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**DEVELOPMENT AND SUBSTANTIATION OF THE CONSTRUCTION
DRYING-DRUM MIXING ASPHALT PLANT COAXIAL TIPE**

5A521106 - Elevating transport machines

DISSERTATION

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Introduction

In the independence of the Republic of Uzbekistan and the market economy much attention is paid to road construction. This is reflected in the published laws. Among the works scheduled in 2006-2010 stress the importance of road construction, in particular, reconstruction or repair of roads, construction of new roads that meet world standards.

In the works of the President of the Republic of Uzbekistan, I.A Karimov, dedicated to overcoming the effects of the global economic crisis in the economy of Uzbekistan, identifies specific ways and requirements. Among them the development of efficient, productive, compact and durable hardware, new technologies, upgrading existing equipment. From this we see that our main task to achieve the best economic results by building modern plants.

Growth of industrial sites and cities, discovery of new mineral deposits, the development of human settlements - all of this has transformed in recent years to quantitatively and qualitatively cargo flows and their direction. Increased need for improved, in particular, bituminous concrete pavement for roads.

The positive performance of the asphalt concrete pavement - silence, steadiness, dust-free, and relatively long life span and speed of the device and saving long life and speed of the device - contributes to their widespread use on the roads of I-III categories.

Mixtures of such coatings are prepared in specialized manufacturing plants called asphalt plants. Asphalt plant may be seasonal lifestyle, mobile, located in one place for one or two construction seasons with a minimum radius of carriage of the mixture, and stationary, located in one place for up to 10 years and more.

Seasonal asphalt plants are built near the road at the base of mobile equipment. The main equipment of seasonal asphalt plant supplied from the machine with a complete technological process, for example, the mixing unit, power unit, gas treating plant, etc. They are usually solved on the basis of the

parterre arrangement in the form of inventory prefabricated, mobile on pneumatic cart.

Efficiency and quality of road construction is largely dependent on reliable and smooth operation of asphalt plants. In their composition includes a large number of complex and expensive machinery and equipment. This composition for its intended purpose and the device is extremely varied and continuously updated with new progressive designs.

To reduce construction time, improve quality and reduce costs is a necessary condition to ensure full and effective use of all machinery and equipment belonging to the asphalt plant. This is especially important because the technical condition of the whole complex of machines and equipment directly affects the quality of asphalt concrete mixtures, and hence on the quality and durability of road surfaces. Production of asphalt concrete mixtures, one of the most energy-intensive processes of road construction, but on the technical condition of the entire fleet of vehicles comprising Asphalt plant, depends on consumption of fuel and energy resources.

Chapter I. Analysis of existing designs asphalt installations

1.1. Review and analysis of the construction of asphalt plants

Asphalt plants are the main manufacturing facilities and road facilities are intended for preparation of various asphalt mixtures for construction, reconstruction and repair sections of asphalt concrete pavement. However, the list carried in the asphalt plant technological operations, and hence the nomenclature of technological equipment asphalt plant is much wider than just the complex operations of the mixing and the list required for the preparation of their equipment.

The list of technological and providing operations include:

- technological operations (set operations), the mixing, including pre-dosing of mineral materials, heating and drying of mineral materials, sorting (screening) and short-term storage of heated stone materials, the exact dosage of mineral materials, bitumen or other special binder, filler and additives, blending components in the mixer and discharge from the mixer ready (commercial) of asphalt concrete;
- manufacturing operations for receiving, storing and feeding into the bunkers on the factions of stone materials, and if necessary to obtain the necessary asphalt plant by size fractions of crushed stone and sand by crushing and screening of larger fractions of crushed stone;
- technological operations for receiving, storage, heating and feeding in doses of bitumen;
- manufacturing operations for receiving, storage and filing in spout filler;
- technological operations for receiving, storage, heating and applying a filler surface-active substances (SAS);
- technological operations for warehousing, temporary storage and shipment of finished asphalt mixture.

For the full range of technological operations in the asphalt plant includes the following process equipment:

- Asphalt plant;

Reception facilities for stone materials, areas for storage and machinery for their application in the bunkers of asphalt mixing plants;

- Receiver for bitumen storage (tanks) for bitumen, bitumen heating equipment, asphalt pumps;
- Reception facilities and playgrounds for the barrels of surfactants or bulk surfactant, heaters and pumps for surfactants for their submission to the mixer;
- Receivers and containers for storage of mineral powder and pumps (pneumatic) for making it to the mixer;
- Boot device (or skip the elevator), ready mix, silos, storage of finished mixture;
- Crushing and Screening equipment for obtaining the required fractions of rubble and sand.

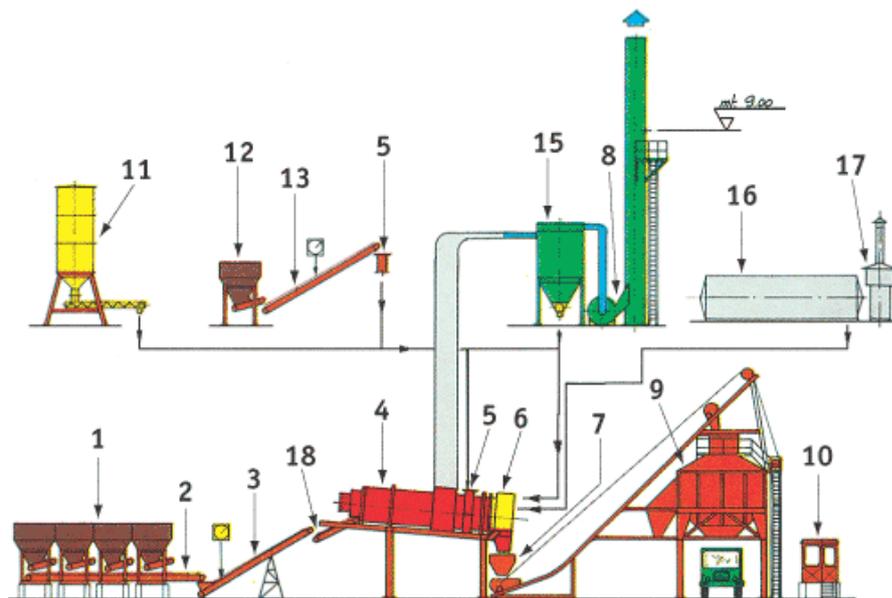


Figure 1.1 Scheme of continuous asphalt plant

1. Hopper feeder, 2. Frame Conveyors, 3. Conveyor control humidity, 4. Drying and Mixing drum, 5. Dispensing and supply of old asphalt, 6. Smesitelnaya Zone
7. Bunker expectations skip, 8. Pylesos Fan, 9. Silo, 10. Control cabin, 11. Silo The mineral powder, 12. Bunker old asphalt, 13. Conveyor with humidity control, 15. Dust collection and dust silo, 16. Bitumen tank, 17. Oil heater, 18. Conveyor drying drum.

In addition to the basic technological equipment the asphalt plant may include:

- Equipment for preparation and storage of bitumen emulsions;

- Storage of fuel (gas, diesel or fuel oil);
- Construction of administrative and domestic purposes;
- Facilities for electricity;
- Boiler;
- Compressor stations;
- Water supply equipment;
- The network of electricity, heat and water;
- Laboratory;
- Repair shop;
- Logistic warehouse.

Asphalt Plant distinguishes:

- By type of accommodation: on with the rail and Trace (onsite);
- For the duration of work in one place: on the stationary, inventory and mobile ;
- The number and total performance of asphalt mixing plants.

When constructing a rail asphalt plant directly from the railway line along which receives all or most of the source materials: crushed stone, sand, bitumen, mineral powder, surfactants and fuel.

When Trace asphalt plant constructing the immediate vicinity of a highway being built to reduce the distance and time of transporting the finished asphalt mixture. All raw materials and fuel are transported by road to rail at the basis of warehouses or directly from the factories producing them: with quarry stone materials and sand, Asphalt plants and mineral powder.

Stationary asphalt plant erect, usually collapsible and expect to operate in the same place 10 years or more.

Inventory asphalt plant construct disassembled and expect to operate in the same place within 2-4 years.

Mobile asphalt plant construct disassembled and expect to operate in the same place up to 1 year.

Number of mixers for asphalt plant ranges from 1 to 6. At asphalt plant stationary, usually from 2 to 6, and the inventory and movable from 1 to 2.

With this in mind below describes the main technological systems of equipment for preparation, storage and shipment of asphalt mixtures.

According to the principle of asphalt installation divided into cyclic (periodic action) and continuous (cw).

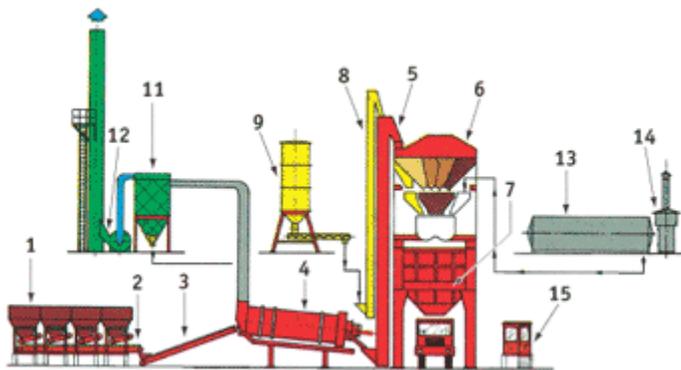


Figure 1.2 With storage hopper under mixer

Classical scheme of asphalt mixing plants cyclic

1. Bunkers – before dosing
2. Frame Conveyors
3. Conveyor drying drum
4. Desiccators’
5. "Hot" elevator
6. Mixing Tower
7. Silo
8. Elevator mineral powder
9. Silo mineral powder
11. Scrubber and Silo dust
12. Hoover Fan
13. Bitumen tank
14. Oil heater
15. Control cabin

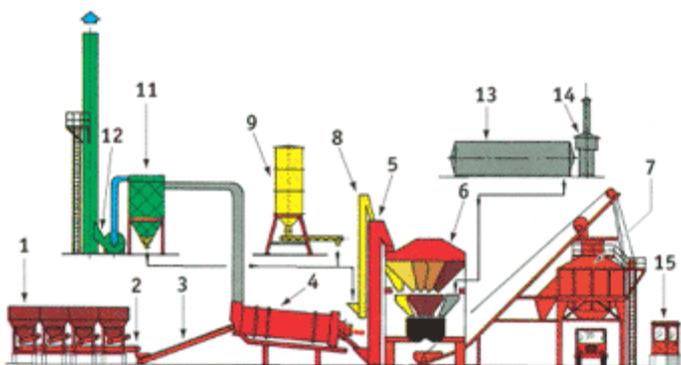


Figure 1.3 Since the vehicle load-dump from a separate storage hopper

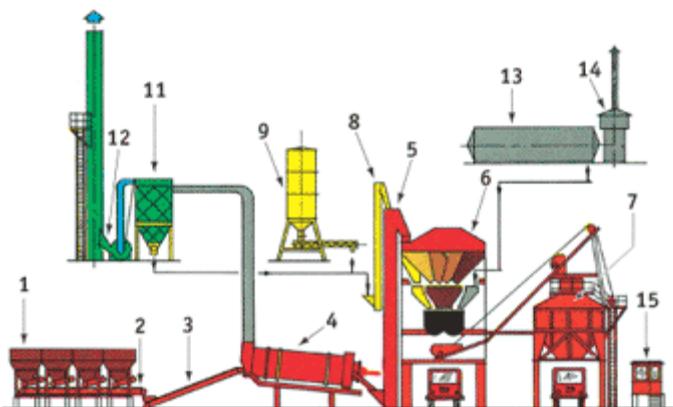


Figure 1.4 Car boot from the mixer and a separate storage hopper

Modern technological solutions used in the production of Asphalt plants DMI allow us to call them the world leaders in the production of Asphalt plant of any capacity and every performance.

Company Ufadormash - Smart Travel Cars is on the territory of Russia and the CIS products company DMI (South Korea), the largest manufacturer of high asphalt and concrete plants. Company DMI gained prominence in the world of product quality and innovation in the development and manufacture of highly reliable systems of electrical and process control systems. Asphalt installation DMI produced in the mobile and stationary performance, capacity from 60 to 360 tons per hour of finished mixture. Asphalt plants DMI able to work in the harshest conditions, including with high humidity and dust source material. Asphalt plants DMI produce as good asphalt mixes, and rubble-mastic and mastic asphalt.

Given the urgency of the matter recycling of old asphalt, the company DMI pays particular attention to this. Realizing that high quality and high-tech recycling old asphalt should significantly change the production process, the company supplies its plants DMI recycling line, which includes an additional power unit, a line of heating the mixture, a line of transportation, and dosage recycled mixture.

Office of Asphalt plant by DMI distributed computer system: each business unit installation is controlled by its microcomputer, relaying information to a central control computer. Failure of any of the microcomputer or the central control computer does not lead to failure of the installation. In addition, all microcomputers duplicated manual control and management system. Thus, you get a highly reliable control system Asphalt plant DMI, excluding the possibility of unintentional stop equipment.

Asphalt plants DMI does not pollute the environment, they meet the highest environmental standards and are allowed to work in particularly critical areas and conservation zones.

Thanks to the use of high-tech manufacturing processes, Asphalt plants DMI, to date, is the best offer on the Russian market in terms of price, quality and

delivery in comparison with similar equipment of European and American production.

1.1.1 Asphalt plants classification

Asphalt mixing plants - a set of basic technological equipment asphalt plant that fulfills the basic operations of the technological process of preparation of asphalt and bituminous mixtures.

Asphalt installation is classified by major structural and technological parameters: by appointment, performance, principle of operation of the mixer, the constructive arrangement of basic units, the mobility.

By appointment Asphalt plant can be divided into three groups. The first group includes facilities for making hot asphalt. The second group consists of the installation, designed primarily for the production of liquid asphalt. Production of hot asphalt and mastic asphalt requires heating source fractions rubble and sand. The third group includes Asphalt plant for the preparation of cold asphalt without heating the initial components of asphalt concrete.

The nominal performance of asphalt mixing plants assess the condition of preparation or fine-grained sand mixtures with the calculated moisture content of stone materials 6%. For distinguished performance of asphalt mixing plants sizes: 12, 25, 32, 50, 100, 150, 200, 250, 400 t / h. Most plants are currently in operation in Uzbekistan, have productivity from 25 to 260 t / h.

According to the principle of mixing Asphalt plant can be cyclical and continuous. In plants cyclical action all preparatory and auxiliary operations associated with the filing of stone materials, their drying and heating, loading supplies into the bunkers and preparing bitumen, carried out continuously. However, dosing, conveying all the components of the mixture, their mixing and unloading of the mixer produced periodically in the form of repeated cycles. Installations of this type are particularly prevalent because they can accurately maintain the desired prescription composition of the mixture, to move quickly to release a mixture of any of the prescription, changing the time of mixing, to obtain

high quality blends. In the continuous process equipment for assembling and installing asphalt plant divided into the tower and a ground. The most widely used set with tower location units.

According to the degree of inventory distinguish the installation of three types: fixed, collapsible and mobile.

An important task in designing asphalt plant - to determine for him on the road under construction. The proper solution of this problem depends not only the cost of the mixture, but the success of the plant, timing of construction of the road. Location of the plant depends on the needs of the mixture, the period of construction, terrain, location of bases and sources of supply of materials for the preparation of the mixture, railway stations, access to electricity and water, industrial or residential facilities, etc.

Decisive for the placement of asphalt plant is the account of technological features of asphalt hot mix - cool in the way and, accordingly, the delivery time from factory to construction site.

Location asphalt plant and its performance should provide the lowest cost of asphalt concrete in place of its installation, the continuity of flow and designed by the pace of construction.

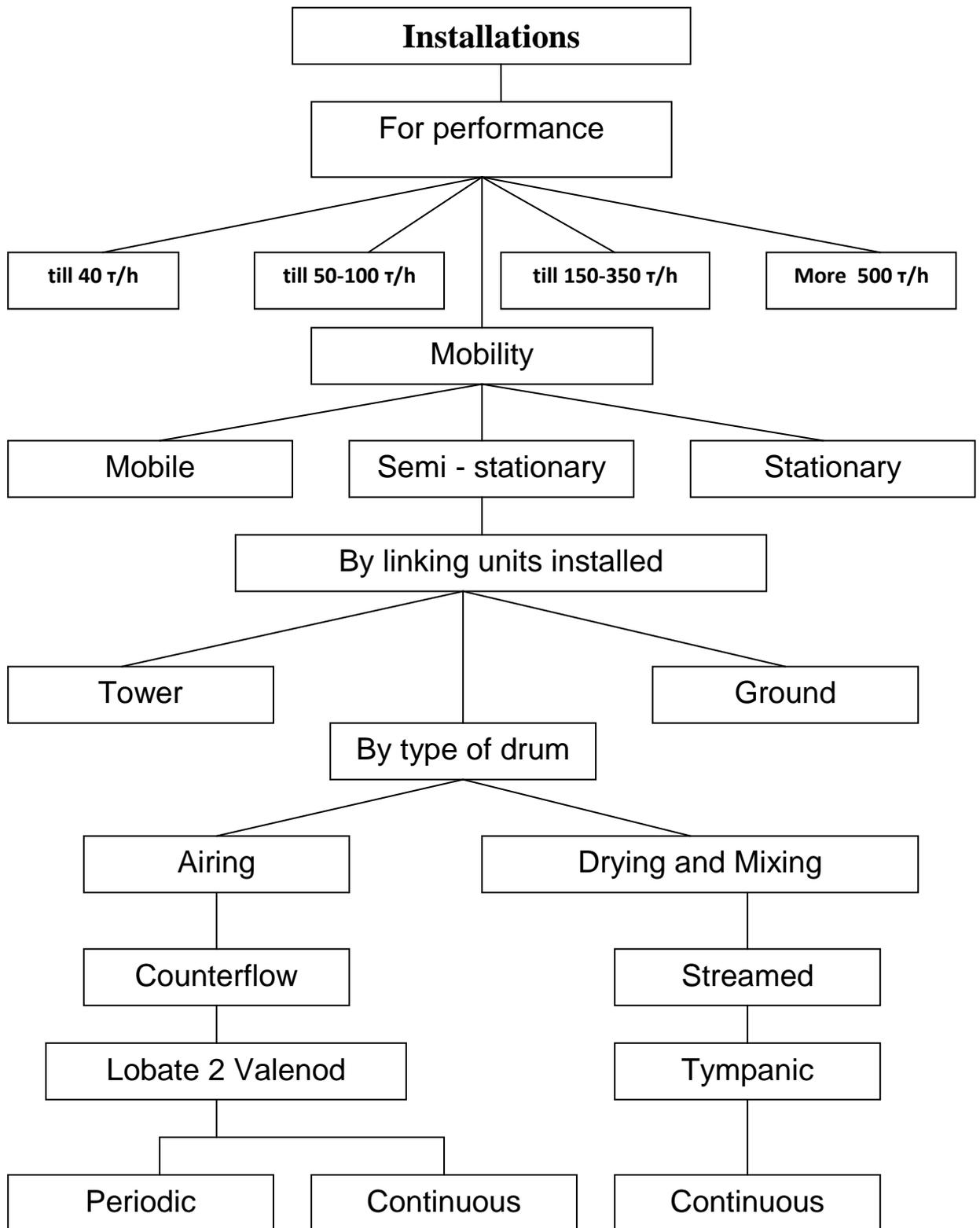


Figure 1.5 Classification of asphalt mixing plants

Preparation of asphalt concrete mixtures (Figure 1.6) consists of the following operations: drying and preheating of stone materials, sorting and fractions, and dosage of mineral binders, stirring the mixture components and delivery of ready mix.

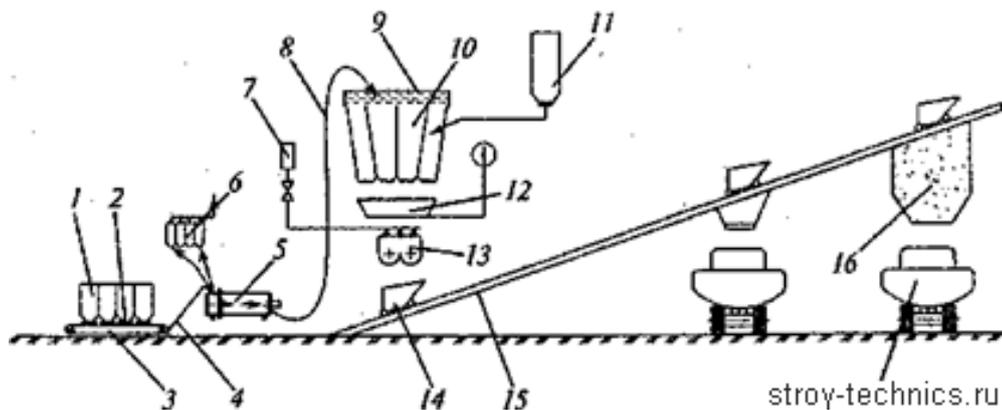


Figure 1.6 Process scheme of preparation of hot asphalt mixtures:

1 - bunker supply unit; 2 – feeder; 3 - conveyor belt; 4 - inclined conveyor; 5 - desiccators; 6 - dust removal system (cyclones); 7 - filler bitumen; 8 – elevator; 9 - drum, 10 - mineral silo materials, 11 - bunker mineral powder, 12 mass-dispensing mineral materials; 13 – mixer; 14 - skip; 15 - skip path; 16 - storage bin asphalt mixture; 17- dump.

To improve the quality of asphalt mixture injected surface-active agents and activators. As a cationic surfactant used and anion substances. By cationic substances include salts of higher primary, secondary and tertiary aliphatic amines, tetra-ammonium compounds; to anion - the higher carboxylic acids, salts (soaps) of heavy and alkaline earth metals of higher carboxylic acids. The use of surfactants can reduce the heating temperature of mineral materials and mixtures to increase the degree of wrapping bitumen surface of mineral particles to reduce the mixing time, improve the workability and compatibility of mixtures. SAW asphalt plant is introduced into the bitumen or directly into the mixer while mixing asphalt mixture.

The greatest effect is obtained with the introduction of surfactant in bitumen-melting installation.

Properties and quality of input in the asphalt mixture of surfactants must meet the requirements of GOST, and other relevant technical specifications on surfactants and activators.

Asphalt mixture is prepared by asphalt plant in the facilities of cyclic and continuous with the gravitational or forced mixing of materials. When the choice primarily used Asphalt plant cyclic action, then - forced continuous mixing and least-Asphalt plant is continuous with the gravitational mixing. In the preparation of asphalt concrete in the mixer periodic operation provided the best conditions possible regulation mixing time and obtaining a mixture of the required quality.

Drying and heating of the stone material must ensure not only the set temperature, but also the complete removal of moisture. In the application of surfactants for the preparation of hot mix allowed moisture of mineral materials not exceeding 2%; cold - no more than 3%.

Thermal calculation drum also provides the definition of the temperature of hot gases along the length of the drum, watch fuel consumption, thermal efficiency, the volume of flue gases and determination of the basic parameters of the drum. Thermal balance of drying drum into account cost-utility of heat in the three zones of the drum, the loss of heat furnace walls of the drum, with flue gases from incomplete combustion of fuel and other unaccounted losses. Automation of the drying unit is to monitor and maintain the desired temperature of the material at the outlet, as well as in monitoring the presence of flame in the nozzle. As the temperature sensors are used thermocouples mounted in unloading bin drying drum, and contactless thermal indicators-thermostats. Adjust the temperature with an electronic device, which when the temperature of the material deviation from a given effect on reversing magnetic starter auxiliary engine that controls the fuel supply nozzle.

The automatic control system for the presence of flame in the nozzle is based on the use of photoelectric sensors. At the expiring flame signal from the photocell is amplified and fed to the auxiliary engine, acting on the valve

supplying fuel to the injectors. In modern asphalt mixing plant for remote ignition furnaces use electric ignition gas powered by an electric spark gap. To heat and dehydration of bitumen used bitumen smelting equipment of continuous and periodic operation. In the continuous action of a gas or electric heating dehydration occurs in a thin layer. The plant consists of multiple steps of bitumen melting pot. They maltha prepared by two-step cycle: some boilers bitumen is heated to 110 - 120 ° C and, if necessary evaporated water then is pumped into other consumables boilers and heat up to operating temperature. If necessary, the introduction of surfactant or diluents bitumen prepared by the three-step cycle: after heating and evaporation of water is pumped into free bitumen boilers, which combine with a surfactant or diluents and then pumped to the boilers and supplies heat to operating temperature. The components of asphalt concrete mixtures dosed by weight, with the exception allowed for bitumen and additives of surfactants, which are dosing by volume. To pre - dosing of mineral materials (prior to entering the dryer drum) use supply units. The accuracy of pre-dosing of materials $\pm 5\%$. When working with very wet materials introduced an amendment to their moisture.

The accuracy of dosing of the components of asphalt concrete and the repair of replacement dosing controls representative plant laboratory. The bodies of departmental control and inspection of metering devices is carried out every 3 months.

Particular attention is paid to regimes of mixing asphalt concrete mixture in mixers cyclical and continuous.

Mode mixing of mineral materials with bitumen plays a key role in the process of mixing. Thoroughly mixed mixture is characterized by a uniform distribution of all its components and the complete wrapping the surface of particles with bitumen. Mixing depends on the type of mixing plant and the type of the coffee mixture. It ranges from 20 to 180 sec.

Improve the quality and performance of the mixture process of mixing can be an intensification of the mixing process, the use of surfactants, activators,

improving the method of introduction of binding and activation of mineral materials. The intensification of the mixing process reduced the cost of binders and mineral powder 10-15%. The method of introducing bitumen also has a significant influence on the mixing and the quality of the mixture.

Large effect is achieved by increasing pressure at injection of bitumen. The mixing of materials occurs in the bitumen haze. Mineral materials evenly and quickly enveloped in reducing the overall cycle time of mixing.

1.2 Modern designs of Asphalt plants

In recent years, the volume of construction of road works considerably reduced. Despite this decline in road construction, the potential demand for road machinery, and including the Asphalt plant remains. This is mainly due to the fact that virtually made repair equipment Asphalt plants.

In the mid-eighties in our country has come a German engineering firm Teltomat. Over the past since 1985, while purchased and installed over 50 Asphalt plants that firm capacity of 100 t / h. In the early 90 s began to explore the domestic market and other German manufacturers. We had the world's leading asphalt mixing plants road machinery - Amman, and Benninghoven, a well as equipment from other manufacturers.

Modern foreign installations with strain-gauge weighing system can increase the accuracy of dosing in order. Microprocessor control system installations that exist today for many kinds of equipment, allow a continuous mode to control the whole technological process of preparing mixtures, to move quickly on the issue of mixtures of any advance issued prescription.

The firm Ammann supplies to our market Asphalt plant tower configuration, working on classic tower technology, productivity from 80 to 240 tons per hour, constructive solutions can be altered depending on the needs of customers, for example, developed a version of the installer with insulating coverings for use at subzero temperatures. Strain-weighting materials provide accuracy up to 0,1%, and

the dispersal of stone materials in 6 fractions and a number of other features ensures the high quality of asphalt mixtures.

Modular design allows units to perform their installation in the shortest possible time, with the dimensions of units and assemblies can transport them by road and rail. Remote installations are equipped with microprocessor-controlled and come fully assembled.

In the domestic market before asphalt installation company Benninghoven: stationary, capacity 40-250 tons/hour; block floor fixed capacity of 100-200 tons / hour; mobile at 60-160 tons/hour.

The system allows the screening plants divided mineral materials in 6 fractions, which together with other technical solutions, including high precision weighing, can guarantee good quality mix. By request of consumers set the burner to work on any brand of fuel oil, diesel fuel, natural gas or LPG, as well as coal dust. All units are equipped with silo ready mix. Flue gas cleaning is performed using fabric filters. Heating bitumen to the working temperature and heating Bitumen wire by using heaters, heat transfer fluid capacity from 300 to 400 kW. Features plants of both companies, namely, a large amount of drying drums and mixers, can recycle old asphalt and use materials with high humidity without reducing the nominal output. Established in the cab allows the computer to move quickly to any recipe mixes, continuously record the amount of cooked mixtures, to comply strictly defined technological regimes.

Company Teltomat produces Asphalt plant capacity from 60 to 300 tons per hour. Burners for drying drum manufactured for operation on lung (diesel) and heavy fuel (fuel oil), as well as natural and liquefied gases. The noise of stone materials in the four and six fractions, along with other structural changes ensures the high quality blends. Aggregate supply has up to 8 bins, which allows release any formulation mixtures. The volume of mixing is increased from 800 to 3000 kg. Heating bitumen to operating temperature, heating bitumoprovodov and equipment by means of heating the liquid coolant heat capacity from 230 to 350 kW. Storage bin of the compounds have a capacity of 80 to 500 tons Bag fabric filters allow you

to clear leaving the drying drum gases with an efficiency up to 2 mg / N m cube. The processes of feeding, weighing, mixing and application of all the materials can be carried out using a relay or microprocessor control, depending on the conditions imposed by the customer. All units have additional equipment for recycling old asphalt.

Foreign manufacturers offer a wide selection of asphalt mixing plants in almost any capacity, stationary and mobile. In this regard deserve special attention to high performance mobile installations. They are usually used in the construction of new roads, which carry a large volume of work, and relocation of costly time and money.

One of these plants is to set firm ASTEC (U.S.). Given the originality of design, it can be considered in more detail. The company produces mobile installations such as M-Rusk capacity from 100 to 400 t / h. The most important feature of the plant M-Rusk is a fundamentally new design of the drying-mixing drum, which makes it possible to combine the positive characteristics of stationary and mobile installations. All elements of the construction units in the form of individual units shipped modules, which can quickly be combined and assembled at the new place. This setting can be effective, and using it as a stationary (ie, when working at one place more than 2-3 years), because even one-time savings on installation and foundation already very significant. Foundations are done only for the storage bins. All other modules installed can be mounted on concreted or paved area. All modules are equipped with sturdy frames installed, which replaced the bases. All electrical cables between the modules are connected by a plug-in connectors. Power plants are made in size and weight with their transportation by road by trailer or by rail.

The fundamental difference of installations such as M-Rusk from others, is the construction of a drying-mixing drum, which is made coaxial (two drums - one inside the other). In this inner drum is drum drier with a counterflow heating. External drum, which does not fully cover the domestic, is equipped inside the blades and a mixer. Vanes is also equipped with and the corresponding outer side

inner drum. Exterior insulation and has a drum does not rotate. Thus, the process of mixing the mixture occurs in the annular space between the two drums. This design significantly reduces heat loss and therefore reduce fuel consumption. This system enables the use of mixing up to 50% recycled crushed asphalt. Due to the damper with hydraulic drive, possible free access to the mixing zone to control or replace the blades.

Dispensing system installation solved by weighing material on the tape, feeding drying drum, using strain gauges.

Calibration of weighing devices running the calibration weights. Unit is equipped with bag house fabric filters in the form of separate units, with automatic cleaning hoses. The design of storage bins allows prolonged storage of the mixture to 3-4 days and more. To this end, provides reliable heating and insulation bins, and avoid contact with air. Download silos by means of heated scraper conveyor. Bitumen is heated by installations NEATES for heating liquid coolants, such as the National Assembly. For ease of installation and transportation of bitumen is stored and heated in a tank with a capacity of 100-200t. heat registers with the system of seamless pipes.

Manage the installation is carried out from a separate cabin with remote control, which also placed a computer control system and regulation processes of mixing. In conclusion, it should be noted that the layout of individual blocks and units can be changed depending on the size and shape of the site, as specified in the design.

In the early 90-ies to the production of asphalt mixing plants, together with foreign firms (Italian and German) have begun AO Susten and Russia-Germany joint venture Rosasafalt. Main Hardware components and parts, determines the technical level, reliability and durability of the plant, available, usually from abroad. producible equipment is consistent with European state of the art and is essentially a pioneer in the manufacture of equipment of this class in Russia. SC Susten "acquired the right to manufacture and sell equipment Italian firm Bernard!. Made now setting M1S875E150 is stationary, tower and works on

classical hot technology. Its distinctive features - the presence of heat-insulated drying drum, thus reducing heat loss during drying and heating of the stone material, and the existence of a universal burner that can operate on liquid and gaseous fuels. System Setup screens provides screening of stone materials in the five fractions, which together with other technical solutions guarantee high quality blends. Set incorporates a storage bin of the compounds, with a capacity of 100 tons and heating the liquid coolant heat capacity of about 350kW, used for heating bitumen to operating temperature and heating Bitumen Wire and equipment. To remove dust, fabric filters are used with a high degree of purification of up to 20 mg/m³. The dust used in the process. Unit is equipped with microprocessor control system with the possibility of continuous monitoring and recording process and the transition to any, predefined recipe mixes.

Since 1998, JSC "Susten" released in conjunction with "Ilan A" and the Italian company Marini mobile Asphalt plant type MAP 100 SPE 160L capacity of 100-160 tons per hour. Power unit installation consists of four bunkers total capacity of 8 m³ and carried on a chassis semi-trailer. Drying drum type E 160 (with a burner that uses diesel or gas fuel) mounted on a trailer. Similarly, mounted and other major components and units: Mobile bag house type GM 384/48; generator 300 kW screw conveyor, screening plant; blocks tanks for asphalt and fuel, operator's cabin with remote control. Remote control system with electronic metering, monitor, keyboard and printer has a memory 100 recipes for different blends.

Joint Russia-Germany joint venture company "Rosasfalt" produces asphalt installation drawings and technology of the former German company Wibau. Available installing different capacity - 50 tons / hour (mobile), 100 and 160 t / h (stationary). Burner, all control systems and automation, mechanical and hydraulic drives, automation systems, computer control systems are delivered from Germany. In adapting the equipment in our conditions into account features of our stone and binder materials. Flue gas purification system based on the filter cloth

clean with efficiency up to 20 mg/m³. Manage the installation of computerized control microprocessor in the control room.

Vibrating Screen for hot materials allows to obtain four fractions. Heating bitumen to the working temperature and bitumen of wires by using plants to heat the liquid coolant. Silo capacity ready mix volume of the mixture, equal to the time of performance.

Kremenchuzke Production Association «Dormashina» produces two Asphalt plant: DS-185, productivity 40-45 tons / hour, and a stationary Asphalt plant is periodic operation of the DC-168 performance 130-150 tons / hour. Compared with the previously units of DS-117-2E and 2K, model DS-185 has higher rates of productivity, reliability and improved system of flue gas cleaning. The design of the installation allows you to quickly change the recipe mix and perform all the operations process. Manage the entire system is centralized and carried out with remote control located in the cab. Drying unit adapted for use of light and heavy fuel. The design of the blades drying drum provides optimum drying of the material and protect the drum from exposure to open flame. Process is managed remotely. Flue gas purification system, which includes a preliminary step purification and four cyclone-type CCN-40, and wet dust collector on the basis of Venturi scrubbers, are able to clean flue gases to 99.2%. Heated bitumen, fuel tanks and communications by hot oil in a closed system. In the heater of the liquid coolant used oil I-20A in the amount of 1,2 m³. Setting blocks are shipped to consumers of high installation preparedness, which reduces installation time and improves the quality of installation work.

The installation of DS-168 includes the following main components and units: power unit, conveyor, dryer unit, mixing unit, the unit of mineral powder, ready-mix tank, bitumen tank is heated, heating bitumen, fuel tank, operator cabin, the heater coolant fire. All processes are automated and have a redundant remote control. Manage the entire system is centralized and carried out with the remote, located in the cab. Using the drying unit using liquid fuel, including heating oil. Before drying drum set grizzly and a hopper for the collection of oversize rocks.

Ignition burner drying drum and management regime of combustion is carried out from the cab. Installation allows unloading of the compounds as a bunker ready mix, and directly from the mixer. Plant Tsentrosvar in Tver manufactures asphalt mixing plants, similar in its parameters set DS-185 ("Dormashina"). This year the plant plans to complete the installation produced by microprocessor control system and fabric filters to clean the flue gases. The following table gives the basic general technical specifications of asphalt mixing plants. Mobile bituminous company ERMONT (France) are based on a drying-mixing drum, in which the zone of drying materials and mixing them with bitumen separated by a screen from the continuous flow of mineral materials. These mixers are available in six types of TSM modifications, performance from 25 to 500 tons per hour. The firm also produces transportable bituminous on the classical scheme, with capacity of 120 to 200 tons / hour, 6 versions.

Asphalt plants (AP) Korean firm DMI initially relied on a highly



Figure 1.7. Asphalt plant Korean firm.

competitive, and hence a high-tech domestic market. Modern technological solutions used in the production of Asphalt plants DMI allow us to call them world leaders in the production of Asphalt plant of any capacity and every performance.

Company Ufadormash - Smart Travel Cars "is on the territory of Russia and the CIS products company DMI (South Korea), the largest manufacturer of high asphalt and concrete plants. Company DMI gained prominence in the world of product quality and innovation in the development and manufacture of highly reliable systems of electrical and process control systems. The leading manufacturers of asphalt mixing plants, known in the world, are:

- Benninghoven , Germany;
- Amman Asphalt, EC (Switzerland, Germany, Italy, France);
- Parker Plant Limited, England;
- Bernardi Impianti S.P.A., Italy;
- Marini (Fayat Group), Italy;
- Ermont (Fayat Group), France;
- Astec, USA;
- SIM, Italy.

In addition to these companies market new products in asphalt mixing plants are:

- Lintec, Germany;
- Teltomat-Gunter Papenburg, Germany;
- Gencor International Ltd, England;
- ACP Holdings PLC, England;
- Kalottikone Oy, Finland;
- KVM, Denmark.

1.3 Research objectives

The following questions are considered for study objectives for this thesis work.

1. Acquaintance with asphalt plants with different capacities and different working conditions
2. Asphalt plant designs in different countries and how they work

3. The technical condition and performance of existing Asphalt plants in the Republic of Uzbekistan
4. Theoretical formulation and modeling of asphalt plant using mathematical and computer modeling tools
5. Computer simulation model design of asphalt plant for analysis of heat flow and exchange by employing SolidEdge and SolidWorks software packages
6. To prepare sound and practical recommendations for energy efficient designs of asphalt plant

Summary for chapter I

The first chapter provides full information about asphalt plants of the Republic of Uzbekistan (their types, working principles, etc), including the following points.

- Acquaintance with Asphalt plants with different capacities and different working conditions;
- Asphalt Plants in different countries and how they work;
- The technical conditions and performances of existing Asphalt plants in the Republic of Uzbekistan.

Chapter II. Research methodology

2.1 Theoretical formulations

The volume of asphalt mixture, cooked on the asphalt plant in the year, calculate the surface area of coatings, which must be built per year in the vicinity of the plant. For urban factories, this volume is a plan for the construction of coatings on the streets for years (for the next 5-10 years). It is necessary to allow for construction growth in subsequent years and a corresponding expansion of the plant. With the construction of suburban road take that one plant can serve a section of road length of 25-50 km

Calculation method of drum dryer

The aim of technological calculation drum dryer is: the definition of the device dimensions (diameter and length of the drum) at a given performance.

1. Moisture is removed from the material in unit time is determined based on the required output unit for dried (ω_k), defined usually on the basis of ω_{product} , with the ultimate moisture standards for products. Initial moisture ω_H content depends on the applied at the previous stage equipment for the separation of the solid phase of the suspension. Number of removed moisture, kg

$$K = \frac{1}{\frac{1}{\alpha_{II}} + \frac{1}{\alpha_E} + \frac{\delta_{CT}}{\lambda_{CT}}} \quad (2.1.1)$$

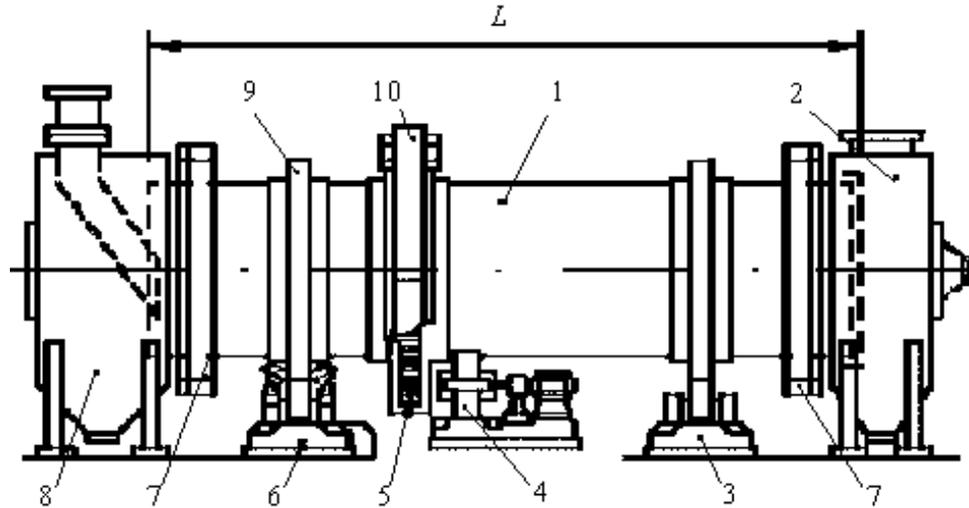


Figure 2.1. Drum dryer: 1 - cylinder, 2 - discharge chamber; 3 - reference station, 4 - wheel drive, 5 - ring gear 6 - stubborn station; 7 - Seal, 8 - loading chamber, 9 - tie, 10 – cover.

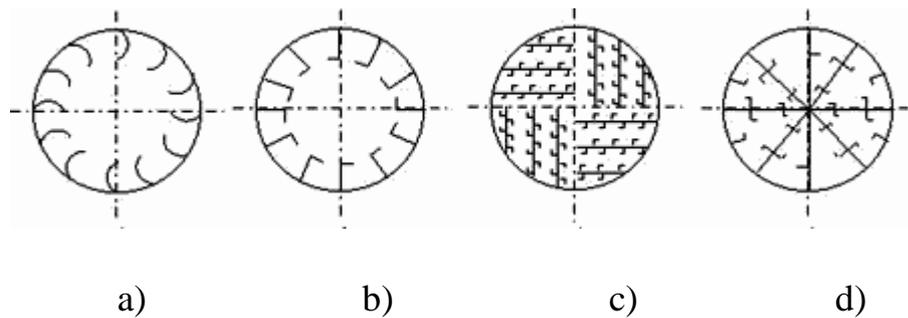


Figure. 2.2 Types of staging devices used in drum dryers, and the β ; a) locinate $\beta=12\%$, b) lifting – lobed , $\beta = 14 \%$; c) Distribution closed, $\beta= 20,6\%$; d) degree of filling the drum , $\beta = 27,5\%$.

Coolant flow and its parameters at the exit of the dryer

The equation of internal heat balance of the dryer

$$\Delta = c\theta_1 + q_{dop} - (q_M + q_{II}) \quad (2.1.2)$$

where - Δ the difference between the proportions of the arrival and consumption of heat directly into the drying chamber, kJ/kg; c - specific heat of moisture in wet material at a temperature , 1 kJ/(kg • K); q_{dop} -specific supply of heat in the drying

chamber, $q_{dop} = 0$; q_m - the specific heat is in the dryer drum with dried material, kJ / kg; $q_m = G_k \cdot (v_2 - v_1)$; $q_n = 22,6$ kJ/kg - specific heat loss to the environment

The equation of the working line drying

$\Delta = \frac{I - I_1}{x - x_1}$	(2.1.3)
------------------------------------	---------

To build a working line drying I - x diagram (Fig. 3) is necessary to know the coordinates (I, x) of two points. Coordinates of the first point x_1 and I_1 are defined by I - x diagram for $x_1 = x_0$ and temperature t_1 . To find the coordinates of the second point are given an arbitrary value of x (eg $x = 0.1$ kg / kg) and determine the corresponding value of I. After two terms carry the line drying to the intersection with the isotherm t_2 . At the intersection point are the parameters of spent drying agent: x_2 , kg / kg and I_2 , kJ / kg.

Flow of dry air in the drying process, kg / s [3]

$$L = \frac{W}{x_2 - x_0} \quad (2.1.4)$$

Consumption of heat for drying, W

$$Q_c = L(I_1 - I_0) \quad (2.1.5)$$

Volume of drum dryers, m^3

where A_v - power drum to evaporate moisture, $kg/(m^3 \cdot h)$ (Table 1). From Table. 2 determine in advance the size of the drum: the length l and diameter D .

Table 1. Thermo physical properties of materials and the kinetic characteristics of drum dryers

Material	Particle size d, MM	Particle number density ρ_{TB} , kg/m ³	Bulk density of the material ρ_{HAC} , kg/m ³	Heat capacity Dj/(кг·K)	Tension on the moisture, A_v , г/(м ³ ·ч)	Type of internal distribution systems drum
Clay	0,2-0,5	1600	1380	0,92	50-60	Lifting paddle
Limestone	1-15	2650	1800	0,92	45-65	
Sands	0,5-2	1500	1200	0,8	80-88	Distribution
Iron pyrite	2,5	5000	3300	0,5	20-30	Lifting paddle
Coal	10-40	1350	800	1,09	32-40	
Phosphorite	1-10	1350	1160	1,05	45-60	
Na ₂ CO ₃	0,5-1	1450	800	1,04	7	
NaCl	1-2,5	2350	1020	0,89	7,2	

2.2 The choice of equipment and technological process of preparation of asphalt concrete

Constructive indicators	Number under the factory specification					
	Internal diameter of a drum, m	1,5	1,8	2,2	2,2	2,8
Length of a drum, m	8	12	12	14	12	14
Thickness of walls of the external cylinder, mm	10	12	14	14	14	14
Volume dryer spaces, м ³	14,1	30,5	45,6	53,2	74,0	86,2
Total mass, t	13,6	24,7	42	45,7	65	70

The actual rate of gases in the drum, m/s

$$\omega_d = \frac{V_g}{0.785 * D^2} \quad (2.1.6)$$

where V_g - is the volume capacity of gas, m³/s

$$V_g = \frac{L}{\rho_g} \quad (2.1.7)$$

where ρ_g - density of air at high temperature in the drum, kg/m³

$$t_{md} = \frac{t_1 + t_2}{2}, \quad \rho_g = 1.293 \frac{273}{273 + t_{md}} \quad (2.1.8)$$

You need to check the condition of ash particles of material from the drum. The rate of ablation, equal to the speed of free wool-particle determine from the equation, m/s.

$$\omega_{CB} = \frac{\mu_{md}}{d\rho_g} \left(\frac{Ar}{18 + 0.575\sqrt{Ar}} \right) \quad (2.1.9)$$

where μ_{md} - the viscosity of the drying agent at an average temperature - Archimedes TV - particle density, kg/m³pcriterion;

$$Ar = \frac{d^3 \rho_{TB} \rho_g}{\mu_{md}^2} \quad (2.1.10)$$

Determination of the angle of inclination of the drum and the frequency of its rotation. necessary to ensure a given performance.

The angle of the drum α , deg.

$$\alpha = \left(\frac{30}{D * n * \tau} + 0.007 * \omega_d \right) \frac{180}{\pi} \quad (2.1.11)$$

where n - number of revolutions per minute drum $n = 0,5 \cdot 0,8 \text{ min}^{-1}$; residence time of material in the dryer, c.

$$\tau = \frac{G_M}{\left(G_K + \frac{W}{2} \right)} \quad (2.1.12)$$

where G_m - is the number of material permanently in the dryer, kg

$$G_M = V_{\delta} \beta \rho_{nas} \quad (2.1.13)$$

where - ρ_{nas} - the bulk density of the material in the dryer, kg/m^3 ; β - factor of filling of a drum a material.

If a corner of an inclination of a drum $\alpha < 0,5^\circ$ the accepted frequency of rotation of a drum reduce and repeat calculation.

2.2. Theoretical formulation of heat flow

The heat transfer from the gas to the drum surface is described by the heat transfer coefficient h ,

$$q = h(T_s - T_{\infty}) \quad (2.2.1)$$

where T_s is the surface temperature, T_{∞} the free stream temperature, and h is called the heat transfer coefficient.

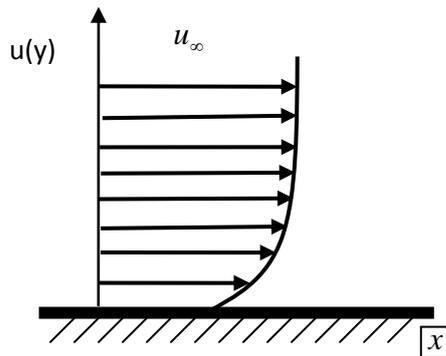


Figure 2.3. Velocity profile close to a wall

We will use two different estimates for h . The first uses the experimentally established correlation between Nusselt number and the Reynolds and Prandtl numbers for turbulent flow over a flat plate, eq (1). The second approach uses the Reynolds analogy between heat and momentum transfer in a turbulent boundary layer.

Flat plate model

The heat transfer coefficient (or equivalently the Nusselt number) is correlated with the Reynolds and Prandtl number,

$$Nu = \frac{hL}{k} = C Re^n Pr^m \quad (2.2.2)$$

where the Reynolds number is $Re_L = \frac{u_\infty L \rho}{\eta}$,

and the Prandtl number is $Pr = \frac{\eta C_p}{k}$

where u_∞ is the free stream velocity, L a characteristic length, ρ the density, η the dynamic viscosity, C_p heat capacity, and k the conductivity. These C , m and n is taken from ref. Incropera – deWitt. In our case there is turbulent flow,

$$Nu = 0.0296 Re_L^{4/5} Pr^{1/3} \quad (2.2.3)$$

From equation (3) and (6) we can get the following equation.

$$h = 0.0296 \frac{k}{L} Re_L^{4/5} Pr^{1/3} \quad (2.2.4)$$

Reynolds analogy

The Reynolds analogy states the relation between heat transfer and momentum transfer in a boundary layer. The relation is easy to derive for laminar flows, but holds also for turbulent flows if the Prandtl number is approximately 1, which is true for gases at standard pressures, but certainly not for liquids like oil. The two processes both rely on small-scale convective material exchange (and not diffusion or conduction),

$$C_f = \frac{2h}{\rho u_\infty C_p} \quad (2.2.5)$$

where C_f is the friction coefficient defined by the wall shear stress τ_w by

$$\tau_{wall} = \frac{1}{2} \rho_{\infty} u_{\infty}^2 C_f \quad (2.2.6)$$

so

$$h = \frac{\tau_{wall} C_p}{u_{\infty}} \quad (2.2.7)$$

The boundary layer velocity profile refers to the manner in which u varies with y through the boundary layer.

2.3. Simple model design of Asphalt plant in SolidWorks

With the full SolidWorks Flow Simulation product, we will have the following advanced functionality options.

Heat Transfer Analysis

- Calculate heat flow in the adiabatic walls approximation or in solid bodies.
- Specify different types of heat sources.
- Assign to models a broad range of solid materials that are stored in the engineering database.
- Define your own materials by assigning them values for physical properties such as thermal conductivity, heat capacity, etc.
- Calculate radiation heat. The engineering database contains radiative surfaces such as Blackbody Wall, Whitebody Wall, Grey Body with an arbitrary albedo, and a broad range of surfaces of real materials.

Fluids and Flow Types

- Analyze the flow of up to ten fluids of different types (liquids, gases/steam, real gases, non-Newtonian liquids and compressible liquids). The database contains numerous fluids with predefined properties.
- Analyze a problem with multiple fluids of different types, provided you separate the areas of the different fluids from each other using fluid subdomains.

- Analyze mutual dissolution of fluids. Mixing fluids must be of the same type.
- Define your own fluids.

Initial Settings

Before you start the calculation, Flow Simulation offers additional settings. If you set the initial condition values closer to the anticipated final parameters, calculation performance improves.

- **Initial fluid parameters.** You can set these parameters globally. For an assembly, you can set them locally for a sub-assembly or individual part.
 - Temperature
 - Pressure
 - Flow velocity
 - Fluid composition
- **Initial temperature.** Set the initial temperature of a solid.
- **Initial mesh parameters.** Set additional parameters that control how the analysis resolves the solid/fluid interface, curved surfaces, narrow channels, small solid features, etc. You can apply these settings globally or, for assemblies, to a sub-assembly or an individual part.

Boundary Conditions

You can set these boundary conditions.

For inlet and outlet:

Mass volume
 Volume flow
 Velocity
 Mach number
 Static pressure
 Total pressure
 Environment pressure
 Wall pressure

For inlet only:

Flow velocity profile, swirl, or vector
 Temperature
 Composition (for assemblies)
 Turbulence parameters

Black Box Entities

To reduce analysis time, Flow Simulation includes several pre-built "black boxes." Black boxes have tabulated integral input and output parameters and are included in calculations. Flow Simulation does not resolve them during an analysis.

- **Fan.** An idealized fan that is fully defined by its fan curve, which means the tabulated dependency of volume flow versus pressure drop. You can use the fan as an inlet, outlet, or internal fan. The database contains fan curves for selected industrial fans. You can also define fan curves yourself.
- **Heat Sink.** An idealized fan combined with the heat sink. Flow Simulation defines the heat sink by the fan curve and the heat resistance curve.
- **Thermoelectric Cooler.** An idealized Peltier cooling device defined by the maximum temperature difference it can develop.

Viewing Results

Flow Simulation includes these features to view the results:

Plots	Animations	Particle studies
3D-profile plots	Flow Trajectories	Reports
Cut Plots	Goals	Point, surface, and volume parameters
Surface Plots	Iso surfaces	
XY Plots		

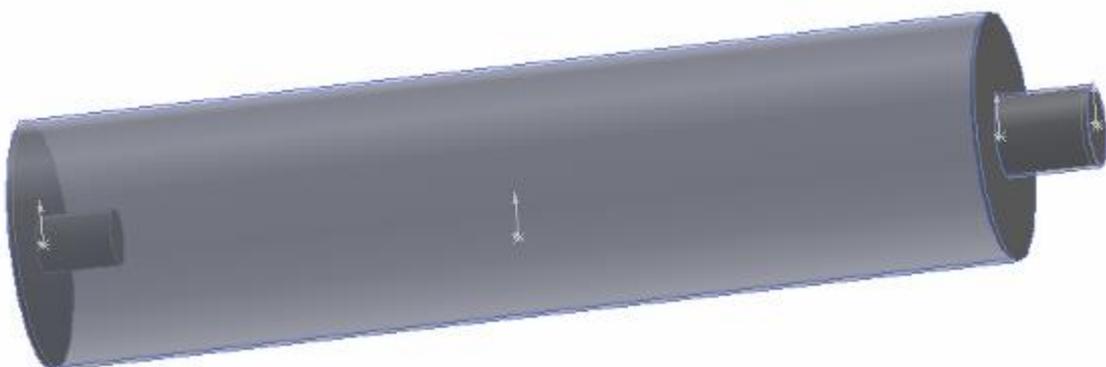
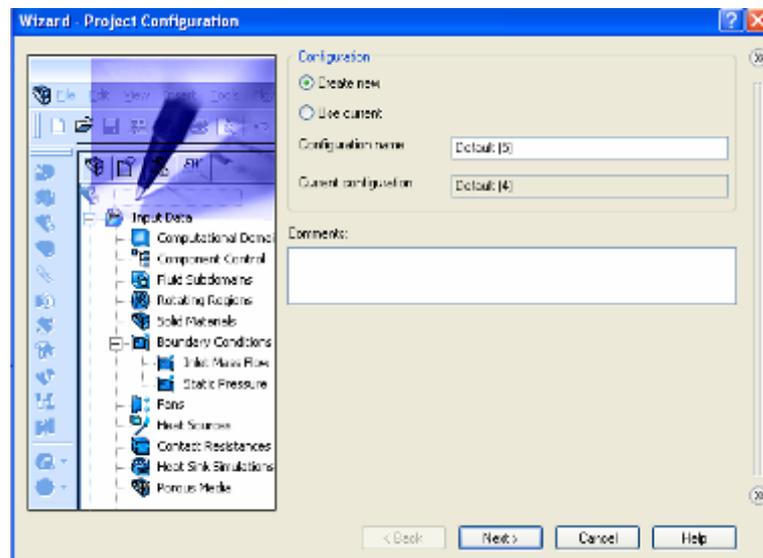


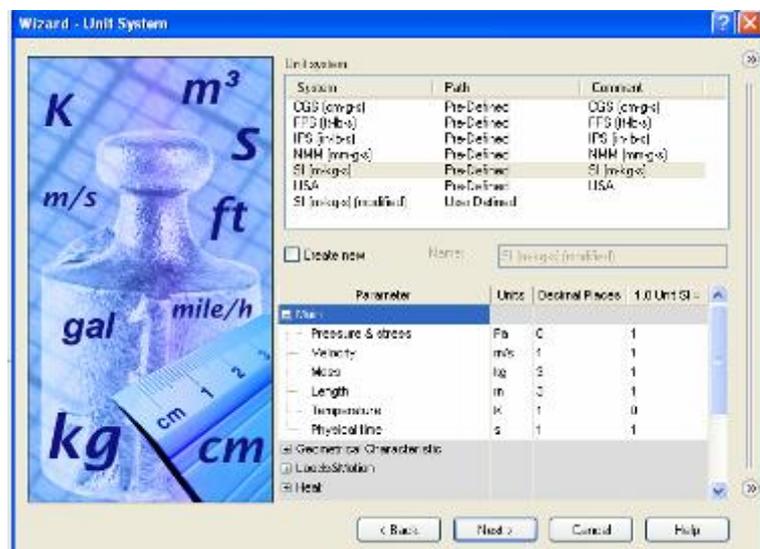
Figure 2.4. 3d model Asphalt plant in SolidWorks

Create a flow simulation project Asphalt factory

1. Flow Simulation, Project Wizard

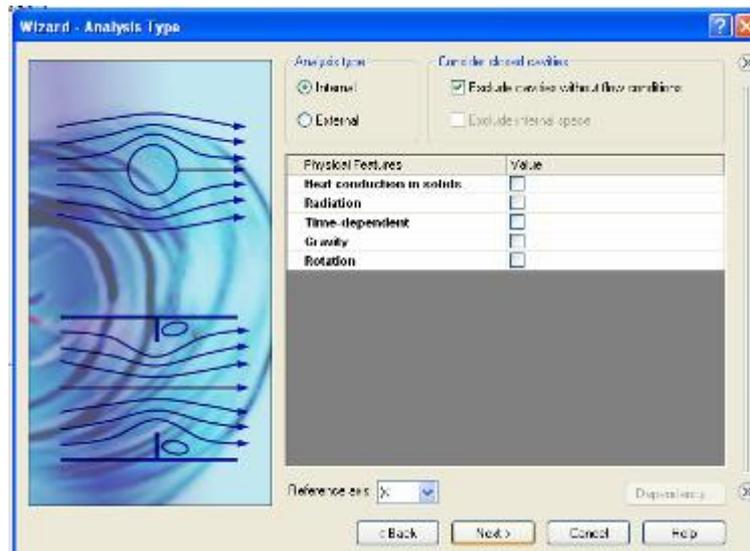


2. Once inside the Wizard, select Create new in order to create a new configuration and name it ABZ. After **next** choose the of units (**SI** for this project).



Within Flow Simulation, there are several predefined systems of units. You can also define our own and switch between them at any time.

3. Leave the default **Internal** analysis type.



We want to analyze the flow through the structure. This is what we call an internal analysis. The alternative is an external analysis, which is flow around an object. In this dialog box you can also choose to ignore cavities that are not relevant to the flow analysis, so that Flow Simulation will not waste memory resources to take them into account.

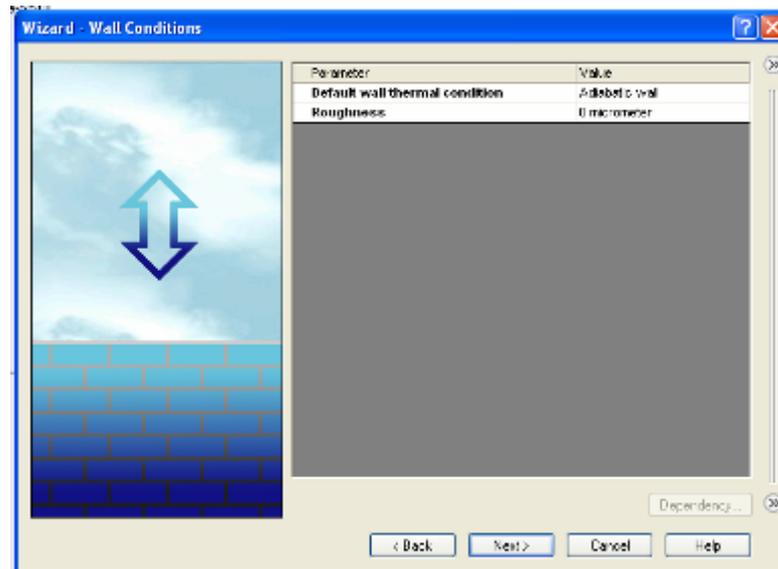
4. In the Fluids tree expand the Gases item and choose Air.



Flow Simulation is capable of calculating fluids of different types in one analysis. Flow Simulation has an integrated database containing in conjugate heat conduction analyses. You can create your own materials. Up to ten liquids or gases can be chosen for each analyses run.

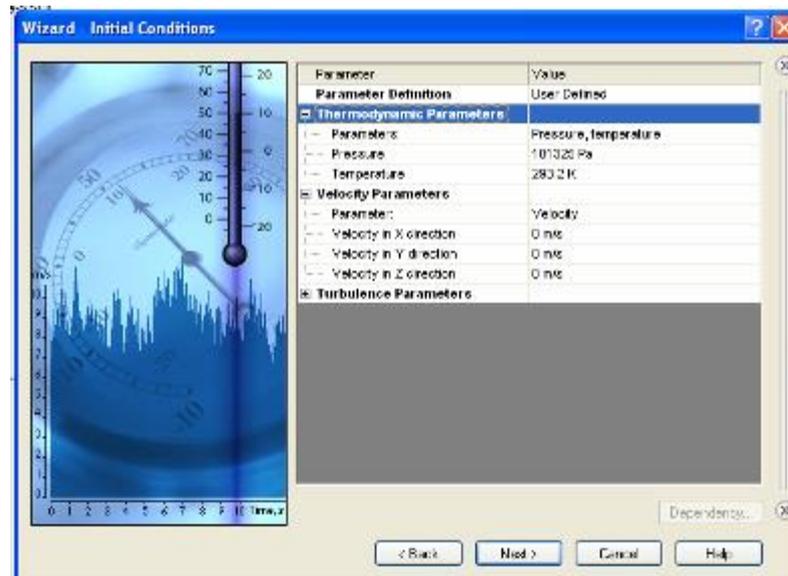
Flow Simulation can calculate analyses with any flow type: Turbulent only, Laminar only or Turbulent and Laminar. The turbulent equations can be disregarded if the flow is entirely laminar. Flow Simulation can also handle low and Mach number compressible flows for gases.

5. Accepting the default wall conditions.



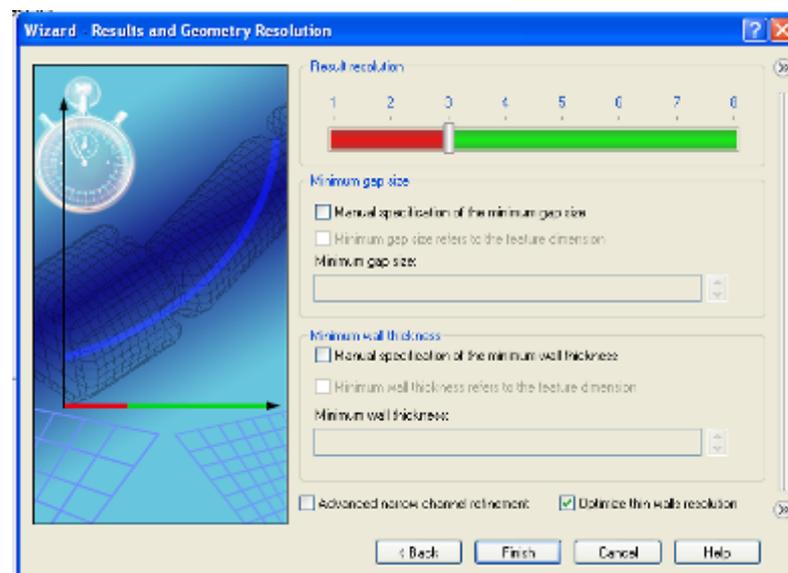
Since we did not choose to consider heat conduction within the solids, we have an option of defining a value of heat conduction for the surfaces in contact with the gases. This step is the place to set the default wall type. Leave the default Adiabatic wall specifying the walls are perfectly insulated.

6. Accepting the default for the initial conditions.



On this step we may change the default settings for pressure, temperature and velocity. The closer these values are set to the final values determined in the analyses, the quicker the analysis will finish.

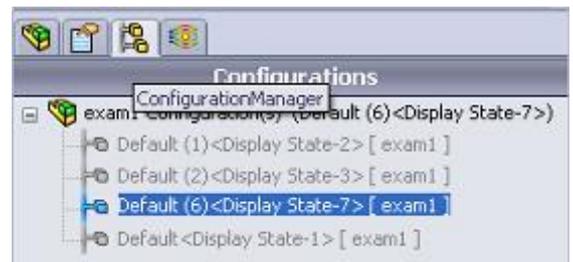
7. Accept the default for the **Result resolution**.



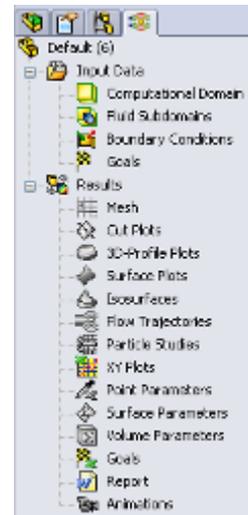
Result Resolution is a measure of the desired level of accuracy of the results. It controls not only the resolution of the mesh but also sets many parameters for the solver. The higher the Result Resolution the finer the mesh will be and the stricter the convergence will be set.

8. Finish.

After that click Configuration Manager to show the new configuration.



Go to the **Flow Simulation** Analysis tree and open all the icons. We will use the Flow Simulation Analysis Tree to define our analysis, just as the Feature Manager Design tree is used to design your models. The Flow Simulation analysis tree is fully customizable: we can select which folders are shown anytime you work with Flow Simulation and which folders are hidden. A hidden folder become visible when you add a new feature of corresponding type. The folder remains visible until the last feature of this type deleted.



Boundary Conditions

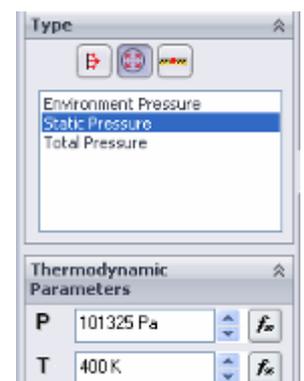
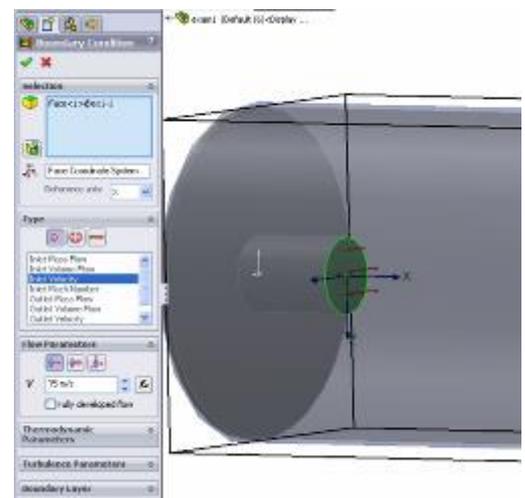
A boundary conditions is required anywhere gases enters or exits the system and can be set as a pressure, velocity, temperature and volume flow.

1. In the Flow simulation Tree, right-click the boundary conditions icon and select Insert boundary conditions.

2. Select the inner face of the **face <1>@ex1-1**

3. Select Flow Openings  and **Inlet velocity**. After that choose **Thermodynamic parameters, turbulent** and **boundary layers** and click **ok**.

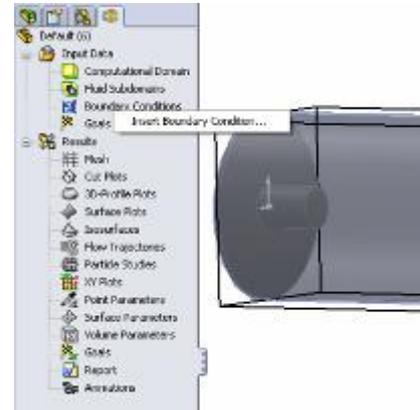
4. In the Flow Simulation Analysis Tree right click the Boundary Conditions icon and select Insert Boundary Condition.



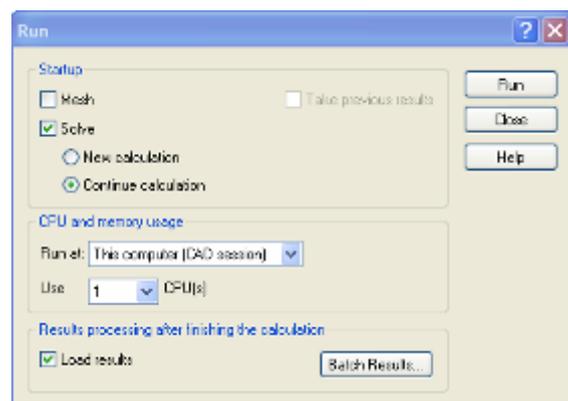
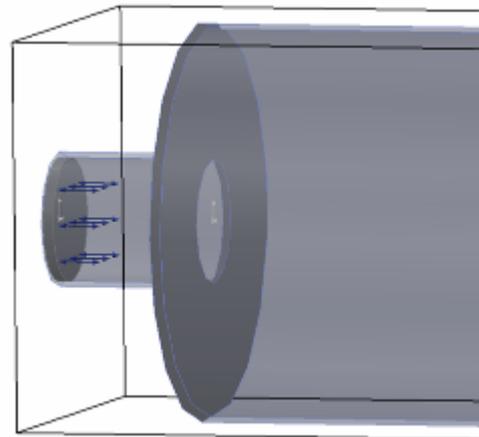
5. Choose Pressure Openings  and Static Pressure for outlet boundary conditions.

Define the Engineering Goal

1. Choose Flow Simulation Analysis Tree Goals icon and select Insert Surface Goals.
2. In the Parameter table select the A_v check box in the Static Pressure row.



Engineering goals are the parameters which the user is interested in. Setting goals is in essence a way of conveying to Flow Simulation what you are trying to get out of the analysis as well as a way to reduce the time Flow Simulation needs to reach a solution. By setting a variable as a project goal you give Flow Simulation information about variables that are important to converge upon and variables that can be less accurate in the interest of time. Goals can be set throughout the entire domain, within a selected volume. In a selected surface area (Surface Goals) or given point (Point Goals). Flow Simulation can consider the average value, the minimum value or the maximum value for goal settings.



Summary for chapter II

The second chapters is made and analyze the balance of heat distribution in the dryer the mixing drum asphalt plant also performed the following work:

- On the basis of the balance equation and the corresponding computer program implemented experimental calculations;
- Theoretical formulation for heat flow simulations
- We have done a simple model design for Asphalt plant in SolidWorks

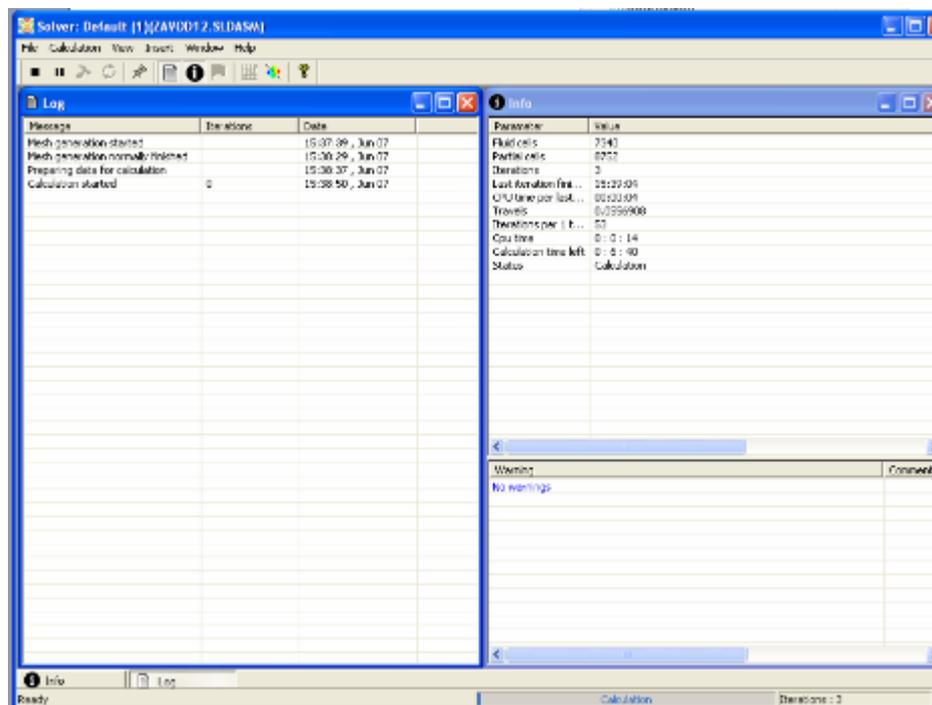
Chapter III. Computer Simulations and Analyses

3.1 Computer simulation result of asphalt plant model

After that we choose Flow Simulation, Solve, Run. The solver should take less than few minutes to run on a typical PC.

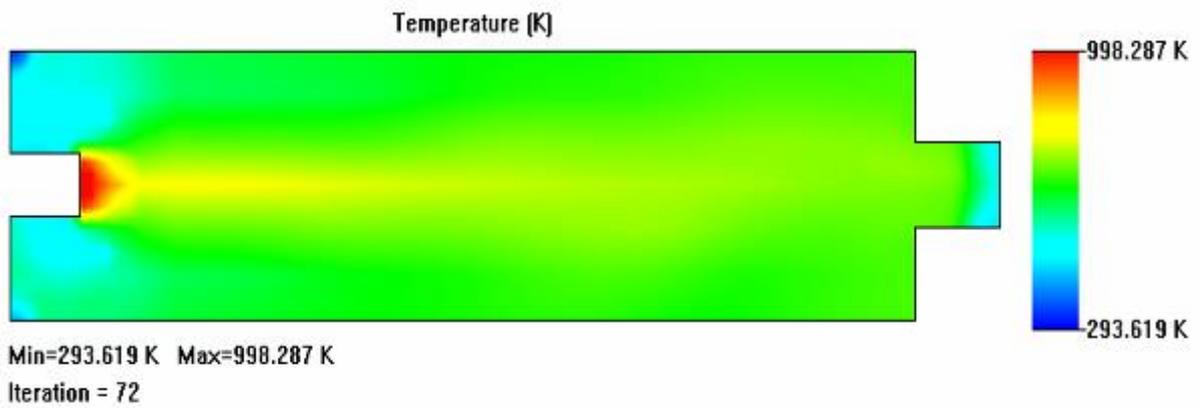
Monitor the Solver

1. This is the solution monitor dialog box. On the left is a log of each step taken in the solution process. On the right is an information dialog box with mesh information and any warnings concerning the analysis .



After the calculation has started and several first iterations has passed click the Suspend button on the Solver toolbar. We employ the Suspend option only due to extreme simplicity of the current example, which otherwise could be calculated too fast, leaving you not enough time to perform the subsequent steps of result monitoring. Normally you may use the monitoring tools without suspending the calculation.

2. This is the Preview Settings dialog box. If we want any SolidWorks plane from the Plane name list and pressing ok will create a preview plot of the solution in that plane.



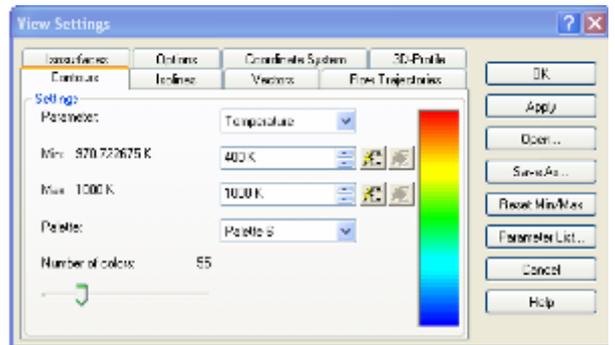
The preview allows one to look at the results while the calculation is still running. This helps to determine if all the boundary conditions are correctly defined and gives the user an idea of how the solution will look even at this early stage. At the start of the run the results might look odd or change abruptly. However as the run progresses these changes will lessen and the results will settle in on a converged solution.

Isosurface Plots

1. Isosuefaces icon and select show. This is the plot that will appear.

The isosurfaces is a 3-Dimensional surface created by Flow Simulation at a

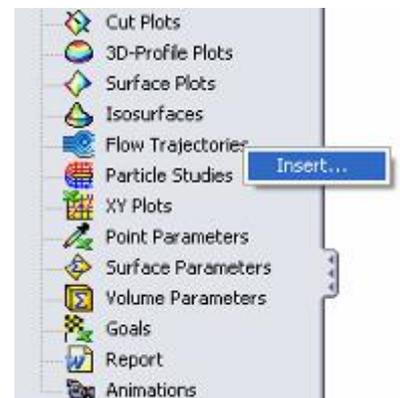
constant value for a specific variable. The value and variable can be altered in the **View Settings** dialog box under the Isosurface tab.



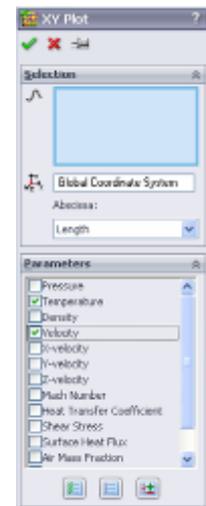
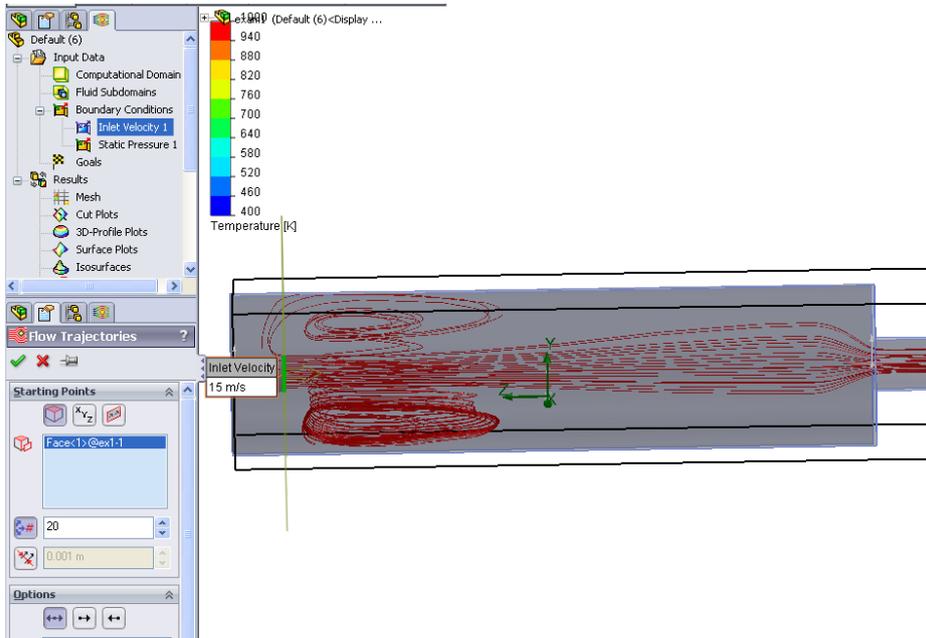
2. After the click **Results** icon and select **View Settings** to enter the dialog.

Flow Trajectory Plots

1. Flow Trajectories icon and select Insert.
2. Flow simulation Analysis Tree tab and then click the Inlet Velocity 1 item to select the inner fase of the face



Flow trajectories we can show the flow streamlines. Flow trajectories provide a very good image of the 3D fluid flow. You can also see how parameters change along each trajectories by exporting data into Excel. Additionally you can save trajectories as SolidWorks reference curves. The trajectories can also be colored by values of whatever variable chosen in the View Setting dialog box.



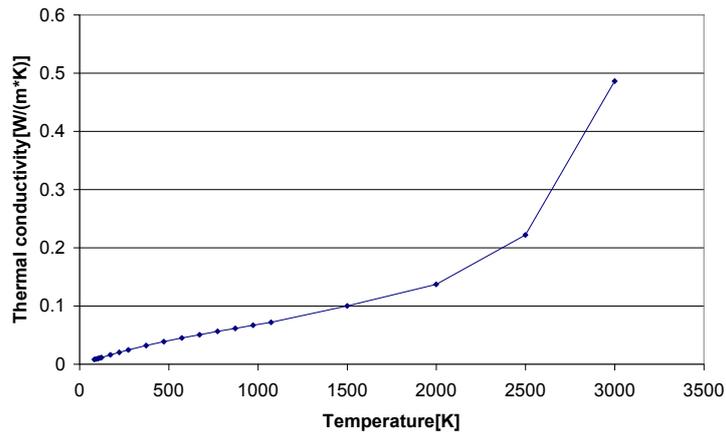
XY Plots

We want to plot temperature and velocity along the value. We have already created a SolidWorks sketch containing several lines.

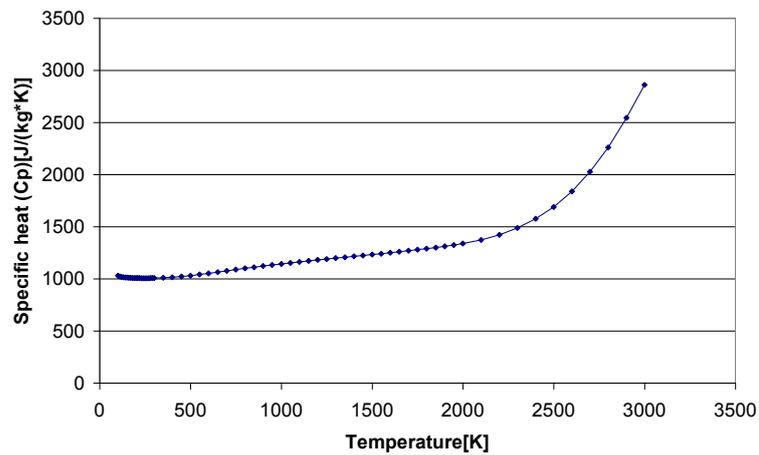
1. XY Plots icon and select Insert.
2. Choose Velocity and Temperature as physical Parameters.

The XY Plot allows you to view any result along sketched lines. The data is put directly into Excel.

Thermal conductivity



Specific heat (Cp)



3.2. SolidWorks software packages Report Generator INPUT DATA

Initial Mesh Settings

Automatic initial mesh: On

Result resolution level: 3

Advanced narrow channel refinement: Off

Refinement in solid region: Off

Geometry Resolution

Evaluation of minimum gap size: Automatic

Evaluation of minimum wall thickness: Automatic

Computational Domain

Size

X min	-3.70038451 m
X max	4.87673549 m
Y min	-1.16232 m
Y max	1.16232 m
Z min	-1.75049549 m
Z max	0.574144512 m

Boundary Conditions

2D plane flow	None
At X min	Default
At X max	Default
At Y min	Default
At Y max	Default
At Z min	Default
At Z max	Default

Physical Features

Heat conduction in solids: On

Heat conduction in solids only: Off

Radiation: Off

Time dependent: Off

Gravitational effects: Off

Flow type: Laminar and turbulent

High Mach number flow: Off

Humidity: Off

Default roughness: 0 micrometer

Default outer wall condition

Heat transfer coefficient: 5 W/m²/K

External fluid temperature: 293.2 K

Initial Conditions

Thermodynamic parameters	Static Pressure: 2000 Pa Temperature: 997 K
Velocity parameters	Velocity vector Velocity in X direction: 25 m/s Velocity in Y direction: 8 m/s Velocity in Z direction: 5 m/s
Solid parameters	Default material: Steel Initial solid temperature: 293.2 K
Concentrations	Substance fraction by mass Air 0.5 Gas 0.5
Turbulence parameters	Turbulence intensity and length Intensity: 2 % Length: 0.0232 m

Material Settings

Fluids:

- Air

- Gas

Solids:

- Steel

Boundary Conditions

Outlet Velocity 1

Type	Outlet Velocity
Faces	Face <1 new2-1 @>
Coordinate system	Face Coordinate System
Reference axis	X
Flow parameters	Flow vectors direction: Normal to face Velocity normal to face: 2 m/s Inlet profile: 0

Inlet Velocity 1

Type	Inlet Velocity
Faces	Face <1 new1-1 @>
Coordinate system	Face Coordinate System
Reference axis	X
Flow parameters	Flow vectors direction: Swirl Velocity normal to face: 25 m/s Angular velocity: 6 rad/s

	Radial velocity: 0 m/s
Thermodynamic parameters	Temperature: 997 K
Concentrations	Substance fraction by mass Air 0.5 Gas 0.5
Turbulence parameters	Turbulence intensity and length Intensity: 2 % Length: 0.0232 m
Boundary layer parameters	Boundary layer type: Turbulent

Goals

Surface Goals

SG Outlet Av Temperature of Fluid 1

Type	Surface Goal
Goal type	Temperature of Fluid
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av Velocity 1

Type	Surface Goal
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Goal type	Velocity
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av X - Component of Velocity 1

Type	Surface Goal
Goal type	X - Component of Velocity
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av Y - Component of Velocity 1

Type	Surface Goal
Goal type	Y - Component of Velocity
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av Z - Component of Velocity 1

Type	Surface Goal
Goal type	Z - Component of Velocity
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av Turbulent Viscosity 1

Type	Surface Goal
Goal type	Turbulent Viscosity
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av Turbulent Time 1

Type	Surface Goal
Goal type	Turbulent Time
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system

Use in convergence	On
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SG Outlet Av X - Component of Heat Flux 1

Type	Surface Goal
Goal type	X - Component of Heat Flux
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av Y - Component of Heat Flux 1

Type	Surface Goal
Goal type	Y - Component of Heat Flux
Calculate	Average value
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Av Z - Component of Heat Flux 1

Type	Surface Goal
Goal type	Z - Component of Heat Flux
Calculate	Average value
Faces	Face<1>@new1-1

	Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Volume Flow Rate of Air 1

Type	Surface Goal
Goal type	Volume Flow Rate of
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

SG Outlet Volume Flow Rate of Gas 1

Type	Surface Goal
Goal type	Volume Flow Rate of
Faces	Face<1>@new1-1 Face<2>@new1-1
Coordinate system	Global coordinate system
Use in convergence	On

Calculation Control Options

Finish Conditions

Finish conditions	If one is satisfied
Maximum calculation time	36000 s
Maximum travels	4

Goals convergence	Analysis interval: 0.5
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Solver Refinement

Refinement: Disabled

Results Saving

Save before refinement	On
Periodic saving	Units: Iterations Period: 100

Advanced Control Options

Flow Freezing

Flow freezing strategy	Disabled
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Engineering Database

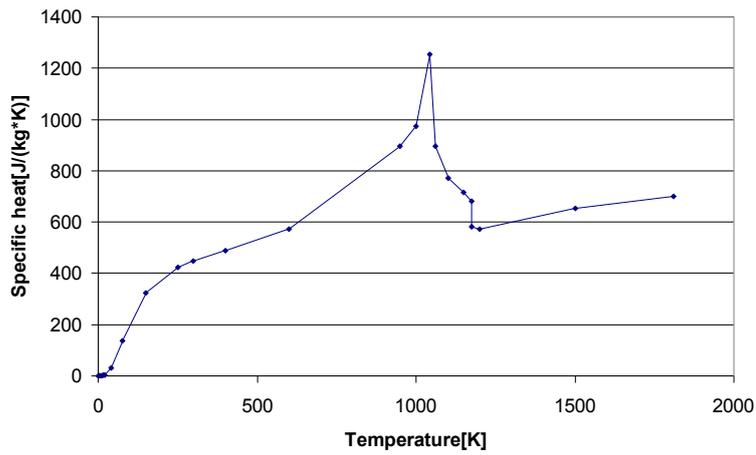
Solids

Iron

Path: Solids Pre-Defined\Metals

Density: 7874 kg/m³

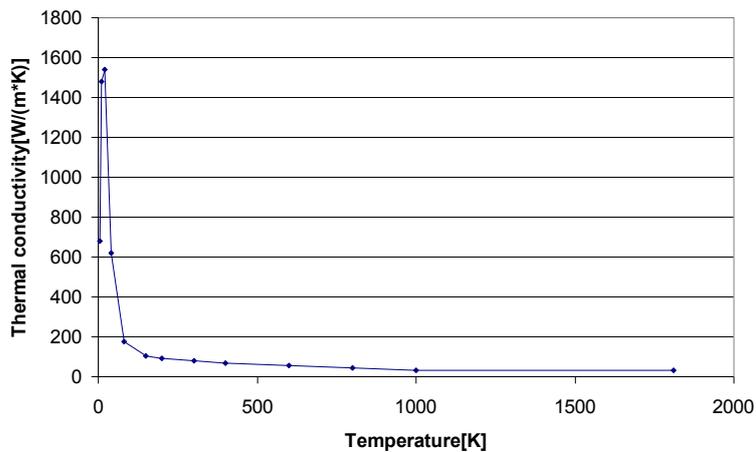
Specific heat



Which is necessary for informing a body for increase of its temperature on the given size.

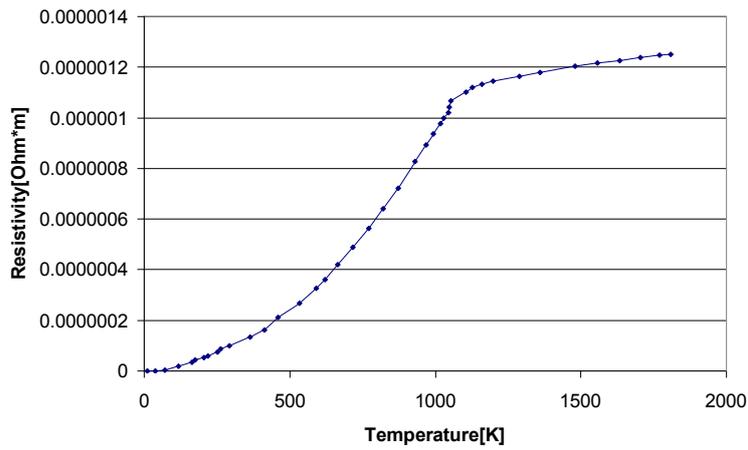
Conductivity type: Isotropic

Thermal conductivity



Electrical conductivity, Axial electrical conductivity, Electrical conductivity in X:

Resistivity



Resistivity is growing until 1000 [K] faster.

Melting temperature: 1811.2 K

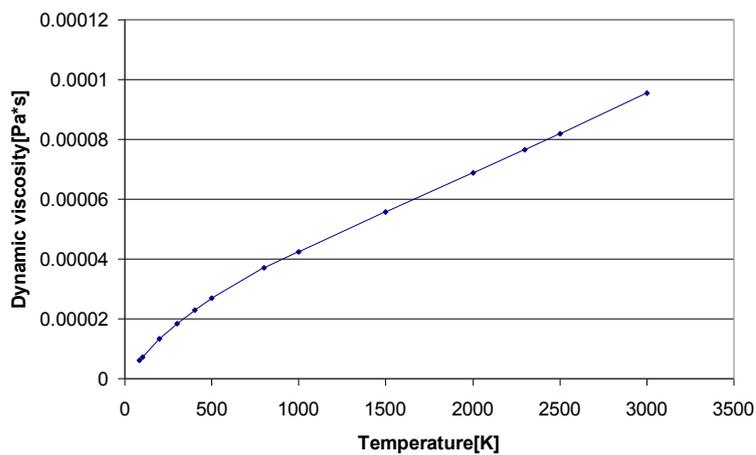
Gases

Air

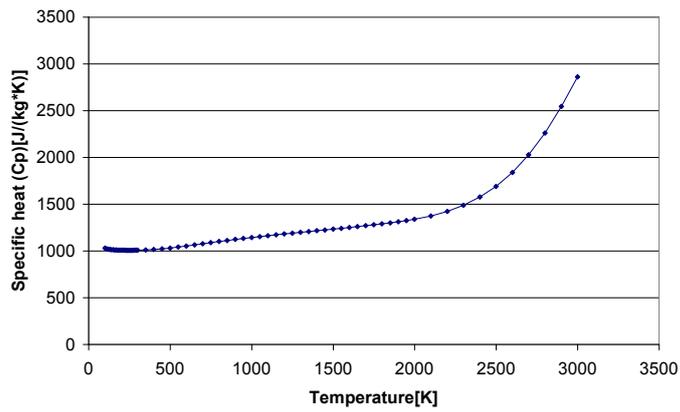
Path: Gases Pre-Defined

Specific heat ratio (C_p/C_v): 1.399

Dynamic viscosity

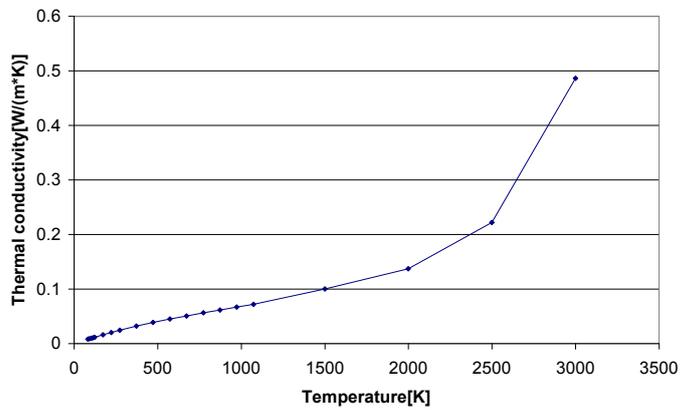


Specific heat (Cp)



Specific heat growing until 2000 [K] slowly after that growing fast.

Thermal conductivity

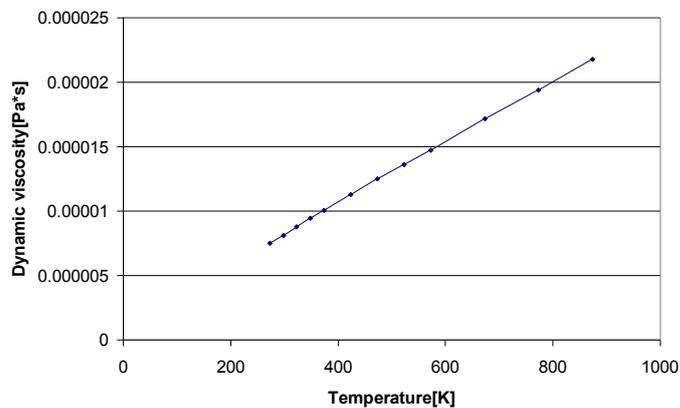


Gas

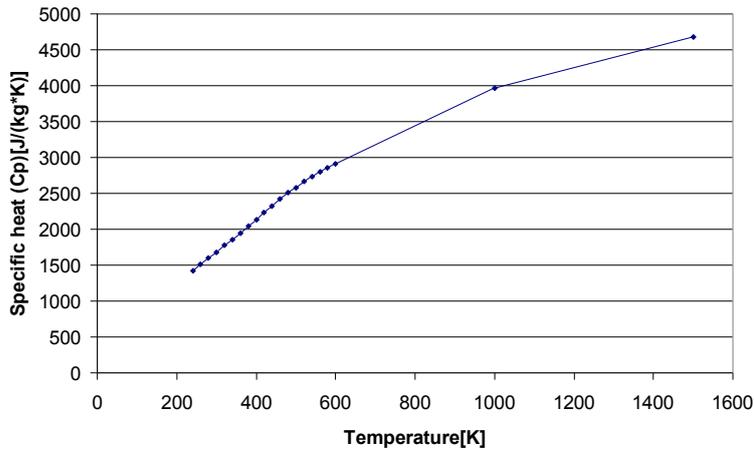
Path: Gases Pre-Defined

Specific heat ratio (Cp/Cv): 1.134

Dynamic viscosity

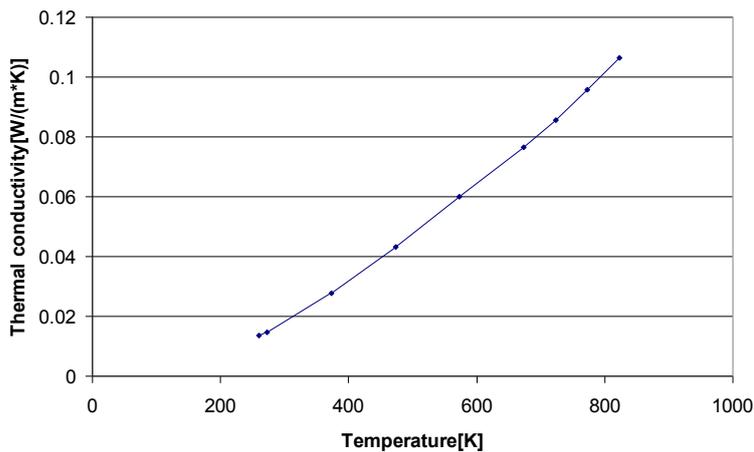


Specific heat (Cp)



As you see this graph, specific heat is growing by changing temperature

Thermal conductivity



Summary for chapter III

The third chapter by means of computer simulation obtained information on the distribution of heat inside the dryer - the mixing drum. Also:

- Obtained by analysis of heat distribution in the section Flow Simulation software package SolidWorks.
- We have taken some results with graphs and they are analyzed.

SUMMARY

Throughout this master's thesis we have studied and identified a few important points regarding to design energy efficient asphalt plant.

1. All widely used asphalt plant designs in the world are studied and some comparison analyses are also performed.
2. Comparison analysis of all studied asphalt plant designs has led to identify the possible leaks of energy losses in a drum dryer.
3. Theoretical formulations of heat flow in asphalt plant is developed for computer simulations and analyses.
4. SolidWorks is employed to create computer Simulation model of Asphalt Plant.
5. Methodology of using SolidWorks package for computer simulation analysis of Asphalt Plant is developed that can be used for academic purposes.
6. Computer simulation tests are performed and found that 20 % losing energy and another defects. With adequate design change of the drum dryer that is feasible to achieve 20% of energy efficiency.
7. Using such computer packages as SolidWorks, SolidEdge or UGS I-deas x substantial resources can be saved if good computer modelling techniques are employed.

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APPENDIX