DETERMINATION OF DUST PRODUCED IN INDUSTRY AND ASSESSMENT OF THE EFFICIENCY OF DEVICES

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Abstract. *It is known that today one of the most common wastes in the industry is dusty waste. Dusty wastes are separated in almost all industrial sectors and released into the atmosphere. As a result, the composition of the atmospheric air is severely polluted. Dusty wastes are often formed in the process of obtaining a certain product, for example, flour dust in flour mills, dust of these materials in the process of production of construction materials, and dust and fluff dust are released in the production of paper. Therefore, dust particles are a part of the manufactured products, and it is of great importance to capture them and return them to the production cycle.*

Sanitary norms in production rooms of industrial enterprises

(QMQ 3.01.02-00) allowed amounts of harmful substances in the air must be maintained. In the production zones of industrial enterprises operating under any normal conditions, the release of dust or toxic substances has a sufficient impact on the human body. This article describes the effects of industrial dust on the human body, methods of dust cleaning and evaluating the efficiency of dusty air cleaning equipment.

Keywords: *industrial enterprises, production, dusty air, pollution, cyclone, device, dusty gas, cleaning equipment.*

Introduction. It is known that the human body has the ability to get used to and adapt to various conditions. But this adaptation takes place only within certain limits. These adjustment limits are defined by SN 245-71. That is why it is necessary to pay special attention to construction rules and regulations, organizational issues, and ensuring fire and explosion protection in ventilation systems when designing and installing ventilation devices. It is also recommended to widely use industry standards and regulatory literature issued by the state construction committees of Uzbekistan.

Purification of emitted air is an important stage of its neutralization, thus ensuring non-pollution of the air environment inside and outside the enterprise [1].

Currently, the main source of atmospheric air pollution is manufacturing enterprises. Environmental protection is one of the most important problems at this time, and it attracts the attention of experts from all over the world [2].

Therefore, it is of particular importance to determine the nature of the dust particles contained in them in order to neutralize dusty air waste. Because the cleaning method and its apparatus differ depending on the properties of the dust particles.

Methods and results. Currently, there are many types of dust air cleaning equipment, but the choice of which one depends on the type of dust classification.

According to the size of the dust particles, the dust of all industrial types is divided into the following 5 classification groups:

I - very large dust;

II - large dust;

III - medium-sized dust;

IV - fine powder;

V - very fine powder;

Depending on the classification group of dusts, dusty air cleaning equipment is also divided into the following five classes depending on their efficiency [3].

The efficiency of dust air cleaning equipment is determined by how much dust is trapped in the air and is usually calculated in %.

Classification of dusty air cleaning equipment according to efficiency

Classification of dusty air cleaning equipment	Size of dust particles that can be effectively captured, mm	According to the dispersion of dust	
		Dust group	Efficiency, %
I	0.3-0.5 and more	V	80
II	2	IV	99,9-80
III	4	IV	92-45
		III	99,9-80
IV	8	II	99,9-99
		II	99,9-95
V	20	I	99,9
		I	99

For example, m_1 kg of dust entered the equipment, m_2 kg of dust was retained in it, its efficiency

$$\eta = \frac{m_2}{m_1} 100\% \tag{3.3}$$

Usually, this value is determined by the concentration of dust in the air entering and leaving the equipment

$$\eta = \frac{C_k - C_{ch}}{C_k} 100\% \tag{3.4}$$

In some cases, two-stage equipment is also used due to the lack of efficiency of dusty air cleaning equipment. In such cases, the overall efficiency is calculated as follows:

$$\eta_{um} = \eta_1 + \eta_2 - \frac{\eta_1 \cdot \eta_2}{100} \tag{3.5}$$

Here η_1, η_2 – the performance of each dust air purifier.

Classification of existing methods of neutralization of dust generated in industry. In general, air dust cleaning devices used in industrial enterprises are extremely diverse and colorful. The main reason for this is that it is an extremely difficult task to neutralize industrial dust or to separate it from the air [4].

Methods of cleaning industrial waste dust gases are divided into 4 groups:

1. Dry mechanical gas cleaning - by impacting dust particles under the influence of external mechanical force;
2. Wet gas cleaning - by applying a liquid (mostly water) to dust particles, suffocating and washing the particles;
3. Filtration - by passing and retaining dust particles through porous barriers;

4. Electrical cleaning - by passing dust particles through an electric field, charging them and pulling them to electrodes.

Dry mechanical dust collector devices can be divided into three groups:

1) Dust collection chambers based on the force of gravity, that is, the force of gravity;

2) Inertial dust collector devices based on the force of inertia;

3) Centrifugal force-based dust collection devices, i.e. cyclones.

Despite the fact that dust extraction and trapping with the help of textile fabrics are widely implemented, currently used devices do not fully meet the requirements of the industry. Larger dusts are not difficult to capture or separate, they are easily separated by centrifugal force-based dust collectors. As the dust particles become smaller, the possibilities of their separation also decrease. Since the weight of fine dust does not differ much from the air molecules carrying it (remember the mathematical expression that there is a particle smaller than the smallest particle), they cannot be completely separated by centrifugal devices, when passing through textile fabrics, the fabric no matter how thick it is, dust will pass through it. On the other hand, it becomes difficult for air to leak through the thickened fabric, which in turn causes some problems [5].

Considering the above-mentioned points, choosing air purifiers, first of all, the composition of the dust in the air, the degree of danger, its fineness, as well as whether it is composed of valuable substances (for example, if it is composed of food products), when cleaning it dust cleaning devices with high efficiency are used [5].

Among the air dust cleaning devices in industrial enterprises, the most simple structure and therefore the most popular is the cyclone. Cyclones are used in almost all industrial enterprises. Separation of dust from dusty air in cyclones is based on centrifugal force. Dusty air is sent to the cyclone through a diverting device. This device is designed to move the air stream obliquely to the cyclone shell. During its movement, the air moves to a conical base, and as the cone narrows, the air movement accelerates, and a sharp decrease in the pressure of the air movement is observed in the lowest part of the cyclone shell [6].

As a result, the air that has reached the lower part of the cyclone cone sharply changes its direction, keeps its spiral movement, goes up and is expelled through the pipe. The separation of dust from the air occurs in the lower part of the cyclone's conical base, when the air movement changes sharply. Because the dust contained in the air is heavier than the air, it cannot turn sharply with the air, but is thrown out of the air by the force of inertia [7].

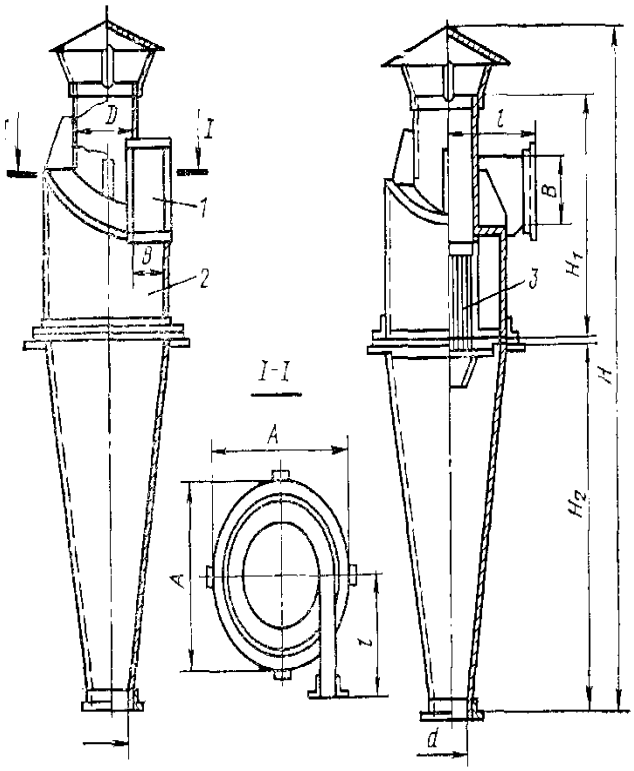
The general theoretical aspects of the air cleaning process in cyclones have not been developed. Therefore, the selection and construction of cyclones is based on practical means.

Based on currently accepted rules, the operation of the cyclone is considered to be based on the law of centrifugal force [5].

$$C = \frac{mV^2}{r},$$

Here, m - is the weight of the particle; V-speed of air entering the cyclone, m/s; r is the radius of the cylindrical upper part of the cyclone or the large side of the conical base, m.

5. Diameter 1500 mm It can be seen from this formula that the larger and heavier the dust, the higher its ability to be captured. But the amount of dust in the air is beyond our control and we cannot change it [5,6,8]. Air movement speed is a variable unit. But experiments have shown that with the possibility of increasing the speed of air movement indefinitely, it creates an unstable (turbulent) state of the air flow, which, in turn, leads to the formation of eddies in the flow [9,10]. The vortices wear out the dusts created by centrifugal force inside the cyclone, and they pass to the inside of the cyclone and cause it to be released into the air without being cleaned. That is why it was found that the most effective speed of the air entering the cyclones is 18-22 m/s.



It is possible to change the radius of the cyclone. The larger the diameter of the cyclone, the lower its ability to catch dust, and the smaller the diameter of the cyclone, the more effective it is. This, in turn, creates certain difficulties. A large cyclone can receive a large amount of dusty air at once [11].

Technical characteristics

1. This cyclone device is designed for the purification of waste gases with a cleaning efficiency of 90%
2. Air consumption is 3 m3/s
3. Hydraulic resistance 650 Pa
4. Height 45000 mm
5. Diameter 1500 mm

Picture 1. Scheme of the cyclone.

As its size decreases, the air intake capacity also decreases. This leads to an increase in the number of cyclones. Air supply to a large number of cyclones should be carried out with the help of air distribution means.

Schedule of connections

Designation	Naming	Number	Conditional transition D, mm	Conditional pressure R, mPa
T	Clean gas inlet	1	130	0,5
Ch	Waste output	1	100	0,5
G	Connecting with the atmosphere	1	150	0.5

Conclusion. Centrifugal dust collectors (cyclones) are dry inertial collectors that use the centrifugal force generated by the air circulation in the container body to separate the dust. The body of the dust collector can be cylindrical, cylindrical-conical or conical in shape.

Dust enters the cyclone through the air inlet pipe and gets a circular movement. Centrifugal force compresses the dust particles against the inner wall of the outer casing, where the dust hits the wall, slides down under its own weight, and is discharged into the dust collector. The air stream rotates and loses its speed and passes to the lower part of the cyclone and into the inner body. Then it is released into the atmosphere through the upper slot. Typically, the dust from the cyclones is transported by a screw conveyor serving the group of cyclones.

It is recommended to remove the dirt with the help of air instead of the screw conveyor, so that the dust from the dust extraction holes does not wear out.

In the process of technological calculations, the amount of the gas mixture being cleaned, the amount of dust particles, the density of the gas mixture and several other operations are performed when the dust cleaning device cleans dusty air from dust particles in the cyclone.

REFERENCES

1. ГОСТ 12.3.002-75 "Ишлаб чиқариш жараёнлари. Умумий хавфсизлик талаблари"
2. ГОСТ 12.0.003-91- “Хавфли ва зарарли ишлаб чиқариш омиллари”
3. QMQ 3.01.02—00 Sanoat korxonalari ishlab chiqarish xonalarida sanitar normalari
4. Musayev M.N., Sanoat chiqindilarini tozalash texnologiyasi asoslari: Darslik. Toshkent-2011
5. Yusupbekov N.R., Nurmuxamedov X.S. va boshqalar. Kimyo va oziq-ovqat sanoatlarining asosiy jarayon va qurilmalari. Toshkent.2000
6. “Хавфли ишлаб чиқариш объектларида хавфлилик даражасини таҳлил қилиш бўйича” Услубий кўрсатмалар «Саноатконтехназорат» давлат инспекцияси бошлиғининг 2009 йилдаги 158-сонли буйруғи
7. Sh. Narziev, Sh. Latibov Prospects of promotion of sport and brewing in the population //SAI. 2023. №B1. URL: https://cyberleninka.ru/article/n/prospects-of-promotion-of-sport-and-brewing-in-the-population (дата обращения: 24.05.2023).
8. G.M. Gulomova, U.M. Turabekova. Problems of ensuring safety at open coal mines in the republic of Uzbekistan. TECHNICAL SCIENCE AND INNOVATION №3/2022 ISSN: 2181-0400
9. V. Murodov, Sh. Narziev Theoretical analysis of fire safety // SAI. 2023. №A3. URL: https://cyberleninka.ru/article/n/theoretical-analysis-of-fire-safety (дата обращения: 24.05.2023).
10. Sh. Khojieva, Sh. Narziev Risks in pharmaceutical activity and professional obligations of the employee // SAI. 2023. №A3. URL: https://cyberleninka.ru/article/n/risks-in-pharmaceutical-activity-and-professional-obligations-of-the-employee (дата обращения: 24.05.2023).
11. Гуломова Гульнара Мухитдиновна, & Файзуллаев Олломурод Тўхтамуродович. (2023). Геолого-тектонические опасности и меры по их предотвращению. research and education, 2(5), 224–230.