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значения энергетическая потребность При этом под энергетической потребностью следует понимать сумму тягово-силовых форм подвода энергии и подвода энергии в виде крутящих моментов, поскольку группы рабочих органов передней, задней и боковой навесных систем могут представлять различную комплектацию.

В-третьих, анализ показывает, что эффективность комбинаций рабочих органов на трех навесных системах возрастает с возрастанием ширины захвата, т. е. влияние ширины захвата на эффективность в трехмашинном МТА на базе МЭС выше, чем другая комбинация.

В-четвертых, все навесные орудия, машины и адаптеры, имеющие силовые вращающиеся рабочие органы, требуют высокого уровня балансировки, а элементы рычажных структур навесных систем должны обеспечить весьма жесткую системную конфигурацию.

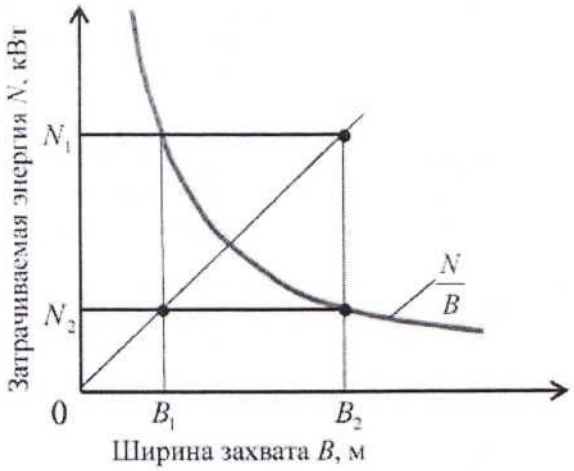

Рисунок 1 — Соотношения *N*, *B* и *Nуд* при постоянной величине B/N.

Теперь, наконец, можно полагать, что энергетическое обоснование МТА в виде трехмашинных схем на основе мобильного СВ МЭС в первом приближении выполнено. В последующих исследованиях назначение СВ МЭС при формировании многоуровневого многопроцессного МТА будет, несомненно, расширено. Но в настоящее время, еще не имея опытного образца, мы можем принять приведенные исследования как достаточные.

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Increase of energy and ecological efficiency of the electric gas purification and the exploitation of electrostatic precipitators

The relevance of the given problem is the purification of gasses selected in technological processes from solid and liquid aerosol particles. Achievements in the development of processes of electric gas purification and drawbacks of the existing electrostatic precipitators related to their considerable sizes and difficulty of exploitation process are presented. The directions of the conducted researches and their results on increase of energy and ecological efficiency of the electric gas purification and the exploitation of electrostatic precipitators are summarized.

Pollution of atmosphere takes special place among problems of protection and safety of the environment. Global character of this problem lies in the destruction of ozone layer and greenhouse effect, which leads to change of climate of the earth and different natural disasters. Moreover, there are regional problems such as acid rains, different allergic illnesses, decrease of harvesting capacity of agricultural crops, extinction of flora and fauna. The issue of provision of favorable conditions for employees at enterprises, the technological process of which is accompanied with a lot of dust and hazardous substances, is critical. Such

enterprises include cement, metallurgic, chemical and other industries of the Republic as well as enterprises for processing of agricultural products and raw materials.

Major share of electric energy (93%) is produced by electric power plants operating on natural gas. The program of stage by stage transition of these electric power plants to solid fuel is developed. High ash (up to 40...60%) low-grade coal from local deposit field will be used as such fuel at electric power station, which will inevitably lead to increased dust content of furnace gases.

At the listed enterprises they mainly use inertial dust collector, the collecting ability of which reduces for particles with the degree of dispersion less than 100 μm and the particles with the degree of dispersion of less than 20 μm are almost not collected.

To collect fine dispersion dust, electrostatic precipitators are more suitable to detect particles the size up to 0,1 μm at insignificant aerodynamic resistance. The development of equipment for electrostatic purification of gasses falls for 50ies-80ies of the last century. Highly effective devices were created, which provide high degree of purification. The sphere of application of electrostatic precipitators became significantly wider. The production of unified electrostatic precipitators is smoothly established and their size range includes devices that provide purification of furnace gasses of boilers of big power-generating units of 300, 500 and 800 MW, big furnaces of cement production and other technological devices[1].

From the beginning of 80ies of the 20th century major works on electric gas purification were mainly related to the increase of efficiency and reliability of already developed electrostatic precipitators. Due to application of thyristor regulation, silicon rectifiers and other semi-conducting elements, the reliability of devices increased considerable. The developed principles of regulation of voltage allowed maintaining of increased load on electrodes of electrostatic precipitators that would ensure high degree of purification.

Noting significant advancement in the equipment for electric purification of gasses, let's analyze reasons, which prevent from wider use of electrostatic precipitators in the processes of purification of gasses selected in technological processes as well as use of them for air purification from solid and fluid aerosol particles in production, social, medical and residential premises.

First of all, significant size and mass of electrostatic precipitators at big power consumption should be noted. The size of electrostatic precipitators of UGZ series is 18,6x12x15,4m to 24,8x21,8x27m; herewith, the zone of settling of aerosol particles is A_1 = 15,4...27m. To sustain the electrostatic precipitators, the power sources with the capacity up to 200kVA are used. The velocity of flow of the purified gas is V_1 = 1...1,5m/s. At such technical parameters, there is a critical question of exploitation and repair of electrostatic precipitators. Hence, electrostatic precipitators are outlined in a separate section in the «Rules for electrical equipment installation» and «Regulations for Operation of Consumer Electrical Installations», which include the following[2]..

Due to big capacity consumed by electrostatic precipitators, there is a converting station device. Not more than 20 converters with total amount of oil up to 10 tons and 12 converters with total amount of oil up to 12 tons can be installed there. In case of a big amount of oil in converters, the premises of substation shall be sectioned with fir-resistant partitions with doors that open either side and with fire endurance not more than 0,75 h.

Laying of lines of negative pole out of the station shall be performed with a special protective cable or tires placed on isolators and in solid and sealed cases.

The doors of cases of high voltage isolators shall be equipped with blocking earthing devices to prevent accidental contact of the staff with the parts of installations under voltage.

«Rules of technical exploitation» specify the responsibilities of the staff on duty, maintenance and capital repair, inspection and testing of electrostatic precipitators, procedure of putting them into operation etc.

To increase energy and ecological efficiency of electric gas purification and exploitation characteristics of electrostatic precipitators, it is required to intensify the process of gasses purification in electric fields. For instance, if one reduces the zone of settling to the value A_2, and the velocity of flow is increased to the value V_2, the consumed capacity of electrostatic precipitators will reduce by $[(V_1/V_2)\cdot(A_1/A_2)]$ times provided the equal productivity. Proportionally to capacity, sizes of electrostatic precipitators will decrease.

Known ways to increase efficiency of operation of electrostatic precipitators[3], using preliminary charge, do not give a desired result. This conclusion is based on the results of the conducted experimental studies of the dynamics of force impact of electric fields on the particles of the material. Interaction of preliminary charge with electric field is manifested in the form of short-time impulsive force with the duration of not less than 0,01s, after which, there is regular process of ion charge of the particle. Hence, it is obvious that determining factor of the process of electric gas purification is density of electric field. Density of electric filed in the existing electrostatic precipitators is sustained on pre-disruptive values. Thus, it is important to develop a way that would allow increasing of density of electric field.

Development of a new way of electric gas purification is determined by the lack of corona effect of constant voltage used in the existing electrostatic precipitators. Being of the kind of independent voltage, it has different elementary processes: appearance, movement and destruction of charged particles. It leads to instability of discharge currents according to frequency and amplitude as well as blocking of charge, reverse corona, transition into spark or arch form. It is obvious that one can increase the efficiency of electric gas purification providing the stability of discharge processes.

The conducted analysis shows that to increase the efficiency of electric gas purification, it is required to stabilize discharge processes at the increase of density of electric field. To do so, one needs to combine independent and dependent charges in one discharge gap.

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[1] Aliev G.M. Feed devices for electrostatic precipitators. – M. – «Energoizdat». 1981. – 136 P.; Korolev Yu.D., Mesyats G.A. Physics of impulse disruption of gasses. – M. – «Nauka». – 1991. – 224 P.

[2] Levitov V.I., Reshidov I.K., Tkachenko V.M. etc. Furnace electrostatic precipitators. Edited by V.I. Levitova. – M. – «Energiya». 1980. – 448 P.; Rules for electrical equipment installation. – M. – «Energoatomizdat». – 1985. – 564 P.

[3] Aliev G.M. Feed devices for electrostatic precipitators. – M. – «Energoizdat». 1981. – 136 P.

The studies were conducted towards the application of unipolar impulses of high voltage because when the time of voltage impact decreases, the electric solidity of discharge gaps increases[1]. This excess is characterized with the coefficient K_e, which is introduced as the relation of voltage impulse amplitude U_a to disruptive constant voltage U_d ($K_e = U_a/U_d$).

The physics of impulse break-down of gasses divides the spheres of development of discharges in the air according to Townsend or streamer mechanism. In the technique of electric gas purification the inter-electrode gaps from 0,05 to 0,15m at pressures close to normal and already at $K_e > 0{,}02$ there is streamer disruptive mechanism[2].

A distinctive peculiarity of development of streamer discharge in electric field at negative polarity of corona electrodes is formation of ions of both signs in similar quantity in the volume of gas. For the process of electric gas purification in the volume of gas, there has to be a flow of negative gas ions. Hence, it is important to involve separation of volume charges. To do so, one needs to create separating electric field in inter-electrode gap with the use of impulse charge with the parameters specified in Figure 1.

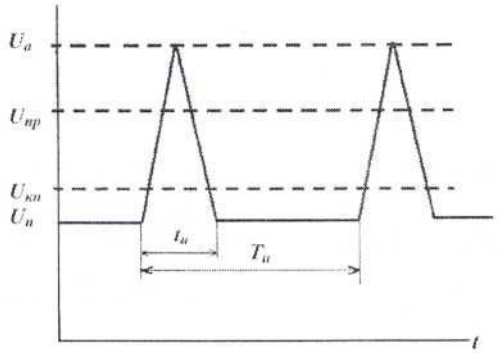

Fig.1. Parameters of unipolar impulses of high voltage

The mechanism of activity of voltage of this form lies in the fact that at the application of voltage impulse with the duration τ_i, the amplitude of which $U_{a.i}$ is higher than disruptive value of constant voltage U_d, in the discharge gap there is independent corona discharge in streamer form. Under the effect of separating electric field created by constant element of impulse voltage U_c in electrode gap in the pause between impulses (T_i-τ_i) there is dependent discharge in the process of which there is neutralization of positive ions and a flow of negative ions towards earthed positive electrode is formed. The value of constant impulse voltage is lower than ignition voltage of corona discharge of constant voltage $U_{c.c}$.

Strengthening of separating properties of electric field is performed by electrode system «earthed electrode — potential electrode with coronate needles».

The conducted theoretical and experimental studies showed the following advantages of streamer form of corona discharge of constant voltage:

- possibility of calculation of feed chain taking into account the parameters of technological discharge gap;
- possibility of automated regulation of voltage on electrodes according to the size of discharge current;
- the value of discharge current increases by two or more times;
- increase of the velocity of purified gas up to 8 m/s and reduction of settling zone of aerosol particles to 1m;
- at the velocity of flow of purified gas of 8 m/s power capacity of the purification process is 33W s/m^3;
- due to the sharp decrease of sizes, creation of electrostatic precipitators in the form of head pieces for the place of gas discharge in the atmosphere without disruption of technological processes;
- increase of the velocity of purified gas from 1 to 8m/s and decrease of the settling zone from 27 to 1m allows reduction of power consumed by electrostatic precipitator by [(8/1)· (27/1)] =216 times;
- significant reduction of works on exploitation and repair of the equipment of electrostatic precipitators.

According to the results of studies, the system of electrostatic precipitators for cotton purification plants was developed, which included: electrostatic precipitators for air purification at cyclone output; electrostatic precipitators for air purification at production premises; the scheme of feed with unipolar impulses of high voltage.

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