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ON THE IMPROVEMENT OF DUST AND GAS PURIFICATION PROCESSES OF INDUSTRIAL WASTES OF PREPARATION PLANTS

D.S. Pustovoi, State Higher Educational Institution «National Mining University», Ukraine

The article analyzes the conditions of local areas for raw material preprocessing for production chain of preparation plant. Characteristics of fine particles in the industrial emissions are represented. Impossibility of complete purification of contaminated flows in centrifugal devices to remove dispersed aerosol which diameter is 5 mcm or less being the most dangerous for the staff is emphasized. It is shown that the solution of the topical problems of today as for creating appropriate atmosphere in shopfloors of any industrial enterprise means the use of electromagnetic fields for coagulation of ultra-microscopic aerosols with the following afterpurification of the flows in cyclones.

Coal preparation is a considerable source of technological contamination of both shopfloor air and the environment.

Various energy devices ensuring preparation of the initial material to perform technological process of end product obtaining are the main sources of dust generation during the process of mineral preparation. Local operations of unloading, crushing, grinding, and screening of mineral raw material as well as spill points of intermediate material during its transportation along the whole production chain are the reason of generated industrial dust contaminating shopfloor atmosphere with solid particles.

Characteristic of industrial dust, its amount and quality is determined by the type of technological process of enterprise area as well as by the condition and peculiarities of the existing aspiration systems that guarantee meeting the requirements of sanitary standards ensuring dust purification technology.

Contaminated airflow or products of combustion (gases) can be considered using one of the forms of polydisperse medium in which air (gaseous substance) acts as disperse medium while solid particles which size is within 0.05 – 500 mcm and more are disperse phase. Maximum size of the particles is determined by their ability to stay in suspended state for some time while transporting heterogeneous flows. Solid particles in industrious dust (mixture of dust and air or gas) are called dispersed aerosols.

Solid particles in aspiration flows usually have arbitrary (irregular) geometrical shape. The following two parameters are used while analyzing dust purification processes at any industrial enterprise:

- median diameter (size) - δ_{50};
- heterogeneity index - σ.

Median diameter δ_{50} is the particle size that is used to divide the mass of dust particles into two equal parts: particle mass less than δ_{50} makes up 50% of all the dust mass as well as the mass of particles being larger than δ_{50}.

Heterogeneity index σ is the dimensionless quantity being determined by the ratio of diameters $\delta_{50}/\delta_{15.9}$ and $\delta_{84.1}/\delta_{50}$. The mentioned ratios $\delta_{15.9}$ and $\delta_{84.1}$ contain diameters of solid particles and fractions being less on their boundaries which masses are 15.9 and 84.1% correspondingly if we consider the whole particle mass.

To calculate dust-catching efficiency it is necessary to know median size δ_{50} of the ones being caught from the air in the process of purification or mean logarithmic deviation of heterogeneity index σ.

Median diameter δ_{50} is usually used to characterize average value of solid particles of industrial dust being analyzed. There are three types of polydisperse systems according to linear size of contaminated flow particles:

- coarse ones at $\delta>100$ mcm; as a rule these particles do not diffuse;
- medium ones at $10<\delta<100$ mcm; they deposit in the air at constant rate;
- fine ones at $\delta<10$ mcm; such particles are in constant Brownian motion diffusing constantly as well.

Depending on the particle size of flow dust contamination corresponding purifying equipment is selected.

As a rule, various structures and types of centrifugal high-efficiency cyclones are recommended for the first two systems. Operation principle of these devices is based on singling dust particle out of the contaminated flow under the action of centrifugal forces being the result of its rotation in a cyclone body.

These devices are easy to manufacture; they are quite reliable with high performance. They are also characterized by relatively low hydraulic resistance. The devices can be used for aggressive and high-temperature contaminated flows.

Structures of centrifugal devices being widely used under conditions of various industrial branches ensures about 85-90% of the whole purification performance.

Their main disadvantage is the fact that it is impossible to catch dispersed aerosol (solid particles of contaminated flows) of less than 10 mcm in size.

The mentioned formations of contaminated air aerosols are unstable systems being subject to constant changes under the action of different factors. Theory of gas flow dust purification calls these transformations coagulation or fine particle coarsening into large molecular formations.

Use of group or battery cyclones of small and large diameters, structures, and modifications improve partially purification degree of disperse media (approximately by 5%). Nevertheless, it does not solve the essential industrial problem connected with the removal of dispersed aerosols which particle diameter is 5 mcm or less.

Fine dust of the contaminated flow is hygienically harmful air component effecting organisms of the staff. If such air is inhaled, the mentioned particles penetrate into the lungs causing serious changes and irritating mucous membrane.

All the represented data show that afterpurification of shopfloor atmosphere at preparation plants is the important and essential problem of today. It can be solved only by thorough and detailed development and practical implementation of advanced afterpurification of industrial flows.

Recently new dedusting methods in the technology of contaminated flow purification have been implemented; these methods are based on the application of strong electromagnetic fields. Use of electric technology is based on the development of conditions for activation within the volume of dust and gas dispersed aerosols. As the result of purification these solid particles approach each other and stick together forming new secondary large conglomerates; after that flows are directed to after purification.

Use of electric fields or electric and ion technology during dust and gas purification allows performing this operation by the direct effect of electric power upon elementary fine particles without transitory transformations into other energy types; such way is possible to be used to process any mineral material.

To intensify the process of ultra-microscopic aerosols (particles) control during coagulation for the formation of the fixed end product, the latter ones should have corona discharge at negative or positive voltage polarity.

There is the following consequence of the main coagulation stages in contaminated flows:

- ionization of dispersed elementary aerosols;
- arranging ordered motion of fine particles;
- formation of the second end product.

The represented data show that we can perform practically full purification of technological emissions to remove dangerous dispersed aerosols in shopfloor atmosphere of dressing plants if centrifugal dust and gas purification is completed with the components of electric technology.

The arrangement of any final functioning of contaminated flow purification at any industrious enterprise should contain proper segment of the electric technology components that allows anticipate physical and chemical coagulation processes of dispersed aerosols of the diameter being less than 5 mcm in the volume of contaminated flow with the following afterpurification to remove newly formed large solid conglomerates.

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