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INFLUENCE OF DUST OF INDUSTRIAL ENTERPRISES ON THE HUMAN BODY

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ABSTRACT

Air purification is one of the most important processes in production. Because human health and the prevention of occupational diseases are one of the main goals. During the processing of raw materials at industrial enterprises, toxic gases and dust are formed, which are considered dangerous to the human body. This article focuses on the centrifugal cyclone used for dust removal and the potential for dust removal is enormous. It has the principle of continuous and continuous operation depending on the concentration of dust. The article discusses a wide range of specific sources for dust formation, particle size, cleaning methods.

KEY WORDS: ***microscopic dust, ultramicroscopic dust, dispersed system, aerosol, bronchitis, pneumoconiosis, cyclones, centrifugal motion, dusty air pressure, dust velocity.***

INTRODUCTION

Dust is very small particles of solid or liquid that can circulate in the air. Clean air in production facilities is essential for the health of workers. When workers breathe in compressed air, the upper respiratory tract itches and the person involuntarily breathes shallowly, which negatively affects lung function and causes various diseases. Itching of the mucous membranes of the eyes in dusty rooms causes conjunctivitis, and at the same time dust particles are also a means of transferring tubercle bacilli and harmful bacteria. Coarser dust gets into the nose and throat. Fine dust enters the respiratory tract. When the air speed is lower than the speed of dust (size 0,1-10 mkm), dust particles slowly settle on the ground at a constant speed. The rotation speed of dust particles can be determined by the following Stokes formula:

$$V_r = 0{,}3 \cdot \rho \cdot d^2$$

where: Vr is the speed of dust particles, m/s; r is the density of raw materials, kg/m^3; d - particle diameter, μm.

The degree of harmful effect of dust on the human body depends on its size: - if dust particles with a size of 50 microns or more enter the upper respiratory tract, it will not cause harm; - if dust particles with a size of 10-50 microns penetrate deep into the respiratory tract, a very small amount of dust gets into the lungs: - if dust particles smaller than 10 microns enter the branches of the respiratory tract, they are dangerous to the body; - It is very dangerous for dust particles less than 1 micron to enter the lungs. Because it causes silicosis. The harmfulness of dust depends on its size and chemical properties. Sanitary standards provide for the maximum allowable amount of dust (REC) in the air of workplaces:

1. For plant and animal dust containing 10 percent or more of free silicon oxide (II) (SiO_2) -2 mg/m^3;

2. For plant and animal dust containing up to 10% silicon oxide (II) (SiO_2) - 4 mg/m^3;

3. For plants and animals, mineral dust containing silicon oxide (II) (SiO_2) in an amount of up to 2% - 6 mg/m^3. For example, if at light industry enterprises the maximum allowable dust level is 4 mg/m^3, air pollution at the workplace is 65-75 mg/m^3 and 1,7% silicon oxide (II) (SiO_2) is eighteen times higher than sanitary standards. According to the sanitary standards for the design of industrial enterprises, harmful substances are divided into five categories according to the degree of harm to the human body:

MATERIALS AND METHODS

1 hazardous substances; 2 highly hazardous substances; 3 moderately hazardous substances; 4 hazardous substances; 5 Less hazardous substances (harmful gases and bacterial contaminants). In the process of processing raw materials for light industry, toxic gases are emitted along with harmful dust. Toxic gases are mainly extracted from waste water treatment plants. These gases include carbon dioxide,

ammonia and, in some cases, hydrogen sulfide. These gases are generated during the processing of raw materials. The maximum permissible amount of such toxic gases is 10 mg/m^3.

Toxins released in the printing industry release styrene, nitrile acrylic acid, chloride and phosphoric acids, acetone, benzene, gasoline, toluene, acetic acid gases, nitrogen and carbon oxides, sulfuric, hydrochloric and acetic acids, which are used in the oxidation process in the textile industry. Compounds of sulfur (Na2S), chlorine (NaCl), as well as other chemicals are used for dyeing fabrics. Carbon dioxide is one of the most common air pollutants in industrial buildings and homes. Carbon dioxide in the atmosphere 0,03-0,04%.

RESULTS

The presence of 4-5% carbon dioxide in the production air is considered hazardous to human health [1].

The excess requires a cleaning process to bring this dust and toxic gases to their maximum allowable concentration. Depending on the size of the dust particles, cyclones should be selected or an electromagnetic field should be generated for existing cyclones. The electromagnetic field can completely separate small dust particles. After all, any speck of dust consists of negative and positively charged ions. To separate the charges, it is necessary to select an electromagnetic voltage and set it in the cyclone. The sizes of dust particles generated during the processing of raw materials by industrial enterprises for the production of finished products are shown in the table below.

Table 1
Dust from manufacturing plants

№	Name of manufacturing enterprises	Dust particle size, μm		
		10-50	1-10	1 and the low
1.	Light industry	20 %	50 %	30 %
2.	textile	15 %	35	50%
3.	Construction Materials	10 %	20 %	70 %
4.	Food industry	5 %	15 %	80 %

As can be seen from Table 1, the bulk of dust emitted by enterprises is dust less than 1 micron in size. This dust adversely affects the health of workers in manufacturing plants and can cause occupational diseases. Therefore, one of the main goals is to take seriously the cleaning of these enterprises from dust or toxic gases. Depending on the type of the manufacturer's products, cyclonic or dust collectors require modification of the working bodies. Correct process operation will prevent long-term operation of technical equipment and adverse effects on the health of workers.

As a result of tests of an industrial device containing cyclones with a diameter of 0,3 m and 0,2 m connected in series by scientists, the average diameter of dust particles was 60 mkm; the degree of contamination of the gas mixture entering the cyclone at a temperature of 1073 K and a pressure of 1 MPa is 7,5 g/m^3. Measurement of the composition of dust and the number of fractions. The gas leaving the first and second cyclones was measured at different rates. The cleaning efficiency in the first cyclone ranged from 75% to 90%, and in the second cyclone, the cleaning efficiency was from 50 to 60%. In both cyclones, for the operation of a two-stage device with a hydraulic resistance of 2000 Pa (with an air efficiency of 6 m^3/s), 15 kW of power was consumed, since it could not completely purify the mixed gas [2].

Research on cyclones shows that high flow rates are required to increase the dust holding effect of the cyclone. However, as the air velocity increases, the flow resistance of the cyclone at the inlet increases.

Table 2
The main indicators of centrifugal cyclone devices

№	Indicators	Cyclone brands				
		SP -3 SL -3	SS -6	VZ 1200	SS -6+ dusty chamber	SS -6 + VZP -1200
1.	Productivity for cleaned air m/s^3	3	6	6	6	6
2.	Hydraulic resistance, Pa	650	630	1400	1100	2000
3.	Cleaning efficiency,%	86	85	93,1	90	97,75

Air was blown into the centrifugal cyclone at a speed of 17 m/s using an air spray. Dust particles are sent from the inlet through the air duct to the moving centrifugal flow, which is the working fluid of the cyclone. The size of the dust particles is measured using a special microline microscope. Thus, the presence of dust particles under the action of centrifugal force and the efficiency of the cyclone are determined.

The settling rate of dust particles in a gravitational field can be determined by the following formula:

$$\omega = \frac{H}{\tau}$$

Where: H is the height of the vertical cyclone;

t is the time of descent of dust particles.

The coagulation effect of dust particles increases as they move in a turbulent flow. This is due to the fact that the resulting holes increase the speed of particles relative to each other and increase the likelihood of their collision with each other and the rate of coagulation. The state of dust particles in a turbulent flow is currently being studied. This is, of course, their effectiveness, and the results regarding the size of the dust particles will be determined during the course of the study.

DISCULUSION

Based on the results of scientific work, an overview of the next cyclone is offered Figure 1.

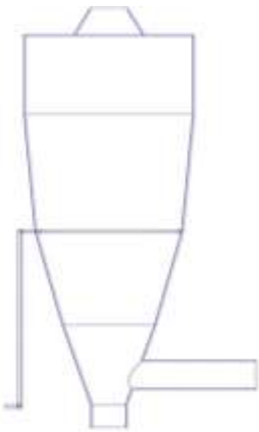

Figure 1. Experimental device of a centrifugal moving cyclone.

The settling of solid phases from a liquid or gaseous medium under the action of gravity is a method of separating different systems, the flow is carried out at a low speed, a large volume of equipment is required. If the process is carried out in a field of centrifugal forces, the settling rate of particles increases. The use of centrifugal forces increases the limit of the availability of various dust and gas systems. To achieve a high degree of air purification, it is important to determine the value of the sedimentation rate of individual particles in the centrifugal and gravitational fields. When studying the effect of particle size on the sedimentation rate of individual particles, the values are determined by calculating the free sedimentation rate and the splitting coefficient in gravitational centrifugal fields [3].

A graphic representation of the influence of the distance between the cyclone inlet nozzles on the degree of air flow cleaning from dust in addition to the input speed is given in the dust collection efficiency [4, 5, 6, 7, 8, 9, 10, 11, 12].

The graph in Figure 3 shows that as the distance between the coalescer and the inlet pipe increases from 100 to 210 mm, the cleaning efficiency increases from 96,5% to 99,2%, and the cleaning efficiency decreases from 210 to 330 mm. the rate is reduced to 95%. As this coagulation zone increases, some of the enlarged particles fly away without reaching the cyclone.

In the course of the experiments, the influence of the deflection angle on the degree of purification of the dusty air mixture was investigated. Several experiments were carried out to determine the optimal deflection angle during the cleaning process. Table 2 below shows the effect of the distance between the inlet and outlet of the cyclone on the efficiency of the air cleaner.

Table 2
Influence of inlet and outlet clearance on the efficiency of a dusty air purifier

№	Cleaning efficiency index of a centrifugally moving cyclone,%	Distance between cyclone inlet and outlet, mm
1.	95	50
2.	96	100
3.	97	150
4.	98	250
5.	100	350

Table 3.
Cleaning efficiency of deflection angle

Angle of inclination of the mesh	15	20	25	30	35	40	45	50	55	60	70
Hydraulic resistance, Pa	5-8	9-11	10-15	14-17	18-22	22-30	23-35	24-36	28-34	39-47	48-61
Cleaning efficiency,%	90,5	92,2	94,5	96,8	98,6	99,2	99,0	98,5	97,6	96,2	95,5

Thus, it can be concluded that the use of two-stage cyclones for air purification in devices used in industrial plants reduces the range of movement of the system, it becomes necessary to use additional pneumatic devices, which leads to another dust suppression furnace.

CONCLUSIONS

As can be seen from the table, the greater the distance between the devices when cleaning dusty air under the action of centrifugal force, the higher the efficiency of the device. Experiments have shown that the choice of a distance of more than 300 mm, taking into account the angle of deflection when cleaning from harmful dust from food industry enterprises, can give the expected effect. In this case, the angle of inclination varied within 15^0-60^0. Table 3 shows the results of experiments to determine the influence of the deflection angle on the cleaning efficiency.

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