DEVICES FOR DRY DUST CLEANING AND THEIR ROLE IN ENVIRONMENTAL PROTECTION

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Annotation. This article provides information on dust emissions from cotton gins. According to research results, cotton ginning enterprises emit complex dust into the environment. This, in turn, reduces the efficiency of dry dust cleaning equipment. The article also provides information on the operating procedure, efficiency and technical indicators of dust cleaning equipment. Based on research, it has been established that dust collectors at cotton gin plants do not meet the requirements of the modern era.

Key words. Environmental problems, environment, industrial enterprises, atmospheric air, dust collector, dusty air cleaning, cyclone.

Introduction. The main factors that pollute atmospheric air are related to industrial enterprises, plants and factories, and motor vehicles. Also, steel smelting furnaces, blast furnaces, coke-chemical industries, nitrogen fertilizer plants, coal and non-ferrous metal mines, and railway vehicles continuously emit toxic substances into the atmosphere.

The impact of the production of industrial enterprises on the environment, human health and lifestyle has developed very quickly and reached an unprecedented level. Wastes from industrial enterprises, household service enterprises move from one type to another in the soil, water or atmospheric air for years. In particular, lead, zinc, arsenic, vanadium, molybdenum, cadmium, mercury and a number of other chemical elements accumulate over time in the form of extremely toxic compounds in the soil, water or air[1].

Due to the increase of carbon oxides in the air, the hemoglobin in the body decreases, the heart and blood-vascular systems are damaged, the disease of sclerosis increases, dizziness, heart rate increases, sleep is disturbed, and the person becomes dizzy. Today, the problem of waste is becoming one of the most urgent environmental issues worldwide. Analyzes show that household and industrial emissions have been increasing year by year in recent years. Especially in the 21st century, the increase in the volume of household waste began to have a very negative impact on environmental sustainability[2].

At the root of environmental problems around the world lies the relationship between man and nature. As a result of the increase of humanity and the wrong attitude to nature, the whole world ecosystem (forests, flora, fauna, soil layer, water layer, etc.) is being destroyed. As a result of the rapid growth of industrial enterprises and their increasing impact on the atmosphere, the whole earth's ecosystem is being destroyed[3].

Problem setting. It is known that cotton ginning enterprises are located in densely populated cities and district centers. And cotton ginning enterprises spread tons of dust and small fibers into the environment, which worsens the ecological situation. Therefore, improving the environmental condition of enterprises is one of the current issues. The source of dusty waste of cotton ginning enterprises is related to the large dust emission during the technological processes of the initial processing of cotton. The amount of dust released depends on whether the cotton is picked by machine or by hand, the class and variety of the cotton produced, the conditions of harvesting and picking, the features and stages of the process, the features and stages of the process[4].

Dusts released during the initial processing of seed cotton differ from dusts released in other industries due to their harsh properties that make dedusting difficult. The main part of the dust coming out of cotton ginning enterprises is waste mixtures, which are divided into organic and mineral types. Organic dust consists mainly of ground pieces of cotton stalks and cotton fibers of various lengths. Due to the stickiness of cotton fibers, dust sticks to mesh surfaces. Machine parts and air ducts are surrounded by small pieces of fibers that ensure the formation of dust. Dusty air begins to move due to the formation of small bumps on the walls[5].

Among the impurities in cotton dust, the mineral type is more important. During the initial processing of cotton, their amount can be up to 80%, and it depends on the degree of contamination of the raw materials, the type of cotton and the method of its picking. The percentage of mineral and organic substances in cotton dust depends on the stage of technological processes. At the beginning of the process, that is, in the seed cotton pneumatic transport system, the dust in the seed cotton can usually contain 10-20% organic and 80-90% mineral dust by mass. At the end of the technological process, for example, during fluff separation or pressing, organic substances in the dust make up 80-90%. Cotton dust contains a large amount of nitrogen, silicon II oxide in the mineral mixture (from 4.8 to 25.2%).

Industrial dust from cotton gins is polydisperse, where the particle size can be as small as a tenth of a micrometer or several millimeters. Microscopic studies have shown that the average size of mineral particles is 10-20 microns. Mineral dust is mainly highly dispersed and its shape is spherical. The shape of fine organic dust (up to 2 μm) is difficult to determine, and dust with a size of 5-10 μm has an irregular,

flat, pointed or non-pointed shape. Dust larger than 100 μm can be curved fibers, leaves, stems and pieces of stems[6].

Materials and methods. When studied based on the type of cotton, its picking method, technological process and processing stage, it was observed that the processing process of type 1 cotton produced more polluted dust from the pneumatic transport system than the cleaning process of low grade cotton. In dust separated from hand-picked 1st grade cotton, 5 μm particles can make up 85% of the total mass. Small impurities harmful to health in machine-picked cotton make up 70%. It contains fiber content. In this case, the fibrous impurity of the dust carries small mineral particles with it.

There is information that sheds light on the medical-biological problems associated with determining this cotton dust and its acute properties that have a negative effect on the human body. Unlike other textile dusts, cotton dust can cause respiratory diseases called byssinosis (Greek word, bysos-cotton). The causes of this disease could not be determined for a long time, but several cases indicate that it is the chemical nature of cotton dust, that is, its organic composition[7].

In recent years, it has been reported that the main causative agents of the disease are fine dust particles present in the cotton stalk and in various stages of the cotton processing process. Research has shown that at the same air pollution level of 0.2 mg/m3, the incidence of byssinosis in the textile industry is significantly lower (13% vs. 0.6%) than in the spinning industry.

Taking into account the high environmental and social harm of cotton dust, sanitary norms have been established in cotton ginning enterprises, in which the norm PDV-60 mg/m3, PDK-0.5 mg/m3 should be at a distance of 300 m from cotton ginning enterprises. One of the important properties of cotton dust is its flammability. There are frequent cases of cotton and dust burning in cotton ginning enterprises, for example, fire may occur due to stones falling on technological equipment. Therefore, dust collection equipment must have fire safety[8].

The process of using dust collectors in cotton cleaning plants is somewhat complicated due to the properties of fiber dust (density, fast drying, viscosity, etc.). For the first time, dust settling chambers were used to capture fibrous dust. Their advantage is the simplicity of their construction. However, the equipment was not widely used in the industry due to its large size, low efficiency, and susceptibility to fire hazards.

In a number of industries, light filters are used, which provide a high level of air purity (more than 99%). However, the stability of this effect can be achieved only by keeping dry and non-sticky dust. When working with dust with a fibrous structure, the filtering process is disturbed, and the regeneration of the fabric becomes difficult. Electrofilters designed for the cleaning of ventilation waste in cotton ginning enterprises were not widely distributed[9].

Acoustic processing of air has practically not found its place in the capture of fiber dust. This can be explained by the fact that the use of sound and ultrasonic generators requires special insulation, and in addition, these generators are effective only when the concentration of dust in the waste is significant. Currently, various types of dust collectors are used to clean ventilation waste from fibrous dust: UTs dust collectors, dust collectors designed by "Uzpakhtasanoatilm", UTsV dust collectors[10].

It should be mentioned that UTsV dust collectors are characterized by high efficiency in air cleaning developed in condensers of gin and linter batteries with fibrous fractions. Currently, they are removed from the industry due to the low production rate (1.5 m3/ s). Their quantity in one piece of equipment should not be less than 4 pieces. It should be said that air purifiers designed to clean dusty air quickly become clogged due to the accumulation of fibrous particles.

When large-diameter dust collectors are used, there are no cases of clogging of dust collector elements and malfunctions, but due to the low efficiency of large-diameter dust collectors, fibrous dust exits the dust collector and pollutes the atmosphere and the environment. Today, ЦС-3 and ЦС-6 type dust collectors (diameter 2300, 3000 mm) are widely used in cotton ginning enterprises. The efficiency of this type of dust collectors reaches 88-92% when a vacuum valve is installed on the dust extraction hole

When operated without a vacuum cap installed in the exhaust pipe, up to 25% air is drawn from the equipment for cleaning into the dust trap, where secondary extinguishing of trapped dust and waste occurs. The efficiency of such dust collectors reaches 60-80%. In recent years, air cleaners with two-stage dust traps have been used in some cotton ginning enterprises. The cleaning efficiency of this equipment is 88-90%[11].

Recently, ВЗП-800 and ВЗП-1200 counter-flow dust collectors with an air efficiency of 3 and 6 m3/s are leaving the industry. The main reason for this is fibrous waste. If there were no fibrous waste, the cleaning efficiency of counter dust collectors would be 96-98%. Despite the variety of vacuum cleaner designs, the efficiency of using any type of dust collector depends on the properties of the dust it cleans.

It is recommended to remove the dust by air instead of the screw conveyor in order to avoid the large amount of dust coming out of the dust extraction tunnels. Fig. 1 and 2 show different types of conical dust collectors.

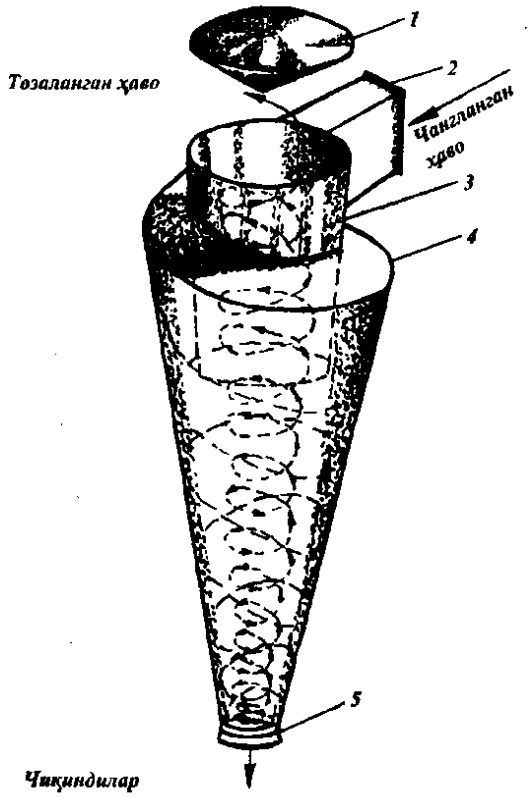

Fig. 1. Drawing of a conical dust collector device:

1- Rain valve; 2 - Inlet pipe; 3 - Internal full truncated cone;
4 - Outer complete truncated cone; 5 - Dust pipe.

Each dedusting device is characterized by its dust capture efficiency, which is determined by the following equation:

$$\eta = \frac{G_2}{G_1} \cdot 100, \ \%$$

where: G_1 - total weight of dust in treated air, mg;

G_2 - dust weight captured by the dedusting device, mg.

Dust capture efficiency can also be determined by the difference in air pollution entering and leaving the dust collector.

$$\eta = \frac{d_1 - d_2}{d_1} \cdot 100, \ \%$$

where: d_1 - dustiness of the air entering the dust collector, mg/m^3;

d_2 - dustiness of the air coming out of the dust collector, mg/m^3.

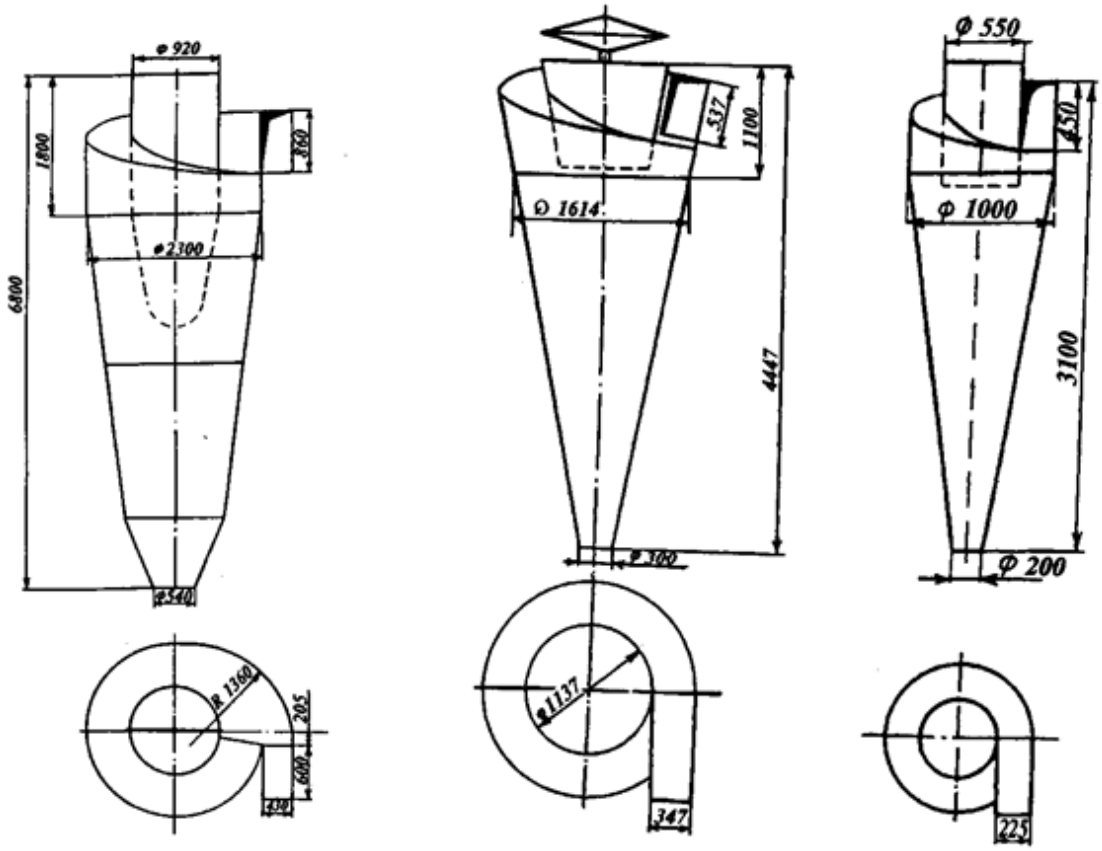

Fig. 2. ЦП -3, УЦВ -1,5 and ЦС -6 dust holders.

The total cleaning efficiency of several successively installed dust collectors is calculated in percent according to this equation:

$$\eta = [1-(1-\eta_1)\cdot(1-\eta_2)\cdot k\cdot(1-\eta_n)]\cdot 100$$

where: η_1, η_2, η_n - dust collection efficiency expressed as a percentage of the unit for each consecutive step.

Table 1 lists the main indicators of dust collectors.

Table 1

The main indicators of the dust collector

Type of dust cyclone	Cyclone diameter, mm	Height, mm	Air consumption, m^3/c	Hydraulic resistance, Pa	Cyclone cleaning effect, %
ЦС-6	2300	6800	6	630	85
УЦВ-3М	1500	4500	3	650	90
ЦП-3, ЦЛ-3	1614	4450	3	650	86
УЦВ-1,5	1000	3100	1,5	700	88

Summary. Cotton gins are significantly different from other industrial enterprises due to the release of dust with a complex composition. This feature of cotton ginning plants reduces the efficiency of dust collection devices in the plants.

Therefore, the efficiency of dust collectors (cyclone) used in cotton ginning enterprises is very low. The principle of operation of cyclones is based on centrifugal force. The dust is separated due to centrifugal force, creating a rotational movement in the cyclone at a certain speed. Not all dust obeys the law of centrifugal force. The reason is that the powder must have a certain weight. As a result, dusts that do not obey this law, i.e. fibrous dusts, get into the environment and pollute it. This will further worsen the ecological situation. The demand of today is to create a dust capture device with high efficiency.

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