuable land, pasture, hayfield, arable land. Alas are widespread in Central Yakutia, North-East Russia, Canada and permafrost soils .

19**ALEVRY** T - sediment or loose sedimentary rock with a predominant grain size of 0.01 - 0.1 mm.

ALLELOPATHY (antibiosis) is a special case of amensalism, in which waste products of one organism are released into the external environment, poisoning it and making it unsuitable for the life of another. Allelopathy is common in plants, fungi, and bacteria.

ALLITIZATION is a type of chemical weathering of rocks characteristic of tropical and subtropical zones. It is characterized by the removal of wood chips, wood chips and earth elements, silica and the accumulation of aluminum, iron and titanium oxides. As a result of allitization, thick weathering crusts and allite soils are formed.

ALLOCHTON(S) - living organisms that are found in a given area, but arose beyond its borders. **An allochthonous organism** is alien to the biotope; a species or organism that has migrated or been transplanted from another territory.

ALLOCHORES - plants, fungi, rudiments that spread with the help of various external factors: wind (anemochory), water (hydrochory), animals (zoochory), etc.

ALBEDO (from Latin albus - light) - a value characterizing the reflectivity of any surface; is expressed by the ratio of radiation reflected by the surface to solar radiation received by the surface. For example, according to Snakin, the albedo of chernozem is 0.15; sand 0.3-0.4; the average albedo of the Earth is 0.39; Moon - 0.07.

ALDEHYDES - organic compounds containing the aldehyde group CHO ; for example, formaldehyde, vanillin. Used in the production of polymers as fragrant substances, etc.

ALPINE FOLDING - complex mountain building, volcanism and eruptions granitic magmas . It began at the end of the Mesozoic era, lasted throughout the Cenozoic (Paleogene, Neogene and Quaternary periods) and has not yet subsided now, as can be seen from the destructive earthquakes and volcanic eruptions . Alpine folding covers the Pacific ocean with him islands And beat with cuts continents. The second folding band passes latitudinal across the Mediterranean Sea to the Malacca Peninsula. Due to their relative youth, the mountains of the Alpine fold are distinguished by their steep slopes and the highest peaks in the world, both on land (the Himalayas) and on the bottom of the oceans. The name of this folding is established by the name of the Alps, where it was first explored. In mountain structures and foothill troughs numerous minerals , rich oil fields (Algeria, Iran, the Middle East, Ciscaucasia, Central Asia, India, Sakhalin and others).

ALPINE MEADOWS (from the name of the highest mountains in Europe) - short grass (10-15 cm) vegetation at the upper limit of its growth, mainly in oceanic and coastal areas longitudinal zones . Develop with short growing season with mandatory heavy snow cover in winter. IN sharp continental zones practically never occur. The grass cover is pressed to the ground, does not have a closed turf, and consists of brightly flowering (to attract pollinating insects) cushion-shaped rosettes, dicotyledons and sedge- grass plants. Used for pasture.

ALPINE BELT is a natural high-altitude zone, the landscapes of which are characteristic primarily of moist mountains of temperate and subtropical latitudes. The alpine belt is located above the subalpine belt, and at significant mountain heights it is replaced by the nival belt. The altitude position is determined by geographic latitude, slope exposure, and the degree of continental climate. Thus, in the Alps and Western Caucasus it is located at an altitude of 2200-3000 m, in the Himalayas - 3600-5000 m. A characteristic feature of the Alpine belt is treelessness and alpine vegetation.

ALPINE TYPE OF RELIEF - a type of relief in mountainous countries that have undergone intense glaciation. It is characterized by jagged ridges, deep dissection , an abundance of screes, and a wide distribution of glacial landforms.

19**ALTERNATIVE AGRICULTURAL SYSTEMS** - methods of producing agricultural products without the use of chemical plant protection products and mineral fertilizers (sometimes purified phosphorus fertilizers, such as Thomas slag, are used in small quantities), as well as without growth stimulants and other chemicals when keeping livestock. The basis of the alternative farming system is crop rotation with the participation of green manure and manure. Food products produced on environmentally friendly farms (usually dietary or baby food) are 2-4 times more expensive, and their quality is confirmed by a special certificate. In Germany, such a certificate can be obtained no earlier than five years after the complete cessation of the use of chemicals. The prospects for an alternative farming system are limited, since complete abandonment of fertilizers inevitably leads to lower yields. For this reason, farms using alternative farming systems do not play a significant role in agricultural production. Even in developed countries (Germany, USA), their share accounts for less than 1% of the total number of agricultural enterprises. The most promising compromise farming systems

ALPHA DIVERSITY - diversity of species (species richness), which is usually expressed by the number of plant and animal species per unit area in a certain standard sample within one community or habitat (elementary sample of biota, local level).

AMENSALISM is a form of interaction in which one population suppresses another, but does not itself experience a negative influence.

Anabiosis is a temporary complete suspension of the body's vital activity, associated with the onset of unfavorable conditions or with a special phase of individual development.

ANAEROBES - organisms that live in the absence of free oxygen.

ANDESITE (from German Andes - Andes) is an effusive rock of medium composition, represented mainly by volcanic glass and porphyry deposits of medium plagioclase and augite. An effusive analogue of diorite. Together with basalt, it forms the bulk of erupted rocks in areas of modern and ancient volcanism .

ANEMOPHILES (from the Greek anemos - wind + phileo - love) - wind-pollinated plants.

ANEMOPHYTES - plants that prefer habitats exposed to strong winds.

ANTICLINAL (from the Greek anti - against and kNpo - bend) - a form behind the laying (elongated fold) of rock layers with a convexity upward. The upper bend is called the lock, the slopes are called wings, and the inner, most ancient part is called the core of the anticline. Anticlines can be straight, inclined, overturned, recumbent, or box-shaped. They are widespread in mountainous countries and make searching easier mineral . In oil and gas areas, oil and flammable gas, being lighter, are concentrated in cores near the castle.

Прямая антиклинальная складка

ANTHROPOS... - (from the Greek anthropos - person), - part of complex words meaning relating to a person (for example, anthropology).

ANTHROPOGENIC LOAD - the degree of anthropogenic-technogenic impact on individual components of the natural environment or on the landscape as a whole. With rational environmental management, the anthropogenic load is regulated through environmental regulation to a level that is safe for ecosystems.

ANTHROPOGENIC ENVIRONMENT - the natural environment, directly or indirectly changed by human economic activity.

ANTHROPOGENIC SUCCESSION - succession caused by human economic activity, its direct or indirect influence on the ecosystem.

ANTHROPOGENIC ENERGY (in agroecosystems) - energy received by humans, as a rule, from exhaustible sources and spent on maintaining the composition and structure of the agroecosystem. Anthropogenic energy enters the agroecosystem in the form of bound energy already spent on the production of agricultural machinery, fertilizers, pesticides, fuel, etc. Direct costs of anthropogenic energy in agriculture are no more than 50% (including 35% for fuel) , the rest is indirect costs (30% for the production of agricultural machinery). However, even the highest investments of anthropogenic energy in the agroecosystem amount to no more than 1% of its energy budget, the basis of which is inexhaustible environmentally friendly solar energy.

ANTHROPOGENIC EROSION - destruction of rocks and soil by surface water and wind due to improper farming (improper cultivation of fields leads to powerful dust storms, etc.).

ANTHROPOGENIC IMPACT - the direct impact of human activity on the natural environment.

ANTHROPOGENIC CHANGES in nature - changes occurring in nature as a result of human economic activity.

ANTHROPOGENIC CHANGES IN THE LANDSCAPE - changes in the properties of the landscape under the influence of anthropogenic influences.

ANTHROPOGENIC LANDSCAPE - consisting of interacting natural and anthropogenic components formed under human activity and natural processes.

ANTHROPOGENIC FACTOR - the influence exerted by man and his activities on organisms, biogeocenoses, landscapes, the biosphere (as opposed to natural or natural factors), i.e. factor of human activity.

ANTHROPOGRAPHY - a school in socio-economic geography (mainly in population geography), which considers the place of human society in the complex of geographical phenomena and its interaction with the natural environment mainly from the standpoint of geographical determinism. The theory of anthropogeography was first outlined in the 19th century by the German geographer F. Ratzel. Subsequently it was used by the American school of environmentalism (HES).

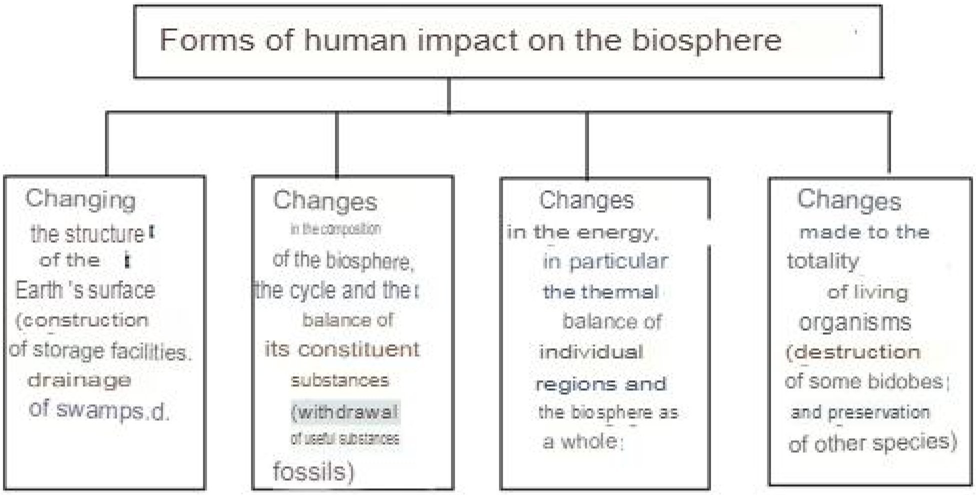
ANTHROPOSPHERE - 1) the term was proposed by D.N. Anuchin in 1902 to designate humanity as a unique geographical phenomenon. Anthroposphere (from Greek anthrohos - person) is a fairly convenient term for defining the sphere where a person plays a dominant role. However, in most dictionaries it is interpreted as a very narrow concept: a) the earthly sphere where humanity lives and where humanity temporarily penetrates; b) the sphere of the Earth and near space, which is directly or indirectly modified by man (EES); c) an integral part of the sociosphere, covering humanity as a set of organisms (HES); d) as a synonym for the sociosphere (Reimers, 1990): 2) "the anthroposphere is a stage in the evolution of the geographical shell, for the functioning, dynamics, development of which is characterized by a high role of human activity." "The modern anthroposphere is a global

19 natural and technical system. Processes arise in it that are uncharacteristic of the natural state of the geographic envelope” (Bokov, Seliverstov, Chsrvapev, 1998, pp. 230, 232). In this understanding, the anthroposphere includes the concepts of “sociosphere” and “technosphere” and is closest to the definition of “noosphere” given by V.I. Vernadsky; 3) anthroposphere - the current state of the biosphere, which began at least in the Quaternary (anthropogenic) period of the geological development of the Earth, which is characterized by the formation of a human ecosystem, consisting of the sociosphere and technosphere, and will certainly lead to the formation of noospheric space with the transition to the newest state of the biosphere - the noosphere .

ANTHROPOPHYTES are plants that grow in new, human-created conditions and have entered the local flora thanks to humans.

ANTHROPOCENTRISM (from the Greek antbropos - man, kentron - center) - the view that man is the center of the Universe and the ultimate goal of the entire universe.

ANTHROPOECOSYSTEM - 1) a functional spatial-natural system, consisting of a community of living organisms and their habitat (biotope), under intense influence of human activity (EES); 2) regional (global) sociosystem - a dynamic self-developing and self-regulating system “human society - nature”, the dynamic balance in which must be ensured by the public mind (Reimers, 1990): 3) the human ecosystem - his living environment, i.e. a type of ecological system where a person is the central element, and all other parameters of the ecosystem are considered as the environment surrounding him.



ANTHROPOGENIC LOAD - the degree of direct or indirect impact of man and his management on the surrounding nature or on its individual components and elements.

APOBIOSPHERE - high layers of the atmosphere (above 60-80 km), into which living organisms do not penetrate, and biological particles are mechanically introduced in limited quantities.

ARGILLITE (from the Greek argillos - clay and lithos stone) is a sedimentary rock, the basis of which is terrigenous particles less than 0.01 mm in size.

19**AREAL** (from Latin area - area, space) - territory or water area within the boundaries of which the objects or phenomena in question are distributed (area of a species, area of a landscape type, area of anthropogenic impact).

ARID CLIMATE - a dry climate with a low amount of precipitation, a negative moisture balance, and large daily and annual air temperature amplitudes.

ARID LANDSCAPE - a landscape formed in a dry, usually warm or even hot climate. Typical arid landscapes are deserts and semi-deserts.

ARCOSES - sands containing large amounts of potassium feldspar ; are formed mainly during the destruction of granites and gneisses. Cemented arkoses are called arkosic sandstones.

ARCTIC ANTICYCLONE - an area of high atmospheric pressure over the Siberian, Canadian, Greenland sectors of the Arctic. The existence of the Arctic anticyclone is due to very low air temperatures throughout almost the entire year.

ARCTIC BELT - a natural belt of the Earth, including most of the Arctic. It is characterized by negative or small positive values of the radiation balance, the dominance of Arctic air masses, a long-lasting polar night, and low temperatures of air and surface ocean waters.

ARTEBIOSPHERE - a layer of near-Earth space in which artificial Earth satellites fly.

ARTESIAN WATER - pressure formation underground water, enclosed between aquifer layers. When there is excess hydrostatic pressure, they pour out to the surface or gush out. Large accumulations of artesian waters are confined to the so-called artesian basins, which in most cases are huge mounds or troughs, tens, hundreds and even a few thousand kilometers in diameter.

ARTESIN BASIN - a pool of groundwater confined to negative geological structures containing pressurized formation water. There are platform and intermountain artesian basins.

ARCHIPELAGO - a group of islands lying at a short distance from each other, most often having the same origin and more or less similar geological structure. There are archipelagos of volcanic, coral and continental origin.

ARCHITECTURE - 1) architecture - the scientific branch and art of designing and constructing structures and their complexes in accordance with their purpose, modern - technical capabilities, aesthetic and environmental views of society: 2) buildings and other structures, as well as organized spaces in a certain way (gardens and parks), connected into regular complexes and creating a materially organized environment for people’s lives and activities (Reimers, 1990).

ASYMMETRY OF RELIEF FORMS (from the Greek asymmetria - disproportionality) - difference in structure, angles of inclination and length slopes oppositely located in the same mountain range or hills _ The reasons for the phenomenon tions are varied: 1. Various rocks exposed on the surface have different slopes _ Basalts, granites, metamorphosed rocks always have steeper slopes than the surrounding ones sedimentary _ 2. For continental regions it matters slope exposure relative to solar illumination (solar asymmetry). So, slopes southern exposure, experiencing sharp daily temperature fluctuations, faster weathered and become cool. The shady slopes, having high humidity, become longer and flatter. 3. Obliquely lying layers rocks create mountain cuestas (Timan, North Caucasus and others), that is, more flat slopes correspond to the plane of inclined layers. 4. As a rule, the starboard side is mostly large valleys in the northern hemisphere it is steep and short, and the left one is long and terraced, while in the southern hemisphere the left one is steeper than the right one. This is due to the undermining effect of the flow deflected by the Earth's rotation.

ASSIMILATORY CAPACITY OF A WATER BODY - the ability of a water body to accept a certain mass of pollutants (also a certain amount of heat) per unit of time without violating water quality standards at a control point or water use point.

ASSIMILATION CAPACITY of an ecosystem is an indicator of the maximum dynamic capacity of the amount of pollutant that can be accumulated, destroyed, transformed and removed outside the ecosystem per unit of time without disrupting its normal activity. The magnitude of the assimilation capacity depends on many natural and anthropogenic factors, physical and chemical properties of the pollutant; however, biological processes play a decisive role. For example, in a practical assessment of the assimilation capacity of the ocean, 3 main processes can be distinguished: hydrodynamics, microbiological oxidation of organic pollutants, and biosedimentation. The term was proposed by Yu.A. Israel (Snakin).

ASSIMILATION , anabolism - the absorption by organisms of nutrients coming from the external environment.

ASTHENOSPHERE (weak sphere) - a viscous, plastic, often molten layer with a reduced speed of seismic waves, located in the upper mantle of the Earth. The upper boundary is usually located under the continents at a depth of 100 km (on platforms and shields - 150-200 km and deeper), under the ocean floor - at about 50 km, in the rifts of mid-ocean ridges - at 2-3 km. The asthenosphere is the main source of magma; crustal masses move in it.

ATMOSPHERE (from the Greek atmos - vapor and sphere - shell) - a continuous air shell of the Earth, consisting of a mixture of gases, water vapor and dust particles. At the Earth's surface, this mixture of gases consists of: nitrogen (78.08%), oxygen (20.95%), argon (0.95%), carbon dioxide (0.03%) and other gases. The upper boundary is at an altitude of 1300 km, above which the atmosphere passes into outer space. The atmosphere consists of concentric layers that differ in their characteristics - the troposphere, stratosphere, mesosphere, thermosphere, exosphere and magnetosphere. In the lowest layer, the troposphere, air temperature decreases with height; the average vertical temperature gradient is 0.6°C/100 m. Above the troposphere, a drop in temperature with height is replaced by an increase. The troposphere contains 4/5 of the total air mass of the atmosphere and almost all the water vapor. It interacts with the underlying shells of the Earth. Most of the geological problems related to the atmosphere are concentrated in the troposphere, especially at its lower boundary.

ATMOSPHERIC PRESSURE (from the Greek atmos - steam) - the weight of a column of air from its upper limit to the earth's surface or ground objects at a given altitude level. Weight of 1 liter of air per level World Ocean - about 1.3 g, and its pressure reaches 1033 g/ $^{\mathrm{cm2}}$. At the level seas at latitude 45° at a temperature of 0° C, atmospheric pressure is equal to the weight of a column of mercury of 760 mm or 1013 mblr, which is accepted as the normal pressure of the globe. With an increase in altitude for every 10 m, atmospheric pressure decreases by 1 mm or 1.3 mlbr, which is measured barometer _ Pressure depends on changes in temperature, and therefore on the time of day, on changes in one or another air masses (cyclones decrease, and anticyclones increase).

ATMOSPHERIC PRECIPITATION - liquid and solid water falling from clouds as a result of condensation of vapors rising mainly from oceans and seas (evaporated water from land makes up about 10% of precipitation).

ATMOSPHERIC FRONT - zone of separation of various air masses V troposphere , for example, arctic And polar air . Its width reaches several tens of kilometers with a height of hundreds of meters and a length of sometimes thousands of kilometers with a slight slope to the Earth's surface (up to 1°). An atmospheric front passing through a given area sharply changes weather

ATOLL - ring-shaped coral island in the form of a narrow ridge, surrounding or semi-surrounding a shallow lagoon (no deeper than 100 m). This coral structure sometimes reaches 2000 m in thickness (A. Bikini) in tropical latitudes Indian and Pacific oceans. It gradually increases uplands ocean floor and often on extinct volcanoes _ Atolls can reach 50 km in depth at a height of up to 4-5 m above water level, and their clusters along the coast form barrier reefs _

ATTRACTANTS - substances that attract animals; They are divided into natural (for example, pheromones) and synthetic.

ATTRACTIVENESS OF THE ENVIRONMENT (from the Latin attraho - attract to myself) - a set of properties and characteristics of the environment, due to which living

19organisms show preference for one or another habitat when searching for food , a place for reproduction, shelter, or several purposes at the same time (Snakin, 2001).

AUTOGENIC MINERALS - minerals formed in sediment or by **crystallization** from solution at the stage of sedimentogenesis, as well as during diagenesis and epigenesis in the process of transforming sediment into rock.

AUTECOLOGY (from the Greek autos - self + ecology) is a section of ecology that studies the relationship of an individual, population, species with the environment. The main task is to identify the physiological, morphological and other adaptations of the species to various abiotic factors (temperature, moisture regime, soil salinity, etc.). Many principles of autecology are used in agricultural practice (when choosing plant varieties and animal breeds), in forestry, and in the field of protection of rare and endangered species of plants and animals .

APHOTIC ZONE (region) - an area of the ocean whose illumination is insufficient for plant photosynthesis. The upper limit is defined as an illumination level equal to 1% of the ocean surface illumination.

APHOTOSPHERE is the area of development of life without sunlight. In the ocean it corresponds to the aphotic zone; in the lithobiosphere it occupies its entire thickness.

A C IDIFICATION OF C IYA (soils, natural waters) (from Latin acidus - sour and facere - do) - increase in acidity (decrease in the value of the hydrogen index - pH) of natural components (water, soil); occurs due to the use of physiologically acidic mineral fertilizers and acidic precipitation (Snakin).

ACIDOPHILES - plants that live on soils with pH <6.7.

AEROBES - organisms that can live only in an oxygen environment (animals , plants, some bacteria and fungi).

AEROSOL is a gaseous medium with solid or liquid particles suspended in it . Aerosols include smoke and mists. Aerosols are the most dangerous elements of chemical pollution of the atmosphere. Typically, aerosol particle sizes range from 0.001 to 1000 microns. The most dangerous particles for human lungs are particles from 0.5 to 5 microns; larger ones are retained in the nasal cavity, and smaller ones do not settle in the respiratory tract and are exhaled. Among aerosols, dusts (solid particles suspended in a gaseous medium), smokes (gas condensation products) and fogs (liquid particles in the air) are distinguished. Currently, at least 20 million tons of particles are suspended in the atmosphere, approximately 3/4 of which are emissions from industrial enterprises. Natural sources of aerosols include volcanoes, geysers, collapsing rocks, dust storms, soil erosion and fires.

AIR TAXATION (from the Greek aer - air and Latin taxatio - assessment) - qualitative and quantitative assessment of natural resources (mainly forests) from aircraft by their visual determination or analysis of aerial photographs. In intensive farming, the same production scheme is maintained as in a compromise farm, but the doses of mineral fertilizers are sharply increased, watering and the use of pesticides in high doses are possible. Crop rotations are simplified to two or three links and do not include green manure or monoculture is used. With increasing anthropogenic energy inputs, the risk of soil destruction increases. Unlike natural ecosystems, agroecosystems are more open, and from them there is an outflow of matter and energy with crops, livestock products, and also as a result of soil destruction (degumification and soil erosion). To compensate for these losses and control the composition of the agroecosystem (regulating the density of populations of weeds, insect pests, etc.), people introduce additional nutrients into the agroecosystem (nitrogen, phosphorus and potassium fertilizers) and spend energy on the production, transportation and application of mineral and organic fertilizers and pesticides, production and repair of agricultural machinery, fuel, etc. However, the amount of anthropogenic energy even in the most energy-rich farms is less than 1% of the solar energy, which is recorded by the plants of the agroecosystem. In the second

20 case, the main condition for ensuring sestaining is environmental optimization of the structure of the agroecosystem. The main task of agroecology is to activate the biological potential of agroecosystems and their constituent elements at all levels (from an individual plant and animal to the entire agroecosystem) and to replace a significant part of anthropogenic energy with the internal energy of biological processes.

AEROTANK (syn. aeration unit) is an artificial structure in the form of a flow-through tank for the biological treatment of wastewater from organic compounds by oxidizing them with microorganisms. Aerotanks are open reservoirs through which aerated wastewater mixed with activated sludge flows slowly.

AEROPHYTES - plants that require well-aerated soil; or when all the organs are in the air; plants that receive basic nutrients from atmospheric air (some epiphytes from orchids and bromeliads, some lichens and others), living mainly on trunks

AGE COMPOSITION OF A POPULATION - the ratio of individuals of different ages in a population. A rapidly growing population usually has a large proportion of juveniles, while a declining population usually has a large proportion of adults and aging individuals; is the most important characteristic of a population of plants and animals, including humans.

ANTHROPOGENIC LANDSCAPE - a geographical landscape created as a result of purposeful human activity, or that arose as a result of an unintentional change in the natural landscape. Anthropogenic landscapes include natural production complexes, urban settlements, etc. Currently, anthropogenic landscapes occupy about half of the land area.

ALPINE MEADOW, a meadow characteristic of mountainous countries, dominated by low perennials (15 - 16 cm) with large bright flowers. The most common are sedge-grass meadows and alpine "carpets" dominated by dicotyledons. Used as pastures.

AVERAGE DAILY MAXIMUM ALLOWABLE CONCENTRATION (MAC_{ss}) is the concentration of a pollutant in the air that does not have a direct or indirect harmful effect on humans when inhaled around the clock.

ACID RAIN - formed by industrial emissions of sulfur dioxide and nitrogen oxides into the atmosphere, which combine with atmospheric moisture and form sulfuric and nitric acids. As a result, rain and snow become acidified (pH number below 5.6).

ABSORPTION DOSE - the energy of any type of radiation absorbed per unit mass of the irradiated medium. It is measured in rads, and for living tissue - in rem (biological equivalents of x-rays).

ASSESSMENT OF (HUMAN) ENVIRONMENTAL IMPACT -activities aimed at determining and predicting the results of interference or intrusion into the biogeophysical environment and the associated impact on human health and well-being by human society with its legislation, policies, technical programs, projects and developments, as well as information synthesis and dissemination activities about human impact on the environment.

AIR CLEANING - removing foreign impurities from the air and bringing its quality to natural using physical and chemical methods.

ANTHROPOGENIC POLLUTION - pollution resulting from human economic activities.

B

BASEPHYLES are organisms that live on alkaline soils. Most steppe and desert plant species are included.

BACTERIOPHAGE is a virus that infects bacterial cells. Most often, bacteriophages multiply inside bacteria and cause their lysis. Typically, a bacteriophage consists of a protein coat and single- or double-stranded nucleic acid (DNA or, less commonly, RNA) genetic material . The particle size is approximately 20 to 200 nm.

BACTERICIDE is a chemical substance of organic origin that kills bacteria. Inorganic synthesized substances

20(*sublimate, formalin* , etc.) with the same effect are called antiseptics.

BASIC MONITORING (BACKGROUND) - a system for monitoring the state and forecasting possible changes in general biosphere, mainly natural, phenomena without imposing regional anthropogenic influences.

BIOTIC EXCHANGE CIRCLE SMALL (BIOGEOCENOTICHIC) - multiple non-stop, cyclical, but uneven in time and open circulation of part of the substances, energy and information included in the biosphere circle of exchange, within the limits of an elementary ecological system - biogeocenosis. The degree of material isolation of the K.b.o.m.(b.) is very significant (for phosphorus, for example, globally about 98%, in the taiga - 99.5%). In agrocenoses, this indicator drops sharply (for phosphorus, from 1900 to 1980, it fell from 80 to 39%), which leads to eutrophication of water bodies and other adverse consequences.

BIOSPHERE RESERVE is a representative landscape unit allocated in accordance with the UNESCO Man and the Biosphere program for the purpose of its conservation, research (and/or monitoring). It may include ecosystems that are completely untouched by economic activity or little changed, often surrounded by exploited lands. As an exception, the allocation of territories of ancient development is allowed. The representativeness (representativeness, specificity, and not uniqueness) of these territories is especially emphasized.

BIOLOGICAL CLEANING - neutralization of waste using biological objects (by passing through thickets of aquatic plants, activated sludge, sawdust, etc.).

BENTHAL (from Greek *benthos* - depth) - the bottom of a reservoir, populated by organisms living on the ground or in its thickness.

BENTHOS is a collection of organisms living at the bottom of a reservoir.

BETA DIVERSITY is an indicator that measures the degree of differentiation of species in animals or plants along habitat gradients. For example, the rate of change in floristic composition of phytocenosis along spatial and environmental gradients of the landscape .

BIOGAS is a mixture of gases in which methane (55-65%) and dioxide predominate carbon (35-45%). B. is formed during the anaerobic decomposition of manure, straw and other organic waste. As a source of energy, biomass is obtained in special installations (digester x), in which the biomass of residues of crop and livestock products, manure, feces, etc. is fermented. A ton of manure subjected to fermentation produces 500 ^{m3} of biomass, which is equivalent to 350 liters of gasoline.

BIOGENIC MATTER - these are geological rocks created due to the vital activity of living organisms: coal, limestone

BIOGENIC ELEMENTS - (biogens) - chemical elements that are certainly included in the composition of living organisms.

BIOGEOGRAPHICAL REGION - a large floristic and faunal division of the globe, distinguished by Ch. arr. according to the general historical and evolutionary development of fauna and flora. As a rule, within the region. flora and fauna are characterized by a high degree of homogeneity. When moving from one region. On the other hand, there is a sharp shift in the taxonomic composition at the level of genera and families.

BIOGEOCHEMICAL CYCLES - biogeochemical circulation of substances, the exchange of matter and energy between various components of the biosphere, caused by the vital activity of organisms and having a cyclical nature. All B.c. are interconnected and form the dynamic basis for the existence of life. Flows of solar energy and the activity of living matter serve as the driving forces of the biological center, which leads to the movement of chemical elements. The central place in the biosphere is occupied by biogeochemical cycles: carbon, water, nitrogen and phosphorus.

The spatial movement of substances within geospheres, or their migration, is divided into five main types:

1. Mechanical transfer (occurs without changing the chemical composition of substances).
2. Aqueous (migration is carried out due to the dissolution of substances and their subsequent movement in the form of ions or colloids). This is one of the most important types of movement of substances in the biosphere.
3. Airborne (transfer of substances in the form of gases or aerosols with air currents).
4. Biogenic (transfer is carried out with the active participation of living organisms).
5. Technogenic, which manifests itself as a result of human economic activity.

BIOGEOCENOLOGY is the study of biogeocenoses or ecological systems. Biogeocenology originated in the depths of geobotany, but subsequently developed at the intersection of biological and geographical sciences, reflecting a comprehensive level of study of living nature. The founder of biogeocenology is Vladimir Nikolaevich Sukachev.

BIOINDICATOR - a group of individuals of certain species of plants and animals, by the presence, condition and behavior of which changes in the environment are judged, including the presence and concentration of pollutants.

BIO-INDEPENDENT SUBSTANCE is a substance created simultaneously by living organisms and inert processes and is a natural structure of living and inert matter. Examples of bioinert substances according to V.I. Vernadsky: soil, sea, river, lake water, oil, bitumen.

BIOLOGICAL PRODUCTIVITY is the increase in the biomass of organisms per unit area per unit time.

BIOLOGICAL RESOURCES - (B. r.) - living sources of obtaining material goods necessary for humans (food, raw materials for industry, material for breeding cultivated plants, farm animals and microorganisms, for recreational use). B. r. - the most important component of the human environment, these are plants, animals, fungi, algae, bacteria, as well as their combinations - communities and ecosystems (forests, meadows, aquatic ecosystems, swamps, etc.). To B. r. also include organisms that are cultivated by humans: cultivated plants, domestic animals, strains of bacteria and fungi used in industry and agriculture.

BIOLOGICAL RHYTHMS - periodically repeating changes in the intensity and nature of biological processes and phenomena.

BIOMASS - the amount of functioning living matter expressed in units of mass, the total mass of individuals of a species, group of species or community of organisms, usually expressed in units of mass of dry or wet matter, referred to units of area or volume of any habitat (kg/ha, g/ ^{m3}, kg/m3 , etc.). The biomass of consumers is isolated,

producers, reducers , etc. Land biomass is approximately 1012 1013 tons. There are phytomass, zoomass, and mass of microorganisms.

BIORHYTHM is an autonomous process of periodic alternation of fluctuations (daily, seasonal, etc.) in the intensity and nature of physiological processes and reactions occurring in living organisms; with their help, the body adapts to changing environmental conditions.

BIOTA (Greek *biote* - life) is a historically established set of living organisms, united by a common area of distribution, living in some large territory, isolated by any (for example, biogeographical) barriers. Unlike a biocenosis, the biota includes species that may not have ecological connections with each other.

BIOTIC RELATIONSHIPS - relationships between different organisms. They can be direct (direct impact) and indirect (mediated). Direct connections occur through the direct influence of one organism on another. Indirect connections are manifested through influence on the external environment or another species.

BIOTIC FACTORS - organisms (microorganisms, plants, animals and their communities) on each other or on the environment. All biotic connections in nature can be divided into a number of types, and each group of relationships plays an important role in nature. Biotic connections are divided into:

20 neutral - when none of the interacting species affects the other (neutrality 00);
- mutually beneficial for both species (symbiosis ++);
- mutually harmful - negatively affect both interacting species (competition - -);
- beneficial-harmful - one species is beneficial, while the other is suppressed (predation, parasitism + -);
- beneficial-neutral - one partner benefits, and the second suffers the effects (commensalism +0);
- harmful-neutral - one type is suppressed, and the second does not feel the impact (amensalism - 0).

BIOTECHNOLOGY is a scientific discipline and field of practice bordering between biology and technology that studies ways and methods of changing the natural environment around humans in accordance with their needs.

BIOTIC POTENTIAL - theoretically possible offspring from one pair of individuals **.** Usually, the higher the lower the level of organization of organisms, so yeast cells, given the conditions for realizing their biotic potential, could colonize the entire space of the globe in a few hours. Large organisms with low biotic potential would require several decades or centuries. The difference between the population size and the realized number of individuals in the population reflects the resistance of the environment. Concepts "B. P." and “medium resistance” are used when establishing the overall effect of limiting factors that determine the size and number of individuals in a population.

BIOTOP is a space occupied by a biocenosis that is relatively homogeneous in terms of abiotic environmental factors.

BIOCENOSIS is a collection of plants, fungi, animals and microorganisms that has a certain composition and an established nature of relationships both among themselves and with the environment. The term was introduced in German. biologist K. Mobius (1877).

BIOECOLOGY is a discipline that studies the relationship of organisms (individuals, populations, biocenoses) between themselves and the environment. The main forms of existence of species of animals, plants and microorganisms in their natural habitat are intraspecific groups (populations) or multi-species communities (biocenoses). Therefore, modern bioecology studies the relationships between organisms and the environment at the population-biocenotic level. The goal of bioecological research is to elucidate the ways in which a species persists in constantly changing environmental conditions.

BOGARA - lands in areas of irrigated agriculture, on which agricultural plants are cultivated without watering.

BONITET is an economically significant, usually comparative, natural characteristic (soil richness, wood yield per hectare, ease of extraction of mineral raw materials, etc.) of an economically valuable group of objects or lands, distinguishing it from other similar formations.

BIOLOGICAL OXYGEN CONSUMPTION (BOD) is an indicator of water pollution, characterized by the amount of oxygen consumed during exposure to the oxidation of chemical pollutants contained in a unit volume of water.

BIOLOGICAL POLLUTION - the introduction into the environment and the reproduction in it of organisms undesirable for humans. Accidental or occurring as a consequence of human activity, the penetration into ecosystems or technical devices of animal species (bacteria) and/or plants that are usually absent there.

C

CONDITIONALLY CLEAN WATER : 1) water that is uncontaminated above the established limit or in which, with the addition of clean water, the concentration of pollutants is brought to the level permitted by law; 2) wastewater, the discharge of which without treatment into a given water body does not lead to a violation of water quality standards in places of water use.

CADASTRE is a systematic collection of data, including a qualitative and quantitative inventory of objects or phenomena, in some cases with their economic (ecological, socio-economic) assessment. Contains their physical and geographical characteristics, classification, data on dynamics, degree of study and ecological, socio-economic assessment with the application of cartographic materials. May include recommendations for the use of objects or phenomena, proposals for protection measures, indications of the need for further research and other data.

State land cadastre - this is a state system of necessary information and documents about the legal regime of lands, their distribution among land owners, landowners, land users and tenants, categories of land, the qualitative characteristics and national economic value of lands.

CARCINOGEN - a factor whose exposure significantly increases the incidence of tumors (benign and/or malignant) in human and/or animal populations, and/or shortens the period of development of these tumors.

CLIMAX - the "final" phase of biogeocenotic succession, or the "final" successional stage of development of biogeocenoses for given living conditions (including anthropogenic ones, for example, "fire climax").

CLIMAX ECOSYSTEM - the final stage of ecological succession; an ecosystem in which populations of all organisms are in balance with each other and with abiotic factors.

CLONE - 1) a group of individuals in same-sex organisms that reproduce division, budding, fragmentation, etc., consisting of the offspring of one individual; 2) genetically homogeneous vegetative offspring of one individual.

COLI-INDEX - a quantitative indicator of bacteriological contamination of water and food products (mainly samples of fecal origin); determined by the number of coliform bacteria - *Escherichia coli* (hence the name) - in 1 liter or 1 kg of substrate. K. and. - an important criterion for sanitary and hygienic control. So, bathing water is considered clean if K. and. ranges from 0 to 10 (lightly polluted - from 11 to 100, polluted - from 101 to 1000, heavily polluted - from 1001 to 10000).

COMMENSALISM is a form of relationship in which one of the cohabiting species receives some benefit without bringing any harm or benefit to the other species . Attitude 0+. This connection is represented by the following types: "freeloading" , "lodging" , co-feeding."

CHLORINATION - treatment of drinking water or wastewater with chlorine for the purpose of disinfection. Since chlorination of drinking water in some cases leads to the formation of mutagen and carcinogen , it is replaced by ozonation .

CHEMICAL POLLUTION - pollution of the environment that is formed as a result of changes in its natural chemical properties or when chemical substances that are unusual for it enter the environment, as well as in concentrations exceeding the background (natural) average long-term fluctuations in the quantities of any substances for the period of time under consideration.

CLARK CHEMICAL ELEMENT -the content of a chemical element in the earth's crust, *lithosphere, hydrosphere, atmosphere, biosphere,* its living matter, the Earth as a whole, in various rocks, space objects, etc. Expressed in units of mass (percentage, g/t, etc.) or atomic percentage.

COMPOST is a fertilizer obtained as a result of microbial decomposition of organic substances, including from municipal waste.

CONVERGENCE is the emergence of similar external characteristics in species and biotic communities of different origins as a result of a similar lifestyle and adaptation to similar environmental conditions (for example, the body shape of a shark and a dolphin, the appearance of deciduous forests in the northern parts of Eurasia and North America).

COMPETITION is a type of biotic relationship in which individuals of the same or different species compete with each other in consuming the same, usually limited, resources. Resources can be of either food or another kind: the presence of places for breeding offspring, shelters, etc. There are intraspecific, interspecific, direct, and indirect K. Relationship by type.

CONSORTION (from Latin *consortium* - participation, partnership) - a set of heterogeneous organisms, closely related to each other and dependent on the central member, the core of the community (individual consortium: core - one individual; population consortium: core - population or species as a whole; sinusial consortium: core - species that make up one ecobiomorph, for example, mesophilic dark coniferous trees). The role of the central member of the family is usually played by the edificator species.

CONSUMERS (consumers) (from Latin *consumo* - consume) are organisms that process and rearrange organic matter and energy stored by plants. Primary, or first-order consumers, include all herbivorous organisms. Secondary, or second-order consumers, are carnivores (predators or parasites) that feed on herbivores and herbivores. Tertiaries or third-order consumers are carnivores that eat carnivores (for example, a hawk that eats a starling, which eats a frog).

CONTINUUM ecological (from Latin *continuum* - continuous), a continuous series of gradually, compared to sharp transitions, for example, from land to water, changing habitats of biological communities over vast geographical areas, environmental conditions that vary in the case of cold to warm, from aridity to humidity, from sharp seasonality of climate to its moderation, etc. The concept of climate can be used in studying the boundaries of ecosystems, ecological series, and the distribution of individuals within communities. The first idea about K. was given by L. G. Ramensky (1910).

COOPERATION (from Latin *cooperatio* - cooperation), a set of relationships between two species, from which both benefit. See also Symbiosis.

COPROPHAGE - an organism that feeds on the droppings of other animals (for example, dung beetles).

COSMOPOLITES (from the Greek *kosmopolites* - citizen of the world), species of animals, plants, distributed in almost all geographical zones (biotopes) of the Earth: cereals, some aquatic and marsh plants, many weeds, houseflies, freshwater crustaceans, gray rat, passerine birds, etc. K. usually include individuals with great adaptive abilities and high ecological valence.

CRYOPHILE - an organism that lives in melt water on the surface of ice or snow, as well as in water that permeates sea ice. Massive growth of algae stains snow (eg “red snow”) or ice.

CRYOFITE is a cold-resistant plant of dry habitats. They form the basis of the vegetation cover of tundras and alpine meadows.

CRYPTOPHYTE is a perennial herbaceous plant, the terrestrial organs of which die off during an unfavorable growing season, and renewal buds are formed on rhizomes, tubers, bulbs and lie deep in the ground (geophytes) or under water (hydrophytes).

CIRCLE OF BIOTIC EXCHANGE LARGE (BIOSPHERIC) -
a non-stop planetary process of a natural cyclical, uneven in time and space redistribution of matter, energy and information, repeatedly entering (except for the unidirectional flow of energy) into continuously renewed ecological biospheres.

D

DDT (dichlorodiphenyltrichloroethane) is one of the most environmentally hazardous insecticides. It is highly stable and concentrated from the environment by living organisms, accumulates in the tissues of the liver, kidneys and brain of mammals, including humans. DDT poses a danger to populations of birds of prey, it disrupts calcium metabolism, and eggs develop thin shells that break during incubation. The total amount of DDT circulating in the biosphere (mainly in the soil) is 280 thousand tons. Currently, the production and use of DDT is prohibited.

DEGRADATION (fr. *degradation* - stage) - a gradual decrease in complexity, energy potential and capacity of the system, practically irreversible in real time, gradual deterioration, loss of original qualities.

DISINFECTION - destruction of pathogens of infectious diseases of humans and domestic animals in the external environment by physical, chemical and biological methods.

DEMOGRAPHY (from Greek *demos* — people, *grapho* - I am writing) - the science of population and the patterns of its development.

DEMOGRAPHIC EXPLOSION - a sharp increase in the rate of population growth. D.v. Associated with socioeconomic conditions: increased food resources, energy, improved medical care, etc. Currently, D. c. occurs in developing countries in Africa, Asia and South America.

DEMOECOLOGY - ecology of populations; studies population dynamics, describes and establishes the reasons for fluctuations in the numbers of various species.

DENITRIFICATION is a stage of the nitrogen cycle in ecosystems , usually an aerobic process of microbiological destruction of nitrogen-containing compounds with the formation of molecular nitrogen, which evaporates into the atmosphere. The process is ensured by a group of soil and water bacteria.

DESTRUCTOR (see decomposers) - an organism that, in the course of its life activity, converts organic residues into inorganic substances suitable for use by producers. They are heterotrophs . Mainly bacteria and fungi.

DETRITUS (from Latin *detritus* - worn out) - dead organic matter in an ecosystem, temporarily excluded from the biological cycle of nutrients. The retention time of detritus can be short (animal corpses and feces are processed by fly larvae in a few weeks, leaves in the forest for several months, tree trunks - for several years) or very long (humus, sapropel, peat, coal, oil) .

DETRITAL FOOD CHAIN - a food chain in which the organic matter of dead plants, animals, fungi or bacteria is consumed by detrital phages, which can become prey for predators. Thus, part of the nutrients contained in detritus returns to the cycle, bypassing the stage of decomposition to mineral compounds and their consumption by plants.

DETRITIFOGES (from lat. *detritus* - worn out and Greek. *phagos* - devouring) - various organisms that feed on dead organic matter - detrito m. D. are divided into reducer , or destructor (these are mainly bacteria and fungi), converting organic residues into inorganic substances available to plants. In the narrow sense, D. - animals that feed on dead tissues of plants and animals or excrement. D. that feed on the corpses of animals are called necrophages, or scavengers (for example, vultures, vultures). This group also includes some large invertebrates, for example, the necrophorus beetle, which is capable of burying the corpses of mice to a depth of 20 cm and laying eggs there so that the larvae can feed on the decomposing corpse of the animal.

DEFLATION - blowing and grinding of rocks with mineral particles brought by the wind, transfer of weathering products.

DEFOLIANT (from Latin *de* from, return and *folium* - leaf) - substance, causing plant leaves to fall off. Calcium cyanamide, magnesium chlorate , and so on are used as defoliants . Unlike herbicides, defoliants do not cause plant death or stunt growth.

DIVERGENCE (from Latin divergence) is the process of divergence of characteristics in initially close groups of organisms during evolution.

DIGRESSION - deterioration of the state of ecosystems under the influence of environmental factors or human activity. Digression can be endodynamic (for example, with biogenic salinization of the soil surface), anthropodynamic (with overgrazing of pastures) and exodynamic (with secondary salinization of the soil, prolonged flooding, etc.). The final phase of digression is kagacenosis, i.e. the destruction and disappearance of a given ecosystem.

DIP AZIMUTH - the angle between the geographic meridian and the projection of the line of fall of any geological body onto the horizontal plane.

DRAINAGE (fr. *drainage)* - natural or artificial removal of water from the surface of the earth or groundwater. Land often needs to drain groundwater or storm water to improve agricultural technology and construct buildings and structures.

DESERT is a type of landscape characterized by extremely unfavorable climatic conditions and sparse flora and fauna. P. are located in tropical, subtropical and temperate zones, as well as in the Arctic and Antarctic. The total area of the world's land is 31.4 million km ^{2}, or 22% of the total land area of the Earth. The biological productivity of P. is minimal. P.'s topography exhibits a complex combination of highlands, fine sandy island mountains with structural river valleys and closed lake depressions. For the most part, the territory of Petrograd is drainless; sometimes it is crossed by transit rivers (Nile, Amu Darya, Syr Darya, etc.); There are many drying up lakes and periodically drying up rivers. Soils are poorly developed. There are (depending on the nature of the substrate) sandy, clayey, rocky, saline, etc. The types of soils are dominated by xerophilic subshrubs and ephemerals. P. plants are characterized by a reduction and sometimes a complete absence of leaves. The fauna of P. is represented by stenothermic insects, reptiles and rodents, ungulates, etc. For everyone, RECREATION is the restoration of health and ability to work by resting outside the home - in the lap of nature or during a tourist trip associated with visiting places of interest to view, including national parks, architectural and historical monuments, museums.

DOMESTICATION (from Latin *domesticus* - domestic), domestication, the process of transforming wild animals into domestic ones, as well as wild plants into cultivated ones. D. leads to changes in the behavior, anatomy, physiology, ecology, and productivity of domesticators. Ch. Darwin (1859) attached great importance to biology in evolution. It is believed that the first animals that were domesticated by humans (back in the Neolithic) were the dog, goat and sheep; from plants - corn, banana, etc. The process of D. new species continues to this day. see also **Cultivated plants** .

DOMINANT SPECIES - leading species, species represented in the biocenosis by the largest number of individuals and biomass. Their dominance is determined by the formula:

$D_i = n_i / N$, where D_i — dominance index; n_i — number of individuals in populations of a given species; N — the total number of individuals in the biocenosis.

E

EMERGENCY RESCUE SERVICE (ASS) - a set of control bodies, forces and means designed to solve problems of preventing and eliminating emergency situations, functionally united into a single system, the basis of which is emergency rescue units (GOST R 22.0.02-94) .

ENVIRONMENTAL SAFETY - 1) a set of actions,states and processes that do not directly or indirectly lead to vital damage (or threats of such damage) caused to the natural environment, individuals and humanity; 2) a complex of states, phenomena and actions that ensures an ecological balance on Earth and in any of its regions at a level to which humanity is physically, socio-economically, technologically and politically ready (can adapt without serious damage). B. e. can be considered in a global, regional, local and conditionally specific framework, including within states and any of their subdivisions.

ECOLOGICAL ARCHITECTURE (ARCHITECTURAL AND BUILDING - ECOLOGY) - 1) the newest direction in architecture, district and city planning, seeking to take into account as much as possible the environmental and socio-ecological needs of a particular person from his birth to his old age. Ecological architecture tries to bring people closer to nature, to save them from the monotony of urban space, physical inactivity, and to correctly distribute the population over the area (combining multi-story buildings with green spaces) (Tetior, 2000); 2) environmental architecture - ARCOLOGY - a scientific direction that studies the relationship of architectural (artificial) objects with the environment, the impact of these structures on public health, developing methods and techniques for the construction of “ecological” buildings, structures and settlements that combine meeting human needs with maximum conservation of wild nature, as well as with the optimal saturation of architectural objects with artificial plantings and a variety of aesthetic architectural forms (Snakin, 2001).

ECOLOGICAL AREA - a region where a species can live due to the presence of conditions suitable for it, regardless of where this region is located and whether it is separated by barriers insurmountable for the species.

ECOLOGICAL-GEOMORPHOLOGICAL ANALYSIS - 1) study of the interaction of components of subsystems, material and energy flows between them, quantitative assessments of various types of anthropogenic impact on the geomorphosystem; identification of evolutionary-dynamic series that differ morphologically, in the spectrum and dynamics of processes, in the naturalness of geosystems and their ability to relax, studying the possibilities of influencing these processes by various types of economy, the nature of modern ones and forecasting the environmental situation for the future (Kovalchuk, 1997); 2) consideration of the “man - relief” system is determined by the need to identify the role of the geographic environment when choosing a location for permanent residence of a person and, in particular, consideration of the relief as the basis of the “city” ecosystem. Man created the city, his own ecosystem, in accordance with his needs, in which he, man, is the first system-forming link, and the other is the natural (geographic) environment. Their interaction forms the urban area and a specific natural-anthropogenic environment - the urban environment, or urban planning system, in which the relief acts as a structural-planning frame and is the basis of the ecological frame. Ecological and geomorphological analysis includes: assessment of the influence of relief on the state of the ecosystem; identification of the harmful effects of geomorphological conditions on the sociosphere: identification (assessment and forecast) of adverse manifestations of exogenous processes under a certain type (types) of economic use of the territory; development of recommendations to reduce both impacts; preservation and controlled change of geomorphological conditions of the territory during economic use.

ECOPHYSICAL ANOMALIES - anomalies of natural and man-made origin that have a significant impact on ecosystems and biota. Ecophysical or ecogeophysical anomalies can only be understood as those geophysical anomalies that are formed with the participation of the lithosphere and are transformed by it (Bogoslovsky, Zhigalin, Khmslepskoy, 2000).

ECOLOGICAL ACCIDENT - a production or transport situation that is not provided for by the current technological regulations and rules and is accompanied by a significant increase in the impact on the environment. Based on the nature of the risk, an environmental accident can be divided into the following groups: emissions and discharges of chemical substances from stationary sources; emissions of bacteriological and biologically active substances; releases of radioactive substances; explosions and fires; sudden collapses of buildings and various structures (hydrodynamic, electric power, utility systems, wastewater treatment plants, etc.); transport accidents (accidents during the transportation of passengers and cargo by land, water and air transport, accidents on pipelines); emergency situations related to testing of military equipment.

ECOLOGICAL AMPLITUDE (from Latin amplitudo - magnitude) - the limits of adaptability (adaptation) of a species or community to changing environmental conditions (Reimers, 1990).

ECOLOGICAL CRITERION - a sign on the basis of which the assessment, definition or classification of environmental systems, processes and phenomena is made. K.e. can be environmentally protective (preserving the integrity of the ecosystem, living species, its habitat),anthropoecological (impact on a person, on his population) and economic (up to the impact on the entire system of “society - nature”).

ECOLOGICAL VALENCE is a characteristic of the ability of living organisms to exist in a variety of environmental conditions **.**

ECOLOGICAL EQUIVALENTS (from the Latin *aequus* - equal and *valens* (valentis) - having strength, significance, price) - organisms (species, ecosystems) that have undergone independent convergent evolution, but occupy approximately the same ecological niches in diverse communities from different parts of the world. In adjacent areas E. e. usually closely related taxonomically, in non-adjacent ones - as a rule, they are not related. Equivalent functional niches turn out to be occupied by biological groups present in the fauna and flora of a given area. For example, large kangaroos in Australia are E. e. bison and antelopes Northern. America (both of them eat cereals); American prairies - E. e. African savannas.

ECOLOGIZATION is the process of consistent implementation of the ideas of nature conservation and sustainable environment in the areas of legislation, management, technology development, economics, education, etc. It means not only the introduction of resource-saving technologies, treatment systems, the “polluter pays” principle, but above all awareness the limbs of our planet, land and ocean, ecological space and natural biota and the existence of a limit to anthropogenic deformation of the natural environment, beyond which an environmental catastrophe occurs and the problem of human survival arises.

ECOLOGICAL SAFETY is the state of protection of every individual, society, state and environment from excessive environmental hazards.

ECOLOGICAL VALENCE (ecological plasticity) - (from
lat. Valentia — strength) the degree of ability of a certain type to withstand changes in any environmental factor (for example, temperature). Species with a wide V. e. are called eurobiont, with a narrow one - stenobiont.

ECOLOGICAL DISASTER - a natural anomaly, often resulting from direct or indirect human impact on natural processes and leading to mass death of plants and animals, economic losses and loss of life.

ECOLOGICAL NICHE is the position of a species that it occupies in the general system of biocenoses, which is determined by the functional relationships of the species, its spatial location and requirements for abiotic environmental factors.

ECOLOGICAL PYRAMID - a graphic representation of the relationship between different trophic levels. The base of the pyramid is level of producers. There can be three types: pyramid of numbers, pyramid of energy, pyramid of biomass.

ECOLOGICAL STRATEGY is a general characteristic of the growth and reproduction of a given species. It includes the growth rate of individuals, time to reach sexual maturity, fertility and other characteristics. Environmental strategy depends on many conditions and especially on factors influencing mortality.

ECOLOGICAL FACTORS are individual properties or elements of the environment that affect living organisms directly or indirectly during at least one stage of individual development. Environmental factors are manifold. They can be divided according to the type of effect on organisms, the degree of variability over time, and the duration of action. Depending on the properties and nature of the influence, environmental factors are divided into three main groups: abiotic (factors inorganic environment, affecting organisms), biotic (microorganisms, plants, animals, influencing other organisms and the abiotic environment itself) and anthropogenic (the totality of the impact of human activity on the organic world).

ECOLOGICAL CRISIS is a potentially reversible situation that occurs in natural ecosystems as a result of an imbalance under the influence of spontaneous natural or anthropogenic factors. Scientists believe that humanity is currently in a state of the eighth environmental crisis, and if the seven previous ones were resolved as a result of the corresponding environmental revolutions, then the current state of affairs can lead to an environmental disaster.

ECOLOGICAL EXAMINATION - assessment of the impact on the living environment, natural resources and human health of a complex of economic innovations (including the transformation of nature) on the scale of a selected region. It includes not just the sum of environmental assessments of technology (equipment), enterprise projects and examination of a nature transformation project, but also their integral analysis for the region in question, ecosystems of various hierarchies, and sometimes even the biosphere as a whole.

ENVIRONMENTAL AUDIT - A systematic, documented process of examining objectively obtained and evaluated audit data to determine whether certain environmental activities, events, conditions, management systems, or information about these items meet or fail to meet audit criteria, and to communicate to the client the results obtained during this process. .

ECOLOGY (from Greek *oikos* - house and *logos* - word, doctrine) is a science that studies the organization and functioning of supraorganismal systems at various levels: populations, biocenoses (communities), biogeocenoses (ecosystems) and the biosphere. The science of the interactions of living organisms and their communities with each other and with the environment. The term was first proposed German biologist Ernst Haeckel in 1866 in the book “General Morphology of Organisms”

ECOSYSTEM (from Greek *oikos* - home and *systema* - combination, association) - a set of co-living organisms and the conditions of their existence, which are in a natural relationship with each other and form a system of interdependent biological and abiotic phenomena and processes.

ELECTROMAGNETIC RADIATION - the process of emitting electromagnetic waves and the alternating field of these waves.

EXPERTISE PROJECT - establishing the compliance of the planned economic and other activities with environmental requirements and determining the admissibility of the implementation of the object of environmental assessment in order to prevent possible adverse impacts of this activity on the environment and the associated social, economic and other consequences of the implementation of the object of environmental assessment.

EXPOSITION SLOPE - the orientation of mountain ranges, hills in relation to flows of matter and energy (for example, the length and intensity of solar radiation). Causes differentiation of microclimates on slopes, affecting animals and plants. Differences in E. s. - one of the reasons for the diversity of mountain landscapes.

EXTREME CONDITIONS (lat. *extremum* - extreme) - extreme, dangerous environmental conditions to which the body does not have the proper adaptations.

ECTOTHERMIC ORGANISM - an organism that receives heat from the environment. These include all plants and most animals.

ELECTROMAGNETIC RADIATION (electromagnetic waves) is a disturbance (change in state) of an electromagnetic field propagating in space (that is, electric and magnetic fields interacting with each other) .

EROSION (from Latin *erosio* - corrosion) is the destruction of rocks, soils or any other surfaces with a violation of their integrity and a change in their physical and chemical properties, usually accompanied by the transfer of particles from one place to another. Erosion is distinguished between rocks, soil, metal surfaces, as well as physical, chemical, and biological E. E. in nature is caused by wind (wind erosion, deflation), sharp fluctuations in the temperature of air and surfaces of objects, moving water (water erosion), solutions of acids and alkalis in it, environmental pollution (chemical and physical), the influence of biological agents (trampling, biochemical impact). A distinction is made between geological, anthropogenic, and zoogenic (pasture) factors. Soil ecology largely depends on agricultural technology **.**

EMISSION RATE (DISCHASE) - the total gaseous and/or liquid waste allowed by the enterprise for discharge into the environment. Volume N.v. is determined on the basis that the accumulation of harmful emissions from all enterprises in a given region does not create concentrations of pollutants in it that exceed the maximum permissible concentration.

ENGINEERING-GEOMORPHOLOGICAL ANALYSIS - relief is a “landscape substrate” (Isachenko, 1965; Demsk, 1977, etc.) and the upper boundary of the geological environment (Sergeev, 1982), and therefore, as a special component, is included both in the geological environment and in landscape geosystem. At the same time, relief is the main object and subject of geomorphology research. Geomorphology, which occupies a borderline position between geology and geography, serves as a link that unites engineering-geographical research and can make them interconnected and complementary (Simonov, 1993). Geomorphological information is the basis for assessing the stability of the geological environment, landscape or urban environment. The study of the relief, its origin, age and modern relief-forming conditions for the construction and operation of structures is necessary, since the relief and relief-forming processes are the external conditions for the existence of the engineering complex. Using methods used in geography and geology, and their own research apparatus, geomorphologists can conduct complex and original studies of the engineering properties of relief, considering the relief as a morphologic, and as a morphologic system, and as a subsystem of the human ecosystem. Engineering geomorphological analysis includes: 1) study of engineering properties of relief, assessment and forecast of relief-forming processes; 2) a wall of interconnections between the relief and engineering structures (stability assessment); 3) determination of the optimal level of technogenic load on the geomorphological system (ensuring sustainability); 4) engineering studies of the terrain to identify connections between modern buried relief and modern relief-forming processes, on the one hand, between architectural relief and human engineering activity, on the other.

ENVIRONMENTAL IMPACT ANALYSIS (ECOLOGICAL ANALYSIS) Analysis) - section (aspect) of project analysis, in which the impact of the project on the environment is assessed, and measures to neutralize or limit damage are determined.

ECOLOGICAL RISK - the likelihood of adverse consequences for environmental resources of any (intentional or accidental, gradual or catastrophic) anthropogenic changes in natural objects and factors, as well as the likelihood of environmental degradation or its transition to an unstable state.

ENVIRONMENTAL CERTIFICATION is an activity to confirm the compliance of a certified object with the requirements of legislative and regulatory acts in the field of natural resource management and environmental protection. S. can be mandatory or voluntary.

ECOLOGICAL RISK ZONE - places on the land surface and in the waters of the world's oceans where human activity can create dangerous environmental situations, for example. zones of underwater oil production on the sea shelf, areas of the sea that are dangerous for passing tankers, where an accident with an oil spill may occur, etc.

ECOLOGICAL DISASTER ZONE - an area where, as a result of economic and other activities, deep irreversible changes in the natural environment have occurred, resulting in a significant deterioration in public health, disruption of natural balance, destruction of ecological systems, degradation of fauna and flora.

ECOLOGICAL WORLDVIEW - a deep awareness of the vital need to preserve the living environment common to all humanity. Component of ecological culture.

ENVIRONMENT CAPACITY - 1) the number of individuals or their communities whose needs can be satisfied by the resources of a given habitat without noticeable damage to its further well-being. The optimal number that maintains the capacity of the environment is established over many years and depends on two opposing principles: the reproductive potential of the population and the resistance of the environment; 2) the ability of the natural environment to include (absorb) various (pollutants) substances while maintaining stability.

ENVIRONMENTAL STANDARDING - the law “On Environmental Protection” defines standardization in the field of environmental protection environment as an activity to establish “environmental quality standards, standards for acceptable impact on the environment when carrying out economic and other activities, other standards in the field of environmental protection, as well as state standards and other regulatory documents in the field of environmental protection.” The system of environmental regulations and standards includes:

- environmental quality standards (MPC - maximum permissible concentrations of pollutants; PDU - maximum permissible levels of harmful physical influences; MDV - maximum permissible exposure standard; OBUV - approximately safe exposure levels);
- standards for permissible impact on the environment (MPV - maximum permissible emissions of pollutants; MDS - maximum permissible discharges of pollutants; standards for the generation of production and consumption waste; standards for the removal of components of the natural environment, etc.);
- other standards in the field of environmental protection (sanitary protection zones, water protection strips and zones, sanitary (mountain sanitary) protection districts).

ENVIRONMENTAL JUSTIFICATION OF THE PROJECT - proof of the probable absence of adverse environmental consequences (deviation from accepted standards) of the implementation of the proposed project and, conversely, improvement in the course of its implementation of living conditions for people and the functioning of the economy. It is probabilistic in nature, since the visible pros and cons due to the uncertainty factor and the principle of incomplete information may not be realized in the primary (pre-project) environmental assessment. O. p. e. can be considered implemented only under the condition of the maximum (preferably one hundred percent) probability of obtaining pluses and the minimum (preferably complete) absence of minuses in the accepted normative scale. The completeness and information security of such a scale depends on the level of knowledge. In each specific case, this level should be the maximum possible for a given stage of scientific development.

ENVIRONMENTAL PROTECTION is a complex of international, regional, state and local measures, including administrative, political, technological, social, legal and public, aimed at preserving the required amount of biota on Earth, ensuring environmental sustainability. At the same time, an unstable state of the environment is possible at local and regional levels.

F

FOREST BONITET is an indicator of the economic productivity of a forest area. Depends on natural conditions and human impact on the forest. It is characterized by the size of wood growth (often the height of the planting) at a comparable age. There are five quality classes from ^most productive) to V.

FREEZING is a form of commensalism in which one species consumes the leftover food of another (such as lions and hyenas). Pilot fish accompany sharks and dolphins, moving with them in a layer of water adjacent directly to the surface of the body of these animals and feeding on food debris and parasites of the animals being accompanied. Bird nests and rodent burrows are home to a huge number of arthropods that use the microclimate of their homes and find food there from decaying remains or other types of cohabitants. Many species are not found outside their burrows at all.

FOREST PROTECTIVE BAND - forest and non-forest areas allocated on the lands of the state forest fund adjacent to roads; designed to protect roads from snow and sand drifts, mudflows, avalanches, landslides, landslides, wind and water erosion, to reduce noise levels, perform sanitary, hygienic and aesthetic functions, to protect moving vehicles from unfavorable roads for at least 50 m on each side roads, along highways - 25 m. A strip of tree and shrub vegetation 15 - 20 m wide, separating the noise source (highway, railway, roadway from the street, etc.) from residential, administrative or industrial buildings, does not reduce noise less than 10 dB, i.e. 10 times.

FILTRATION FIELDS - territories intended (usually specially designed) for biological treatment of wastewater from pollutants and, as a rule, not used for other purposes.

FACULTATIVE ANAEROBES - organisms that can live both in the presence of oxygen and without it (some bacteria and fungi).

G

GAMMA DIVERSITY is an indicator of diversity at the territorial level, commensurate with the landscape, combining alpha and beta diversity. The simplest indicator of G.r. - list of species.

GEOMORPHOLOGICAL ANALYSIS OF THE URBOSPHERE - regional ecological - and geomorphological studies of habitats, aimed at studying the patterns of formation of urban systems (city systems), at studying the influence of economic, environmental, physical and geographical conditions on the process of choosing locations for the city, on the sphere of vital interests of a city dweller. Geographical space, to some extent subject to changes associated with urban planning and included in the sphere of interests of citizens (in particular, recreation), was called the urbosphere.

GEOMORPHOLOGICAL ANALYSIS is a type of geomorphological research in which the main operation is the division of the object under study into parts for the purpose of studying its essence (Simonov, Bolysov, 2002).

GEOBOTANY is the science of the patterns of connections between plants and plant communities (phytocenosis) with environmental conditions. Geobotany includes several disciplines: phytocenology - the science of the nature of phytocenoses botanical geography - the science of the patterns of distribution on the planet of species and sets of species in certain territories (floras), geography of vegetation. The study of the life forms of plants and the assessment of environmental conditions by vegetation were considered as branches of geobotany.

GEOECOLOGY -1) syn. landscape ecologists (geographic ecologists) ; 2) a scientific discipline that studies the laws of interaction between the lithosphere and the biosphere, taking into account human activities, including the role of geological processes in the functioning of ecosystems (geological ecology).

GLOBAL (from Latin *globus* - sphere) - covering the entire globe, planetary.

GLOBAL MONITORING is a system for monitoring the state and (on this basis) predicting possible changes in global processes and phenomena, including anthropogenic impacts on the biosphere as a whole.

GLOBAL POLLUTION - biosphere pollution of the environment external to the polluting object by physical, chemical or biological agents found far from sources of pollution and almost anywhere on the planet.

H

HALOPHYTES - plants adapted to grow on saline soils, usually found in steppe and desert zones. G. are distinguished by special physiological adaptations for life in saline soil conditions. All adaptations for plants to tolerate high concentrations of salts in the soil are associated with their water regime. Halophyte species are used as indicators of soil salinity, which can be caused by irrigation of black soil in the steppe zone or regular use of salt to accelerate the melting of snow on roads.

HELIOPHYTES are light-loving plants in open areas with good lighting. Plants of steppes, deserts, semi-deserts (feather grass, wormwood, cereals) or upper tiers of forests (pine, birch).

HEMICRYPTOPHYTES (from *hemi. ..* And *cryptophytes)* - plants in which renewal buds are retained at the soil or leaf litter level during unfavorable periods of the year for vegetation. Protected by scales, fallen leaves and snow cover. There are many people who treat G. herbaceous plants of mid-latitudes (buttercup, creeping tenacious, dandelion, etc.).

HUMAN ECOLOGY is a science that studies the patterns of emergence, existence and development of anthropoecological systems, which represent a community of people who are in dynamic interaction with the environment and thereby satisfy their needs.

HETEROTROPHS (Greek *heteros* - other, other, *trohpe* - nutrition) - microorganisms, animals, some plants and fungi that feed on ready-made organic substances, using, transforming and decomposing complex compounds. They live off autotrophs.

HYDROCHORY - distribution of fruits (and seeds) of plants using water. Characteristic of plants of sea coasts and freshwater ecosystems (nymphaeum, sedge, pondweed, chastuha), the seeds of which can withstand prolonged exposure to water without loss of germination. Hydrochory is promoted by sea surf, hollow water in river floodplains and river currents.

HYGROPHILES are terrestrial organisms adapted to living in conditions of high humidity. They live in wetlands, wet forests, floodplains, along the banks of reservoirs, as well as in the soil (earthworms, etc.) or in rotting wood (many insects, centipedes). Plants of wet habitats are usually called. hygrophytes.

HYGROPHYTES are terrestrial plants that grow in conditions of high air and soil humidity. These are plants of the lower tiers of damp forests - impatiens, thistle, many tropical herbs, plants of moist soils of temperate zones - papyrus, rice, sundew.

HYDROSPHERE is the watery shell of the Earth. It forms an intermittent water shell. The average depth of the ocean is 3800 m, the maximum (Mariana Trench of the Pacific Ocean) is 11,022 meters. Over 96% of the volume of the hydrosphere is made up of seas and oceans, about 2% is groundwater, about 2% is ice and snow, about 0.02% is land surface water (rivers, lakes, swamps, reservoirs). Some of the water is in a solid state in the form of glaciers, snow cover and permafrost, representing the cryosphere.

HYDROPHYTES - (from *hydro. .* and Greek *phyton* - plant) terrestrial-aquatic plants, partially submerged in water or attached to the soil only with their lower parts. They live along the banks of rivers, lakes, ponds and seas, as well as in swamps and marshy meadows. Some G. can grow in wet fields as weeds, such as chastuha, reed, etc. The

21 root system of G. is well developed and serves both to conduct water and nutrients dissolved in it, and to strengthen plants in their places a habitat.

HOMEOSTASIS is a state of internal dynamic equilibrium of a natural system, supported by the regular renewal of its basic structures, material-energy composition and constant functional self-regulation of its components.

HUMUS is soil organic matter formed as a result of the decomposition of plant and animal residues, as well as waste products of organisms and the synthesis of humic organic substances by microorganisms, ecosystem detritus . Humus is the basis of soil fertility.

HABITAT OF A SPECIES - a spatially limited set of conditions of the abiotic and biotic environment, ensuring the entire development cycle of individuals, a population or a species as a whole - a place (territory, water area) with certain conditions where a given living species is found.

HEAVY METAL - with a density of more than 8 t/m ^{3} (except for noble and rare ones). M. t. include: Pb , Cu , Zn , Ni , Cd , Cj , Sb , Sn , Bi , Hg . In applied works to the list of M.t. Pt , Ag , W , Fe , Au , Mn are also often added . Almost all M.t. toxic. Anthropogenic dispersion of M.t. (including in the form of salts) in the biosphere leads to poisoning or the threat of poisoning of living things.

HARD LEAF FOREST, a type of forest ecosystems characterized by a xeromorphic structure (hard leaves, twig-like stems), sclerophyll, and weak assimilation during the summer heat. Distributed mainly in the Mediterranean - holm and cork oaks, strawberry trees, heather, and myrtle dominate; in Australia - eucalyptus, acacia and casuarina; in America (Chile, USA) - evergreen oak and strawberry tree.

HUNTING is a branch of environmental management associated with the rational use (exploitation and protection) of hunting resources. There are O. x. fishing and sports (amateur). The ultimate goal of improving O. x. — creation of cultural hunting that will ensure long-term and inexhaustible use of hunting resources.

HALF-LIFE - The time it takes for half of the original radioactive material or pesticide to decay.

HAZARD CLASS - an indicator characterizing the degree of danger to humans of substances polluting the natural environment. For different objects - for chemicals, for waste, for air pollutants , etc. - different standards and indicators have been established. Substances are divided into the following hazard classes:

1 class - extremely dangerous;
2 class - highly dangerous;
3 class - moderately dangerous;
4 class - low-hazard.

2 Hazard Class departure for the natural environment	The degree of harmful impact of hazardous waste on the environment natural environment	Criteria for classifying hazardous waste as hazardous to the environment
Class I (extremely dangerous)	**very high**	**The ecological system is irreversibly damaged. There is no recovery period.**
II class (highly dangerous)	**high**	**The ecological system is severely disturbed. The recovery period is at least 30 years after complete elimination of the source of harmful effects.**
III class (moderately dangerous)	**average**	**The ecological system is disrupted. The recovery period is at least 10 years after reducing the harmful effects from the existing source.**
IV class (low-hazard)	**low**	**The ecological system is disrupted. The self-healing period is at least 3 years.**
Class V (virtually harmless)	**very low**	**The ecological system is practically undisturbed**

Extremely hazardous substances (I)

Benzopyrene, Beryllium, Dimethylmercury, Diethylmercury, Soman, Lindane (gamma isomer of HCH) Ozone, Pentachlorobiphenyl, Mercury, Selenium, Tetraethyltin, Tetraethyl lead, Trichlorobiphenyl, Ethylmercuric chloride, Thallium, Polonium, Plutonium, Protactinium, Oxide lead, Soluble lead salts, Tellurium, Hydrogen fluoride, Phosphorus oxychloride, Hydrogen cyanide, Dimethyl sulfate, Vinyl chloride, Potassium cyanide, Sodium cyanide, Strychnine, Dioxins

Highly hazardous substances (II)

Atrazine, Boron, Bromodichloromethane, Bromoform, Hexachlorobenzene, Heptachlor, Hydroxide sodium, DDT, Dibromochloromethane, Cadmium, Cobalt, Lithium, Molybdenum, Arsenic, Sodium, Nitrites (by NO_2), Lead, Selenium, Hydrogen sulfide, Silicates (by Si), Strontium (Sr^{2+}), Antimony, Formaldehyde, Phenol, Fipronil, Phosphates, Chloroform, Carbon tetrachloride, Chlorine, Trichlorosilane (HSiCl3) , Sulfuric acid, Nitric acid, Hydrochloric acid

Moderately hazardous substances (III)

Aluminum, Barium, Iron , Manganese, Copper, Nickel, Nitrates (by NO_3), Phosphates ($P0_4$),
Chromium (Cr^{6+}), Zinc (Zn^{2+}), Toluene

Low hazardous substances (IV)

Simazine, Silver, Sulfates, Chlorides, Gasoline, Ethyl alcohol

Indicator name	Standard for hazard class			
	I	II	III	IV
Maximum concentration of harmful substances in the air of the working area, mg/m ^{3}	**less 0.1**	**0.1 — 1.0**	**1.1—10.0**	**more 10.0**
Average lethal dose (LD_{50}) when administered into the stomach, mg per 1 kg of body weight	**less 15**	**15-150**	**151 — 5000**	**more 5000**
Average lethal dose when applied to the skin, mg per 1 kg body weight	**less 100**	**100-500**	**501 — 2500**	**more 2500**
Average lethal concentration in air, mg/m3	**less 500**	**500—5000**	**5001—50 000**	**more than 50 000**
Inhalation Poisoning Possibility Quotient (POICO)	**more 300**	**300—thirty**	**29—3**	**less than 3**
Zone of acute action - the ratio of the value of the average lethal dose (or concentration) to the value of the threshold of acute action	**less 6.0**	**6.0—18.0**	**18.1 - 54.0**	**more 54.0**
Zone of chronic action - the ratio of the threshold value of the acute action of a poison to the value of the threshold of its chronic action	**more 10.0**	**10.0—5.0**	**4.9—2.5**	**less 2.5**

I

INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE AND NATURAL RESOURCES (IUCN), an international non-governmental organization created in 1948, with consultative status with UNESCO, for the protection and rational use of natural resources. Includes 502 institutions (state, scientific, national, etc.) from 130 states, as well as 24 international organizations (1984).

IRRIGATION FIELDS - Areas designated for the biological treatment of wastewater and typically used for agricultural or forestry purposes.

INFRORED RADIATION - optical radiation with a wavelength from 770 nm (i.e., greater than visible) to 1 - 2 mm, emitted by heated bodies.

IONIZING RADIATION - electromagnetic (X-rays, gamma rays) and corpuscular (alpha particles, beta particles, flux of protons and neutrons) radiation, to one degree or another penetrating living tissues and producing changes in them associated with “knocking out” electrons from atoms and molecules or the direct and indirect formation of ions. In doses exceeding natural (background radiation), I.i. harmful to organisms.

INDEX (INDICATOR) OF SPECIES BIODIVERSITY -

the relationship between the number of species and any indicator of “significance” (number of individuals, *biomass, productivity* , etc.). The species diversity *of the trophic* *group* is determined by Ch. arr. rare species, while the indicators of “significance” are the few *dominant species.*

INTRODUCTION - the deliberate or accidental transfer of individuals of any living species outside the range.

IONOSPHERE - a layer of the atmosphere (lower I. from 50 - 80 to 400 - 500 km, upper I. - up to several thousand km), characterized by a significant number of positively ionized molecules and atoms of atmospheric gases and free electrons. I. plays an important role in the propagation of short-range radio waves on earth; aurora and ionospheric magnetic storms are observed in it, which affect the state of terrestrial organisms.

ICEBERG (from English ice - ice, berg - mountain) - a floating block of ice up to 100 m high above the water and up to several tens of km long. It is formed as a result of the deposition of ice from the edges of glaciers descending to the sea in the polar regions.

ICHTHYOPHAGES (Greek, from *ichthys* - fish, and *phago* - yes), animals for which the main food is fish. Many of them feed mainly on live fish (cormorants, pelicans, mergansers, etc.), some consume live and dead fish (gray and white herons, osprey, some species of gulls), and a number of species, along with live and dead fish, use fish waste and other food (herons, gulls, loaves, etc.). I. are carriers of parasitic helminthic diseases of fish: diplostomatosis (herons, storks), ligulosis, etc. I. parasites can cause great harm to pond fish farms, both in nursery and feeding ponds, especially during the release of ponds.

IMPACT MONITORING - monitoring of local, regional and anthropogenic impacts in particularly dangerous points and areas.

Monitoring sources impact	**Sources of influence**
Monitoring factors impact	**Impact factors**
	Physical Biological Chemical
Monitoring state biosffy	**Natural environments**
	Atmosphere Ocean Land surface with Biota rivers and lakes. The groundwater
	Geophysical monitoring Biological monitoring

L

LANDSCAPE ARCHITECTURE - 1) construction taking into account the landscape features of the area. Landscape architecture strives to achieve three main goals: the implementation of tasks for the functional and spatial organization of the human living environment; transforming landscapes while preserving their natural (ecological) features;

solving aesthetic problems (Reimers, 1990); 2) architecture of open spaces. Its goal is to create a favorable external environment for the life and recreation of the population in cities, suburban and resort areas, and rural areas, taking into account environmental, functional, aesthetic, technical and economic requirements. Historically, it arose at the intersection of landscape gardening art and urban planning in the second half of the 19th century. The specificity of landscape architecture is that it deals, first of all, with natural materials and objects - the relief of the earth's surface, its vegetation, reservoirs, watercourses, which form complex interconnected landscape systems, which also include anthropogenic components. The tasks of landscape architecture, in addition to the traditional purposes of gardening art, also include landscaping and improvement of residential areas, streets, roads, city centers, industrial areas, agricultural enterprises, nature reserves, historical landscapes (Dictionary of General Geographical Terms, 1976).

LANDSCAPE AND ARCHITECTURAL ANALYSIS - includes the determination and assessment of technogenic transformation of the relief (morphosystem, morpholithosystem) when creating comfortable conditions in the recreational area, in the city; The purpose of this analysis is recommendations for organizing the relief, preserving the landscape appearance of the city, monitoring the state of the urban ecosystem and justifying the monitoring system.

LIVING MATTER - according to V.I. Vernadsky, “the totality of all living organisms currently existing, numerically expressed in elementary chemical composition, weight, energy.” J.v. inseparable from the biosphere, being one of the most powerful geochemical forces on our planet, and has a number of unique properties. The total mass of living matter (in dry form) is estimated at 2.4-3.6 * 1012 tons. Zh.v. makes up approximately 0.01% of the total mass of the biosphere

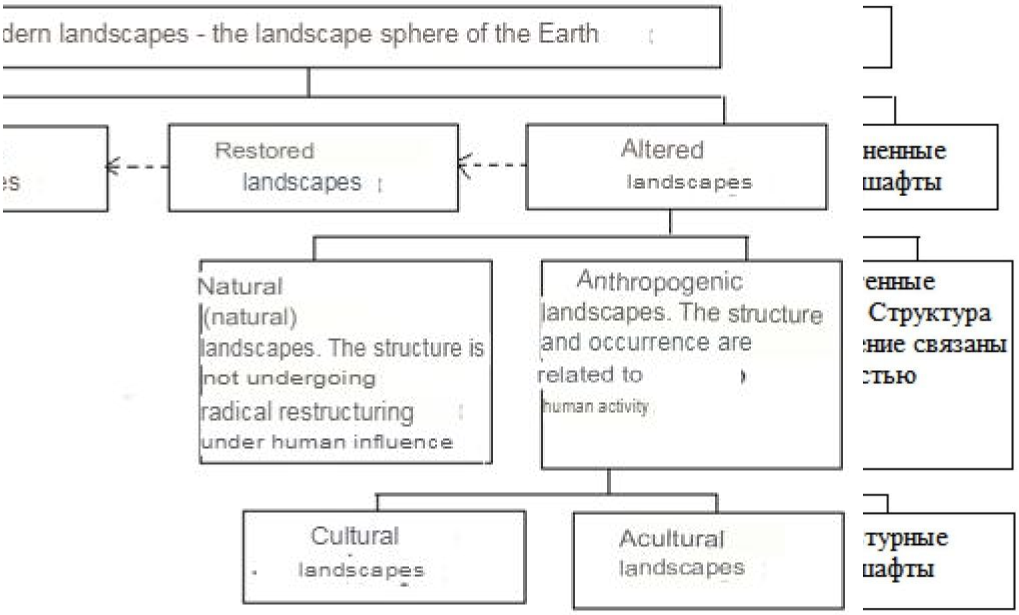
LIFE FORM - 1) in botany - the external appearance (habitus) of a plant, reflecting its adaptability to environmental conditions. J. f. also called a unit of ecological classification of plants - a group of plants with similar adaptive structures and not necessarily related by kinship (for example, cacti and euphorbia form the life forms of stem succulents). J. f. in plants it changes during individual development. The same plant species under different conditions may have different life forms; 2) in zoology, the concept of life form. began to be used only in the 20th century. and is not yet sufficiently developed. When isolating J. f. and classifications of organisms according to them use the presence of similar morphoecological, physiological, behavioral, etc. adaptations for living in the same environment. Thus, D.N. Kashkarov (1944) proposed the following system of animal forms: swimming, burrowing, terrestrial, tree-climbing, aerial.

LIGHT POLLUTION - a form of physical pollution of the environment associated with periodic or prolonged excess of the level of natural illumination of the area, including through the use of artificial lighting sources.

LAW OF MINIMUM (Liebig's law) - a law according to which the endurance of an organism is determined by the weakest link in the chain of its environmental needs, that is, life opportunities are limited by that environmental factor, the amount of which is close to the amount required by the organism

LAGUNA (Italian *laguna),* a shallow natural lake-like body of water separated from the sea by alluvial spits, atolls, coral reefs or connected to it by a narrow strait. It is characterized by high biological productivity and is easily polluted.

LANDSCAPE is a natural system homogeneous in terms of development conditions, the main category of territorial division of the geographical envelope. A natural geographical complex in which all the main components: relief, climate, water, soil, vegetation and fauna are in complex interaction and interdependence, forming a single inextricable system that is homogeneous in terms of development conditions. Based on the nature of the impact on humans, landscapes are divided into topophilic (attractive) and topophobic (irritating).



LARVICIDE is a substance used to combat insect larvae (including butterfly caterpillars).

LIMITING FACTOR - a factor primarily responsible for limiting the growth and (or) reproduction of an organism or population.

LITORAL (from Latin *litoralis* - coastal, coastal), an ecological zone of a sea or fresh water body, occupying the coastal or bottom part of shallow water, in which light penetrates to the bottom.

LITHOSPHERE - the upper solid shell of the Earth, composed of rocks and their derivatives of volcanic origin, sedimentary biogenic compounds, and weathering products. Gradually passes with depth into spheres with lower strength of matter. Includes the Earth's crust and upper mantle. The thickness of the Earth is 50 - 200 km, including the earth's crust - up to 75 km on continents, 10 km under the ocean floor.

LITHOPHYTES (from *Lito.* .. and *..fit)* - petrophytes, plants adapted to life on rocks and stones (for example, some lichens, algae, etc.). Settled on these substrates, L. participate in the soil-forming process.

LICENSE - a permit (usually paid) issued by specially authorized state bodies for the right to perform a single or repeated specified number of times during the time specified in the Law an economic action or an action affecting the economy (shooting game, catching fish, releasing products of a certain kind, releasing pollutants , trade, use of an invention protected by a patent, etc.).

LOCAL (lat. *lokalis* - local) - relating to a limited area.

LUMBRICIDE is a substance used to control worms.

LOW WASTE PRODUCTION, optimal industrial production that produces a small

22amount of waste. One of the most effective and promising forms **environmental protection** from pollution

M

MAXIMUM PERMISSIBLE CONCENTRATION OF THE WORKING AREA - such a concentration of a harmful substance that, during daily work throughout the entire working period, cannot cause illness during work or in the long-term life of the present and subsequent generations.

MAXIMUM PERMISSIBLE DISCHARGE (of substances into a water body) (MPD) - the mass of a substance in wastewater, the maximum permissible for discharge in the established mode at a given point per unit of time in order to ensure water quality standards at the control point. The MPC is established taking into account the maximum permissible concentration of substances in places of water use, the assimilative capacity of a water body and the optimal distribution of the mass of discharged substances between water users discharging wastewater.

MAXIMUM PERMISSIBLE RESIDUAL QUANTITIES (MRQ) - amounts of harmful substances in food products that can accumulate in organisms.

MAXIMUM PERMISSIBLE EMISSION (MAE) is a standard for the emission of a harmful (pollutant) substance into the atmospheric air, which is established for a stationary source of atmospheric air pollution, taking into account technical standards and background air pollution, provided that this source does not exceed hygienic and environmental air quality standards and other environmental regulations.

MAXIMUM PERMISSIBLE DISCHARGE (MAD) - the mass of a substance in wastewater, the maximum permissible for discharge with the established regime at a given point of a water body per unit of time in order to ensure water quality at the control point.

MAXIMUM PERMISSIBLE LEVELS - physical impact on the environment - levels of noise, vibration, ionizing radiation, electromagnetic field strength, etc., which should not have a direct or indirect harmful effect on a person with unlimited long-term exposure.

MPC (maximum permissible concentration) - standard; the amount of a harmful substance in the environment, with constant contact or with exposure over a certain period of time, which has practically no effect on human health and does not cause adverse consequences in his offspring; environmentally normal, the maximum concentration of a pollutant in the environment, which, with everyday influence over a long period of time, does not cause changes in the human body.

MORPHOLOGICAL ANALYSIS is a method of reconstructing the course and development of movements of the earth’s crust based on studying the external appearance of the earth’s surface (especially the profiles of the slopes of river valleys) and the nature of exogenous relief-forming processes. Based on A.M. formed ideas about the formation of relief and the course of continuous interaction of endogenous and exogenous forces, and the shape of the slopes reflects, according to these ideas, the relationship between erosion-denudation processes and tectonic uplifts. The method was proposed by the German scientist W. Penck (published posthumously in 1924) (GES).

MAGNETOSPHERE is a zone of manifestation of the magnetic properties of a cosmic body. The structure and properties of M. are essential for life on Earth (M. retains high-energy particles coming from space) and space research. There is an opinion that has not yet been strictly proven about the possibility of the influence of human economic activity on the Earth's mineral mass.

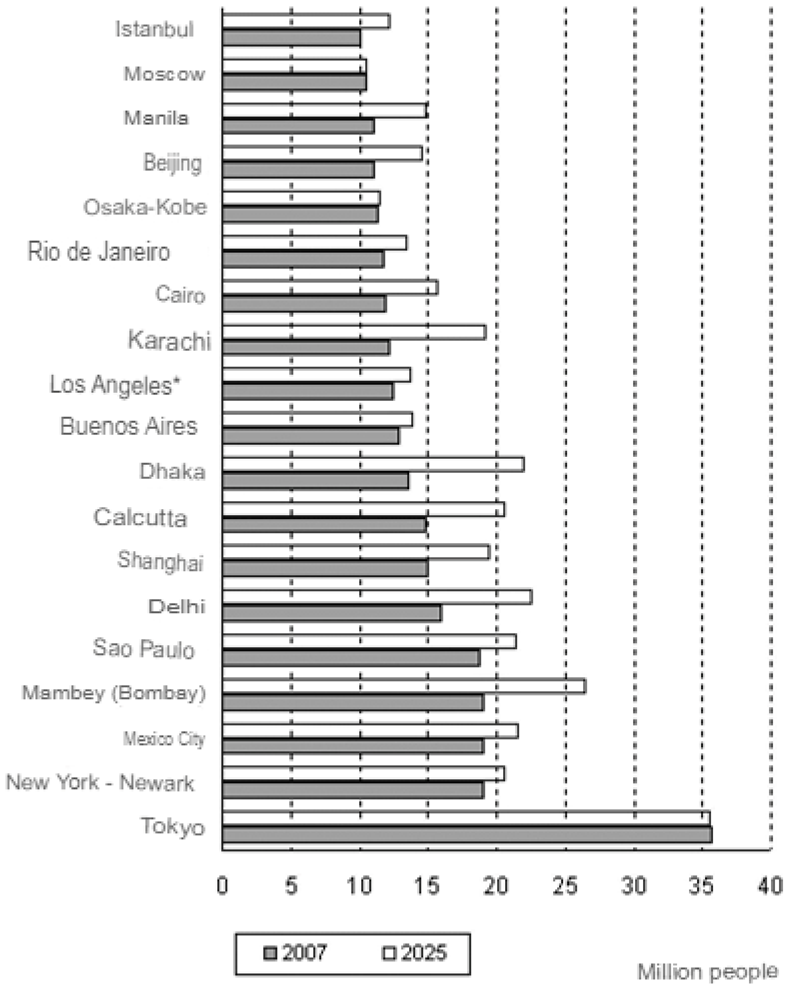
MACROBENTHOS , a set of bottom (benthic) organisms with body sizes greater than 2 mm (insect larvae, large mollusks, oligochaetes, polychaetes, echinoderms, higher crustaceans, etc.).

MACROFAUNA , a set of animal organisms with body sizes exceeding 10 mm (arthropods, worms, mollusks, fish, birds, etc.).

MANGROVES (MANGROVES, MANGROVE FORESTS) - thickets of evergreen low-trunked (up to 10 m) trees and shrubs with above-ground respiratory roots, growing on the coasts of tropical and subtropical seas in the tidal zone.

MARGINALITY - marginal, border position of a natural formation, for example, a strip of semi-deserts and deserts;

MEGAPOLIS is a very large urban agglomeration, including numerous residential settlements (a functional connection of a number of urban agglomerations).



MAXIMUM SINGLE CONCENTRATION (MPC $_{MR}$) - the concentration of a pollutant in the air (populated areas) that does not cause reflex reactions in the human

Body.

MAXIMUM ALLOWABLE CONCENTRATION (MAC) - the amount of a harmful substance in the environment, with constant contact or exposure over a certain period of time, which has virtually no effect on human health and does not cause adverse consequences in his offspring. Recently, when determining MPCs, not only the degree of influence of pollutants on human health is taken into account, but also the impact of these pollutants on wild animals, plants, fungi, microorganisms, as well as on natural communities as a whole.

MAXIMUM PERMISSIBLE EMISSION (MAC) - release of harmful substances into the atmosphere, established for each source of air pollution, provided that the ground concentration of these substances does not exceed the maximum permissible concentration (MAC). Unit of measurement - g/s, t/year (volume (quantity) of pollutant emitted by individual sources per unit of time).

MAXIMUM PERMISSIBLE DOSE (MAD) - the maximum amount of a harmful agent, the penetration of which into organisms (through breathing, food, etc.) or their communities does not yet have a detrimental effect on them. A one-time traffic rules and traffic rules for a certain period of time (hour, day, etc.) are established.

MESOFAUNA , a concept from the classification of fauna by size; M. primarily includes arthropods up to several millimeters long (communities of animals of medium size - from 500 microns to 10 mm).

MESOPHILES - animals that live in places with average moisture. moderately moisture-loving animals that normally exist at average temperatures (20-40°C). They predominate in the temperate zone (salamander, roe deer, hazel grouse, newt, etc.).

MESOPHYTES are plants that can tolerate short and not very severe drought. They grow in moderately humid, moderately warm climates. M. is the most common group of plants. It includes plants of forests, meadows, as well as deciduous trees and shrubs. Mesophytes have a constant need for water. They can survive a short drought, but with a regular lack of water they become dehydrated and dry out. Occupy an intermediate position between **hygrophytes** and **xerophytes** .

MESOSPHERE - a layer of the atmosphere lying above the stratosphere, within 50 - 80 km above the Earth's surface, and is replaced by the thermosphere: characterized by a decrease in temperature with height (from approximately 0 ° to - 90 ° C).

MELANISM is the phenomenon of dark coloration of animals, depending on the presence of pigments (melanins) in their integument. Industrial M. - the emergence of dark forms of butterflies (more than 70 species) as a result of natural selection of melanists in habitats contaminated with soot.

METATENKI (from *meta.* .. and English *tank* - storage tank; artificial reservoir), closed large reservoirs (components of biological water treatment stations or treatment facilities), loaded with sludge from settling tanks. Thanks to the artificial heating of the mass, a huge number of anaerobic bacteria develop in metal, as a result of whose vital activity the breakdown of proteins into amino acids and ammonia occurs with the release of hydrogen sulfide, as well as the fermentation of fatty acids with the formation of carbon dioxide, methane and hydrogen. Various flammable gases released as a result of anaerobic fermentation are separated to heat the masses placed in the metal from the settling tank.

MYCORRHIZA - a symbiotic habitation of fungi on the roots and tissues of plant roots, ensuring that the symbionts receive part of the nutrients from each other. There are ectotrophic M., when the mycelium of the fungus entwines the roots of the plant, remaining on their surface, and endotrophic M., in which the fungus penetrates the tissue of the roots. M. is characteristic of most flowering plants (at least 90%), with the exception of aquatic and parasitic plants, some buckwheat, cruciferous, and sedge plants.

MICROCOSM - 1) an ecosystem extremely limited in extent microecosystem (often meant artificial). Widely used for modeling large ecosystems; 2) a figurative expression to designate the “world” of an individual grain of sand, drop, atoll, etc. (literally “miniature world”).

MINERALIZATION - 1) the process of decomposition of organic compounds to carbon dioxide, water and simple salts, occurring with or without the participation of decomposers; 2) concentration of salts in waters; expressed in mg/l, g/l, g/m^3 and %$_0$; with increasing climate dryness, as a rule, it increases: for example, water in the river. Pechora has M. 40 mg/l, and in the river. Emba - 164 mg/l.

MODELING (from Latin *modulus* - measure, sample) - a method of indirectly studying objects of reality on their natural or artificial analogues - models. Currently, computer modeling has become widespread, where the analogue of the object of study is its mathematical description entered into the computer.

MONITORING (from the English *monitor* - warning) - a system of regular long-term observations of the state of various environmental parameters. It is customary to divide M. into basic, or background, M. global, M. regional and M. impact, as well as by methods of conducting and objects of observation (aviation, space, human environment).

MONOCULTURE, the only agricultural crop cultivated on the farm; long-term cultivation of one crop or one species in the same field without observing crop rotation.

MONSOON FORESTS (from the French *mousson* - seasonal wind), forests of tropical and subtropical latitudes, shedding their leaves in the dry season. Distributed in Hindustan, Indochina, tropical Africa, America and other places. In M. l. dominated by teak *(Tectona grandis*), sal *(Shorea robusla)* etc. There are numerous lianas and **epiphytes** . In some places, evergreen species are found in the undergrowth. The grass cover is closed.

MUTAGENESIS (lat. *mutatio* - change, *genes* - giving birth) - the process of occurrence of hereditary changes in the body - mutations.

MUTAGENS - physical and chemical factors, the impact of which on living organisms causes the appearance of mutations. As a result of anthropogenic pollution of the environment, huge amounts of metals accumulate. M. include many pesticides, nitrogenous fertilizers (nitrites), heavy metals, some drugs, radioactive substances, viruses, bacteria and etc.

MUTUALISM - a symbiotic relationship in which the presence of each of the two species becomes obligatory for the other partner, a form of coexistence of organisms in which the partners or one of them cannot (cannot) exist without each other (without a cohabitant). For example, termites and some microorganisms of their intestines that convert wood cellulose into digestible substances; The human stomach and intestines are home to 400–500 species of microorganisms, many of which humans cannot do without.

N

NATURAL DISASTER - loss of stability of a natural, naturally -anthropogenic or anthropogenic system, occurring as a result of changes in its internal and external functional characteristics - parameters.

NATURAL RESOURCES - the totality of the natural conditions of human existence, the most important components of the natural environment around him, used directly or indirectly to satisfy various human needs. These include solar and thermal energy of the Earth, water, land, soil resources, etc.

NATURE USE - a set of all forms of exploitation of natural resource potential and measures for its conservation. P. includes: extraction and processing of natural resources, their renewal or reproduction; use and protection of natural conditions of the living environment and conservation (maintenance), reproduction (restoration) and rational change in the ecological balance (equilibrium, quasi-stationary state) of natural systems, which serves as the basis for preserving the natural resource potential of society.

NATURAL RESOURCE POTENTIAL - theoretically the maximum amount of resources that can be used by humanity on the planet and its immediate environment, that is, without undermining the conditions under which humans can exist and develop as a biological species and a social organism. It is determined by the level of ecological balance of the biosphere and its large divisions, which constitutes the limits for such existence and development.

NATURAL MONUMENT - unique irreplaceable, scientifically, culturally, educationally and health-improvingly valuable natural objects, which are small tracts (rivers, lakes, sections of valleys and coasts, landmark mountains) and individual objects (rare and reference geological outcrops, reference areas of mineral deposits fossils, waterfalls, caves), as well as natural objects of artificial origin (ancient alleys and parks, sections of abandoned canals, ponds), not recognized as historical and cultural monuments or not included in unified natural and historical monuments. Meteorites found on the territory of the Russian Federation are also subject to protection.

NATURAL FOCALITY - a natural occurrence of vector-borne diseases in humans and agriculture. animals (for example, tick-borne encephalitis) to a certain area where species of organisms necessary for the continuous circulation of the causative agent of this disease live. O. p. has a pronounced biocenotic character. The concept of O. p. was introduced by E. N. Pavlovsky (1938).

NATIONAL PARKS are a vast territory that includes specially protected natural (not subject to human impact) landscapes or parts thereof, intended, in addition to the main task of preserving natural complexes intact, mainly for recreational purposes. The territory of the village is zoned.

There are currently four types of national parks:

- open type, where all or almost all the territory is accessible to the public;
- resort type - around climatic or balneological resorts, where public access is open or partially limited;

[23] semi-closed type, where visitors are not allowed into most of the territory, and it functions as a nature reserve ;

- protected national parks, almost completely closed to tourism and preserved in the interests of science.

Unlike nature reserves, where human activity is almost completely prohibited (hunting, tourism, etc. are prohibited), tourists are allowed into the territory of national parks, and economic activity is allowed on a limited scale. Currently, there are 41 national parks in Russia, the total area of which is more than 70,000 km ^{2} (7.8 million hectares). 0.45% of the territory of Russia. The first national park in the USSR, Lahemaa , was founded in 1971 in Estonian SSR. Subsequently, the list of protected areas expanded. In the following years, the status of national parks was given to: Sochi National Park, Elk Island (1983); "Samara Luka" (1984); "Mari Chodra" (1985); Pribaikalsky National Park, Transbaikalsky National Park , etc.

NATURAL AREA - an area not changed by human activity

NOISE POLLUTION is a form of physical pollution that occurs as a result of an increase in the intensity and frequency of noise above the natural level, which leads to increased fatigue of people, a decrease in their mental activity, and when it reaches 90 - 100 dB d **EXCEPTIONS (H. Gause's law).** Even if two closely related species live in the same place, a deeper analysis shows that they avoid competition in some way: they have differences in daily or seasonal activity or in food. Thus, two related species of cormorant - great and crested cormorants - feed in the same waters and nest on cliffs. In fact, their nesting sites vary somewhat, and they feed on different fish. The great cormorant forages for food near the bottom (flounder and shrimp), while the crested cormorant catches planktonic fish in the upper layers of the water.

NITROGEN FIXERS - microorganisms (bacteria, blue-green algae, actinomycetes) that bind atmospheric nitrogen into compounds available for plant nutrition.

NITRATES - salts of nitric acid with anion (NO 3), a necessary element of plant nutrition. Widely used in agriculture as fertilizers and in the food industry as an additive. Nitrates themselves are relatively non-toxic, but can be converted into the much more toxic nitrites in the body.

23

Product	Nitrate content, mg/kg
Potato	150
White cabbage	400
Carrot	200
Tomatoes	100
cucumbers	150
Bow (feather)	400
Radish	1500
Eggplant	300
Beetroot	1400
Bulb onions	80
Leafy vegetables (lettuce, sorrel, parsley , dill* celery, etc.)	1500
Melons	90
Watermelon	60
Sweet pepper	200
Zucchini	400
Grape	60
Apples	60
Pears	60
Baby food products (canned vegetables)	50

NITRITES - salts of nitrous acid with anion (NO_2). They are used in the food industry for salting meat and fish and giving products an attractive appearance , and prevent the occurrence of dangerous bacterial infections (for example, botulism). Capable of reacting with amines in the body, forming carcinogens .

NOOSPHERE (from the Greek *noos* - reason *and spbaire -ball)* - lit. “thinking shell”, the sphere of the mind, the highest stage of the evolution of the biosphere, associated with the emergence and development of humanity in it. The formation of science assumes that human activity in various spheres is based on a comprehensive scientific knowledge of natural and social activity, that the political unity of mankind will be achieved, wars will be excluded from the life of society, and the basis of the cultures of all peoples inhabiting the Earth will be eco-humanistic values and ideals. The term was introduced by the French philosopher E. Leroy in 1927, the concept of “noosphere” was developed by the French scientist P. Teilhard de Chardin, the modern doctrine of the noosphere in 1930 -1940. created by V. I. Vernadsky

O

OBLIGATE ANAEROBES - organisms that are unable to live in an oxygen environment (some bacteria).

OUT(O)ECOLOGY is an ecological discipline that studies the relationship of an organism (species, individual) with its environment. The branch of ecology that studies the relationships of populations, communities and ecosystems with the environment is called synecology (Reimers 1990).

OUTWELLING - the introduction of nutrients from land into coastal water bodies, which are ecotones between freshwater and marine ecosystems (estuaries, estuaries, estuaries, coastal bays, etc.).

OZONE "HOLE" (OZONE) - a significant space in the planet's ozonosphere with a noticeably reduced (up to 50%) ozone content. To date, the "D" region has been registered as expanding from year to year (expansion rate - 4% per year). over Antarctica (extending the contours of the continent) and a less significant similar formation in the Arctic. The reasons for the emergence of "D" o., first noted in the early 80s of the 20th century, are not yet entirely clear. Their origin is assumed to be both natural and anthropogenic (from emissions of freons and deforestation as oxygen producers).

OCCURENCE - an indicator of the uniform distribution of individuals over the area in this area or in individual, sometimes small areas of it. It is expressed by the frequency of individuals on sample plots as a percentage of the total number of studied plots. The dimensions of the site can be expressed in cm ^{2} (to take into account the occurrence of microorganisms), in dm ^{2} (for herbaceous plants and invertebrate animals) to tens of km ^{2} (to determine the occurrence of large vertebrate animals).

P

PALEARCTIC FAUNARY REGION (from paleo ... and Greek *arktikos* - northern), zoogeographic. an area covering Europe, Asia (north of the Indus, the Himalayas and the Yangtze River), Africa, the Arabian Peninsula (without the southern part) and a number of islands (Commander, Kuril, Sakhalin, Japan, Iceland, Cape Verde, Canary, Madeira, Azores). In fauna it is close to the Neo-Arctic region. Among mammals, the following genera are endemic: chamois, yaks, saiga, musk deer, badgers, raccoon dogs, muskrats, rheas, etc.; among birds - genera: blue magpies, snowcocks, desert jays, black vultures, robins, etc.; from reptiles - round heads; of fish - golomyanka. There are Mediterranean, Central Asian, Manchurian-Chinese and European-Siberian subregions.

PAMPA - lowland subtropical steppes in South America, occupied by perennial grasses and forbs.

PERSISTENCE (from Latin *persisto* - I remain, I persist), the ability of a chemical substance to retain its properties in the environment for a long time. In ecotoxicology, for example, P. is one of the most important general characteristics, showing the ability of chemicals not only to pollute the environment for a long time, but also to spread over long distances.

PHYSICAL WASTE DISPOSAL - exposure to physical agents - radiation, light, etc. In order to destroy hazardous or harmful components.

PRODUCTION RATE - 1) a limit for the removal of individuals from a population, establishing the number and age-sex composition of animals with the expectation of maintaining the natural density and structure of populations or changing them to an economically feasible level; 2) a certain limitation on the production of a given type of animal or group of animals (for example, ducks by an individual hunter in one day, etc.).

PURIFIED WATER - water that has been brought to the level of impurities that does not exceed the natural background or permissible value.

PURE WATER - water that does not contain contaminants. From a sanitary point of view, V.ch. - does not cause deterioration in human health.

POLLUTION - the introduction into the environment or the emergence in it of new, usually not characteristic of it, physical, chemical, biological factors, leading to an excess at the time in question of the natural average annual level of concentrations of the listed agents in the environment, and, as a consequence, to negative impacts on people and the environment Wednesday. In its most general form, health is everything that is in the wrong place, at the wrong time, and not in the quantity that is natural for nature, that brings its systems out of balance, that differs from the usually observed norm and/or what is desirable for humans .

POPULATION - a collection of individuals of the same species that jointly inhabit a certain territory and have the ability to freely interbreed and produce fertile offspring. Contacts between individuals within the same population are more frequent than between individuals of different populations.

POPULATION WAVES— periodic and non-periodic fluctuations in population numbers under the influence of abiotic and biotic environmental factors, characteristic of all species.

PHYSICAL POLLUTION - pollution of the environment, characterized by deviations from the norm in its temperature-energy, wave, radiation and other physical properties.

Q

QUARANTINE is a system of measures that ensures the prevention of the spread of infectious diseases and the penetration of unwanted species of organisms into places where they do not yet live.

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R

RADIOACTIVE RADIATION - emission of alpha, beta and gamma rays.

RESIDENTIAL ZONE (RESIDENTIAL) - an area of a populated area intended exclusively or almost exclusively for housing with the removal from it or prohibition of the construction of industrial facilities in it.

RESERVE - a territory or water area specially protected by law, completely excluded from any economic activity (including visits by people) for the sake of preserving intact natural complexes (standards of nature), protecting living species and monitoring natural processes. IN Russia has 101 natural reserves. The oldest - Barguzin State Natural Biosphere Reserve - was organized in 1916 as a sable hunting reserve, created to save the most valuable fur-bearing animal - the Barguzin sable - from predatory extermination. The largest is the Great Arctic State Nature Reserve (area equal to 4 million 169.2 hectares) - the largest in Eurasia.

RECYCLING WATER SUPPLY - re-entry of used water into technological cycles or household water supply networks after its purification (in technological cycles sometimes without it).

Technological edge of V.o. — use of water without entering it into natural cycles.

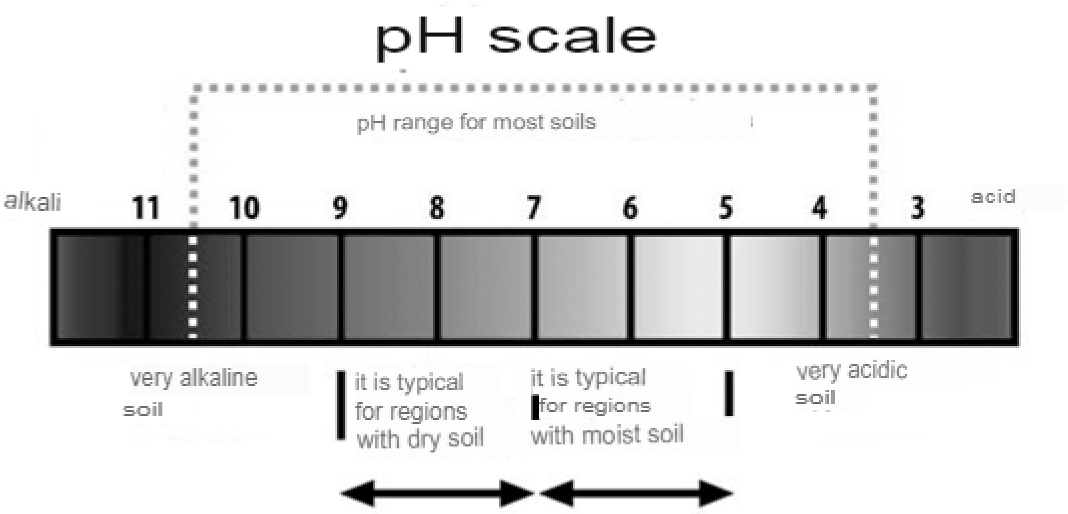
RESERVOIR - an artificial reservoir formed by a water-retaining structure for the purpose of storing water and regulating flow.

RED BOOK - list and description of rare and endangered animals, plants and mushrooms. It provides information about the main reasons for the extinction of specific species and ways to save them. The International Union for Conservation of Nature (IUCN) published the first volume of the Red Book in 1966. In the USSR, the Red Book was established in 1974. New editions with updated and amended lists of species are usually published in 5 - 10 years. Species that are no longer in danger of extinction due to the measures taken are removed from the Red Book, and those whose numbers have begun to decline catastrophically are listed.

REGIONAL MONITORING - monitoring of environmental processes and phenomena within a certain region, where these processes and phenomena may differ both in natural nature and in anthropogenic influences from the basic background characteristic of the entire biosphere.

RISK ANALYSIS - research aimed at determining the essence and probability of risk (ecological, economic, technological, etc.) arising during the functioning of natural and man-made systems, the implementation of a project or the implementation of a given policy.

ROAD TRANSPORT - a complex that includes vehicles , infrastructure facilities for the operation of vehicles and roads (draft federal law “On ensuring the environmental safety of road transport”).



R

RATIONAL NATURE MANAGEMENT is a system of activities designed to ensure the economical exploitation of natural resources and conditions and the most effective mode of their reproduction, taking into account the long-term interests of the developing economy and preserving people's health. Etc. - highly efficient management that does not lead to sudden changes in natural resource potential, for which humanity is not socially and economically prepared, and does not lead to profound changes in the natural environment around humans, damaging his health or threatening his very life.

RECREATIONAL LOAD - the degree of influence of vacationers on natural complexes or recreational facilities (for example, natural ecosystems, forest parks). Expressed as the number of people per unit area or man-days per unit area or per object for a certain period of time **.**

RECLAMATION - artificial restoration of soil fertility and vegetation after man-made disturbance of nature (open-pit mining, etc.) using special technologies. Includes restoration of landscapes, soils, vegetation, etc.

S

SPATIAL ANALYSIS - in geography : a set of analytical methods of geographical research related to the study of spatial structures. The main groups of such methods: spatially - quantitative (method of geographical fields, method of gravity models, etc.); statistical; matrix models; topological methods and models based on graph theory: cartometric analysis; theory of spatial interaction and movement; concept of geographical location; system-structural analysis. The same methods of spatial analysis are used in different geographical disciplines (GES) (see: Ecological space).

SMOG is a combination of dust particles and fog droplets (from the English " *smoke* " - smoke, soot and *" fog "* - thick fog). There are London smog (a mixture of smoke and fog, which occurs when the atmosphere is polluted with soot or smoke containing sulfur dioxide) and Los Angeles smog (photochemical smog caused by air pollution from vehicle exhaust gases containing nitrogen oxides; it occurs in clear sunny weather with low air humidity , ozone and peroxyacetyl nitrate (PAN) are formed.

SOIL, soil cover, one of the most important natural resources of our planet, a means of production and an object of labor, the main source of food, the most valuable property of nations, peoples and states. P. is a gigantic ecological system that, along with the World Ocean, has a decisive influence on the entire biosphere. It actively participates in the cycle of matter and energy in nature and maintains the gas composition of the Earth's atmosphere. The landscape consists of many biogeocenoses (ecosystems) and landscapes, the main interconnected components of which are rocks, plants, animals, and microorganisms. P. is the most important biotic adsorbent and neutralizer of pollutants. Preservation of the Earth's soil is the most important condition for ensuring and maintaining ecological balance in the biosphere. According to FAO, by the mid-80s of the 20th century. was plowed and cultivated for approx. 1.5 billion hectares of P., i.e. 10.8% of potentially usable land.

SANITARY PROTECTION ZONE - a strip separating an industrial enterprise from a residential area (settlement).

SECONDARY SUCCESSION is the successive development of communities in which natural vegetation has been eliminated or severely disturbed, but the soil has not been destroyed. An example of secondary succession is, for example, the development of a community on the site of a spruce forest destroyed by fire. In the territory it previously occupied, soil and seeds were preserved. The herbaceous community will be formed the following year. Further options are possible: in a humid climate, rush grass dominates, then it is replaced by raspberries, which is replaced by aspen; in dry climates , reed grass predominates, it is replaced by rose hips, and wild rose by birch. Under the cover of an aspen or birch forest, spruce plants develop, eventually displacing deciduous trees. Restoration of a dark coniferous forest occurs in approximately 100 years.

SODD - the top layer of soil, penetrated by roots, rhizomes, as well as the bases of shoots of turf grasses and sedges, giving it cohesion. D. is characterized by a high nitrogen content and is characteristic of meadows and steppes, as well as grassy sedge bogs. D. protects the soil from erosion.

STATE NATURAL RESERVES - territories (water areas) of particular importance for the conservation or restoration of natural complexes or their components and maintaining the ecological balance. There are 24 state natural reserves of regional importance in Tatarstan of various profiles. State natural reserves of regional significance of the Republic of Tatarstan with a complex profile - “Ashit”, “Kichke-Tan”, “Sviyazhsky”, “Chatyr-Tau”, “Chulpan”, “Stepnoy”, “Spassky”, “Chistye Meadows”, “Baltasinsky”, "Long Glade" and others.

STATE NATURAL RESERVES - are environmental protection, scientific research and ecological educational institutions aimed at preserving and studying the natural course of natural processes and phenomena, the genetic fund of flora and fauna, individual species and communities of plants and animals, typical and unique ecological systems.

STATE NATURAL BIOSPHERE RESERVES -state nature reserves , which are part of the international system of biosphere reserves ,carrying out global environmental monitoring . There is one biosphere reserve in Tatarstan. The Volga-Kama State Natural Biosphere Reserve was established on 13 April 1960 by Resolution of the Council of Ministers of the RSFSR No. 510 with the aim of protecting the remaining undisturbed forest and forest-steppe ecosystems of the middle Volga region. It occupied an area of 10,091.2 hectares. The reserve consists of two sections - Saralovsky and Raifsky.

STATE ENVIRONMENTAL CONTROL is a part of state law enforcement activities for the implementation of environmental law, which consists of checking compliance with environmental requirements and the implementation of environmental measures by enterprises, institutions, organizations and citizens in the process of economic or other activities associated with impacts on the environment.

STATE ECOLOGICAL EXAMINATION – see environmental assessment.

SOUND RADIATION (sound) - excitation of sound waves in an elastic (solid, liquid, gas) medium. Audible sound - 16 Hz - 20 kHz, infrasound - less than 16 Hz, ultrasound - 21 kHz - 1 GHz and hypersound - more than 1 GHz.

SOURCE OF POLLUTION - 1) point of release of substances (pipe, etc.); 2) an economic or natural facility that produces a pollutant; 3) the region where the pollutants come from (during long-distance and transboundary transport); 4) extra-regional background of pollution accumulated in the environment (in the air - CO_2, in the water - their acidity, etc.).

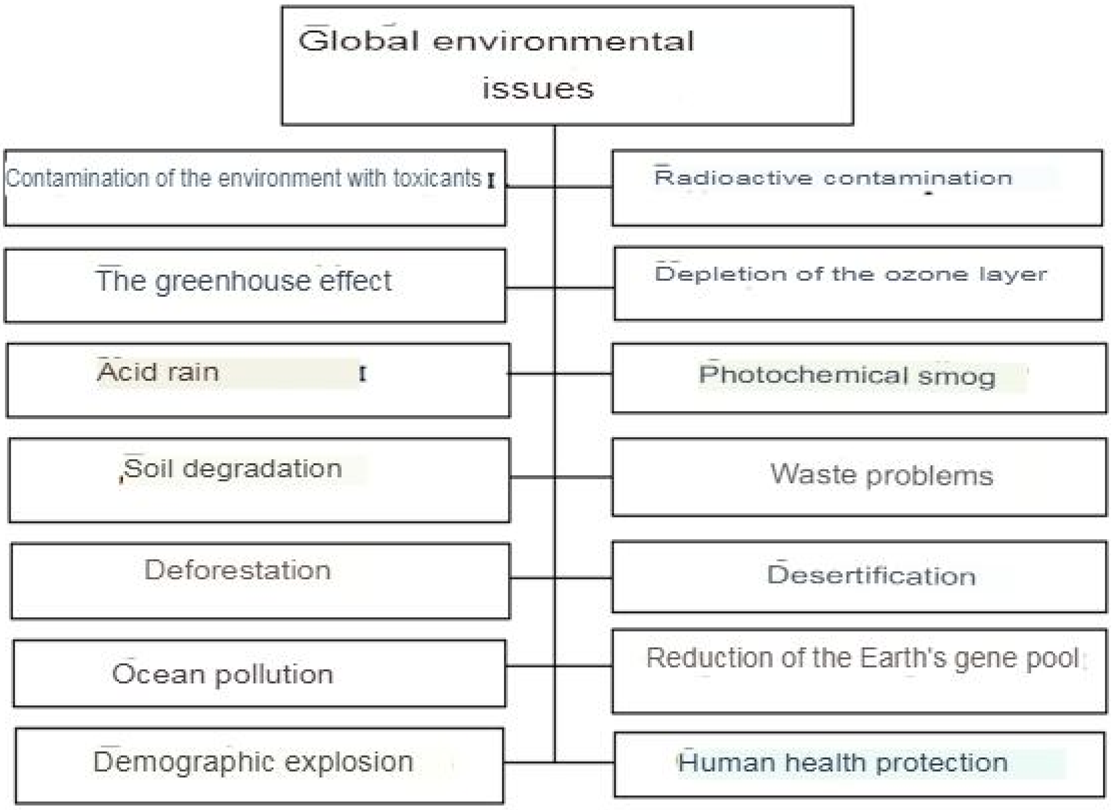
SURFACE WATERS - waters located on the surface of the land in the form of various water bodies. There are sea, lake, river, swamp and other waters. Surface water resides permanently or temporarily in surface water bodies. Objects of surface water are: seas, lakes, rivers, swamps and other watercourses and reservoirs. There are salty and fresh waters of land. Surface water is contrasted with groundwater .

SOIL SALINIZATION - an increase in the content of easily soluble salts in the soil (sodium carbonate, chlorides and sulfates), caused by the salinity of soil-forming rocks, the introduction of salts by ground and surface waters, but more often caused by irrational irrigation. Soils are considered saline when they contain more than 0.25% salts in the solid residue (for gypsum-free soils).

SUPERPARASITE - superparasite, superparasite, organism parasitizing in (or on) another parasite.

SANITARY AND HYGIENIC STANDARD is a qualitative and quantitative indicator, the observance of which guarantees safe or optimal conditions for human existence (for example, the standard of living space per family member, the standard of water quality, air quality, etc.). Synonym: hygienic standard.

STANDARDING THE QUALITY OF THE ENVIRONMENT (water, air, soil) - establishing limits within which changes in its natural properties are allowed. Usually the norm is determined by the reaction of the most sensitive species of organism to changes in the environment (indicator organism), but sanitary-hygienic and economically feasible standards can also be established.



SOIL ACIDITY - the concentration of hydrogen ions in the soil solution (active, or actual, acidity) and in the soil absorption complex (potential acidity).

SOIL acidity	Acidity level
Strongly acidic	1.5 or less
Medium acid	1.6—5
Subacid	5.1— 5.5
Close to neutral	5.6-, 1
Neutral	6.7-, 3
Slightly alkaline	7.1-
Alkaline	8.1 - .5

T

TECHNOGENIC LANDSCAPE is a type of anthropogenic landscape, the features of the formation and structure of which are determined by human production activities associated with the use of powerful technical means. The impact can be direct (mechanical disturbance of land, vegetation, flooding, etc.) and indirect (pollution by industrial emissions, acidification of sediments, disturbance factor, etc.).

TERRITORIAL-PRODUCTION COMPLEX (TPC) -
a group of enterprises and institutions that perform a certain national economic function and are interconnected, in addition to production ties, by the joint use of territories, natural and labor resources located in this territory, as well as production infrastructure (structures, buildings, transport systems not directly related to the production of material goods, but necessary for the production process). Often has a specialization based on the leading natural resource of the territory (for example, TPK Kursk magnetic anomaly). An interconnected set of TPKs constitutes a regional TPK, which serves as the basis for the formation of an economic region.

TOXIC DOSE - the minimum amount of a harmful agent that leads to noticeable poisoning of the body.

TREE STAND - a collection of trees forming a more or less homogeneous forest area. D. can be pure (from one breed) and mixed (from two or more breeds); simple (crowns in one tier) and complex (several tiers); same-age and uneven-age. The composition of the forest stand is a list of tree species that form the forest, indicating the share of participation of each of them in the total stock of the forest stand. To indicate the composition of forests in forest taxation, conditional formulas for the composition of the forest stand have been established. In them, tree species are designated by the first letters of their generic name. Tree species with the same initial letters of the name are designated by the first two or three letters of their name (for example: aspen - Os, alder - Ol). In the forest stand composition formula, along with the letter name of the tree species, a composition coefficient is indicated, reflecting the share of its participation in a given forest stand, which is determined by the ratio of the wood reserves of its constituent species or the sum of the cross-sectional areas of their trunks. The unit of the composition coefficient corresponds to ^% of the stock of a given species in the total stock of the forest stand. For example, if a forest stand contains 2 tree species - pine and spruce, the stock of which is 70 and 30%, respectively, the composition of such a forest stand will be characterized by the formula 7C3E.

TECHNOSPHERE (from the Greek *techne* - art, craftsmanship and *sphaira* - ball, sphere) - part of the biosphere, transformed by people with the help of direct and indirect influence of technical means (scientific and technological revolution) in order to best meet the socio-economic needs of humanity

THERMAL WASTE DISPOSAL - their treatment at a temperature of 600 - 1000 ° C in special reactors.

THERMAL POLLUTION (thermal) is a form of physical pollution of the environment, characterized by a periodic or prolonged increase in its temperature against the natural level.

TRANSBOUNDARY POLLUTION - environmental pollution that covers the territory of several states or entire continents and is formed due to the transboundary transport of pollutants.

TENANTRY is a form of commensalism in which one species uses another (its body or home) as a shelter or home (the habitation of many species of arthropods in rodent burrows and bird nests). Epiphytic plants (algae, mosses, lichens)

V

VISIBLE RADIATION - optical radiation with a wavelength from 740 nm (red light) to 400 nm (violet light), causing visual sensations in humans. It consists of 3 types: visible light, which we can see, and infrared and ultraviolet radiation, which we can only feel. These types of radiation are distributed as follows - visible light occupies 44%, infrared radiation 53% and ultraviolet 3% of the entire solar spectrum

VERMICIDE is a means of killing worms.

VICARISM - mutual replacement of species in similar ecosystems distant from each other

VIOLENTS - a type of plant strategy according to L. G. Ramensky, characterized by high competitiveness (“siloviki”, “lions”). These are trees, less often shrubs and grasses with a powerful habit and a developed root system, the most powerful in their ability to form communities or penetrate into them, develop energetically, capture territory, retain it, suppress rivals with superior vital energy and complete use of environmental resources. In successions , violents dominate in the last stages (for example, oak in the forest, reed in the river deltas of the middle zone).
VIRUS(S) are non-cellular life forms that can penetrate certain living cells and reproduce only within those cells. V. are intracellular parasites at the genetic level.

W

WATER TURBIDITY - the content of suspended substances per unit volume of a mixture of water and these substances, expressed in weight units (g/m3 ٬ mg/l) or volume units. Marine water, as a rule, increases in reservoirs as they approach the shore (depending on the waves eroding the shore), and in watercourses - from the surface to their bottom (increases due to the current eroding bottom sediments). Maximum M.v. observed during high water. Usually M.v. grows with a decrease in the water content of the area: in the rivers of the forest belt of the European part of Russia it ranges from 50 to 100 g/m ^{3}, in the forest-steppe - 100 - 200 g/m ^{3}, in the steppe and semi-desert - 250 - 500 g/m ^{3}. The most muddy river in the world is the Yellow River (35 - 40 thousand g/m ^{3}).
WATER USE - the procedure, conditions and forms of use of water resources: 1) use of water bodies to meet the needs of the population and the national economy; 2) the use of water for economic or domestic purposes without removing it from water bodies, by “passing it through itself” (hydroelectric power plants or a water mill). V. is possible without changing the quality of water and with a change in its quality (including the species composition of the animal and plant world).
WATER CONSUMPTION - consumption of water from a water body or from water supply systems. A distinction is made between return water - with the return of withdrawn water to the source and irreversible water - with its consumption for filtration, evaporation, etc.
WATER SUPPLY is a technological process that ensures the collection, preparation, transportation and transfer of drinking water to subscribers.
WASTE-FREE TECHNOLOGY is a technology of a separate production or industrial complex aimed at the rational use of natural resources, ensuring the production of products without waste. Includes a set of measures to ensure minimal losses of natural resources in the production of raw materials, fuel and energy, as well as maximum efficiency and cost-effectiveness of their use.
WASTE DEWATERING is a technological method of separating water from waste or waste for the purpose of their further processing (briquetting, incineration, etc.).
WEATHERING is the process of mechanical destruction and chemical change of rocks and minerals of the earth's surface and near-surface layers of the lithosphere under the influence of various atmospheric agents, ground and surface water, the vital

activity of organisms and the products of their decomposition. There are chemical, physical and
biological weathering.

WATER DISCHARGE - 1) a set of sanitary measures and technical devices that ensure the removal of wastewater outside *a populated area* or industrial enterprise; carried out from the sewer; 2) V. with the help of a drainage canal - freeing a river bed from water for the purpose of carrying out hydraulic engineering work in it or to protect some objects from flooding by the river during the period
flood or *flood.*

WATER PROTECTION ZONE - an area adjacent to water bodies, where a special regime of economic and other activities is established to prevent their pollution, clogging and depletion, as well as to preserve the habitat of fauna and the growth of flora;

WEATHER SENSITIVITY (Greek *meteora* - atmospheric phenomena) - the body's sensitivity to weather changes.

WASTE DISPOSAL - placing it underground, in geological workings (abandoned coal mines, salt mines, sometimes specially created cavities) or the deepest depressions of the seabed without the possibility of reverse extraction.

WATER HARDNESS - the content of dissolved salts of alkaline earth metals - calcium, magnesium, etc. It is measured by the sum of milligram equivalents of calcium and magnesium ions contained in 1 liter of water. There are general fluids. (the total amount of calcium and magnesium contained in water), removable and permanent liquid. Depending on the general fluid. distinguished: very soft (up to 1.5 mEq), soft (1.5 - 3 mEq), moderately hard (3 - 6 mEq), hard (7 - 9 mEq), very hard (over 9 mg-eq.) water. Until 1953 J. century. measured in degrees of hardness, showing how many grams of calcium oxide are contained in 100 liters of water. 1 degree of hardness is equal to 0.35663 mEq. calcium or magnesium ions. In some countries even now Zh. v. measured in degrees.

X

XENOBIOTIK (from the Greek *xenos* - alien) - any substance foreign to a given organism or their community (pesticides, household chemicals, etc., pollutants) that can cause disruption of biotic processes, including disease and death of living organisms.

XEROTIZATION (from the Greek *xeros* - dry), a gradual decrease in the degree of soil moisture and a general increase in dryness in ecosystems, landscapes, etc. due to the gradual human impact on the soil cover, which sharply increased during the era of the scientific and technological revolution (afforestation of territories, pumping of groundwater for industrial purposes, destruction of vegetation and formation of shifting sands in pastures, etc.).

XEROPHILE - an organism adapted to life in conditions of lack of water, and therefore lives in places with low humidity (animals - lizards, turtles, etc.). Xerophilous plants in dry habitats that can tolerate prolonged drought ("drought-tolerant") are called xerophytes.

XEROPHYTE - a xerophilic plant in places with insufficient moisture, which can tolerate temporary wilting with a loss of 50% of moisture or can live in arid areas. There are different categories of plants: succulents and sclerophytes. They have devices that allow them to obtain water when there is a shortage of water, limit the evaporation of water and store it during drought.

Z

ZONING OF A NATIONAL PARK - dividing its territory into areas with different modes of operation. As a rule, 3-4 zones are distinguished: reserve, economic and recreational (in addition toalso called the buffer zone).

ZOOPLANKTON is a collection of animals that live (as a rule, freely floating) in the water column of sea and freshwater bodies of water and are able to resist transport by currents. Z. is an integral part of plankton. Z., although very rarefied, is found almost to the maximum depths of the World Ocean.

ZOOPHAG - an organism that feeds on animals, a carnivorous species.

ZOOCENOSIS is a collection of animals living together under certain conditions. Z. can arise between different species due to the attraction of some animals by others, and the relationship in a zoocenosis is often one-sided (for example, parasites and the host).

Examples of questions during the final control:

1. What does mining mean?
2. Hygienic standard for atmospheric air quality.
3. Groups into which mineral resources are divided?

1. What does the environment consist of?
2. Classification of environmental protection methods.
3. Types of land disturbance

1. Anthropogenic impact on the environment.
2. Sources of environmental pollution.
3. Main water pollutants.

1. The main directions adopted in mining for environmental protection.
2. Methods of mining.

3. Environmental standard for atmospheric air quality.

1. Basic requirements of the Law “On Environmental Protection”.
2. Composition and properties of mine water.
3. Placement of radioactive waste repositories.

1. Consequences of the impact of mining on the environment.
2. Economic methods of influence aimed at preserving the environment.
3. Placement of oil and gas storage facilities.

1. How are harmful emissions into the air and water bodies cleaned?
2. Integrated use of mineral raw materials.
3. What laws of the Russian Federation is the economics of environmental management based on?

1. What does the concept of environmentally “dirty” technologies mean?
2. Stages of mine water purification.
3. Use of the underground space of the earth's bowels.

1. Recycling of natural resources.
2. Types of land disturbance occur during the development and enrichment of mineral resources
3. Location of Nuclear Power Plants.

1. Rational placement of sources of environmental pollution.
2. Mining and technical land reclamation.
3. Disposal of enrichment waste and sludge.

1. Characteristics of the main atmospheric pollutants.
2. Biological land reclamation.
3. Circulation method of heat energy production.

1. Main types of environmental pollution.
2. Determination of economic damage from environmental pollution.
3. Fountain method of heat energy production.

1. Methods and methods for cleaning the atmosphere from harmful impurities.
2. Economic incentives for environmental protection.
3. Development of placer mineral deposits.

1. World freshwater resources and volumes of its consumption.
2. The nature of the formation of alluvial mineral deposits.
3. Types of thermal resources of the earth's interior.

1. Water quality standardization indicators.
2. Soil quality standardization indicators.
3. Types of payments and taxes for environmental pollution.

1. Polluting properties of wastewater from mining enterprises.
2. Purposes of using the earth's interior.
3. Minerals extracted from placer deposits.

1. Technologies for purifying mine water from harmful impurities.
2. Conditions for mineral raw materials.
3. Mineral nodules.

1. Use of mining waste.
2. Extraction of silts and other similar minerals.
3. Geotechnologies.

1. Use of by-products.
2. Methods of generating electricity.
3. Hydrogeothermal resources.

1. Current state of the environment.
2. Technology of environmentally closed production.
3. Extraction of metals and other minerals from waste.