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INNOVATIVE SOLUTIONS FOR DUST CONTROL IN COTTON GINING ENTERPRISES

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Abstract: The article describes the technological process of primary processing of cotton, which is accompanied by a significant release of dust from technological and transporting machines into production premises and the atmosphere. The norm of air dust content in the production premises of a cotton gin plant is no more than 10 mg/m3. To create normal sanitary and hygienic conditions, production premises and individual dust-emitting installations are dedusted. Before exhaust dust-laden air is released into the atmosphere, it is also cleaned of dust. At the beginning of the technological process, during transportation and cleaning of raw cotton from impurities, mineral dust is mainly released from it and pollutes the air; at the end of the technological process, especially during linting and compaction, dust of organic origin is released. Despite the installation of the necessary dust removal equipment, many problems and unresolved issues remain.

Keywords: Raw cotton, dust removal, equipment, cyclone, workshop, atmosphere, air, rate, dust, fraction, cleaning, dust suction, percentage, result.

Introduction. The dust released from raw cotton consists of organic and mineral fractions. The organic fraction consists of crushed particles of cotton bushes or bolls and a mass of small short fibers. The mineral fraction of dust consists of earth, sand and other waste impurities that are added to raw cotton during harvesting and the period of its transportation and storage.

At the beginning of the technological process, during transportation and cleaning of raw cotton from impurities, mineral dust is mainly released from it and pollutes the air, and at the end of the technological process, especially during linting and compaction, dust of organic origin is released.

The dust content of the air exhausted from technological equipment in production workshops depends on the type, humidity and contamination of raw cotton; when processing raw cotton of low grades, dust emission is most intense; Table 1 shows the approximate composition of dust released with the air during pneumatic transportation of raw cotton (III grade hand-picked, Namangan-77 variety).

Table 1. Disperse composition of dust.

Particle size, μ	0-50	50-70	70-90	90-160	160-190	190-250	250-500	500-1000	1000 or more
The content of particles of a given size in dust, %	3	12	9	5	4	11	12	9	3

Data on the amount and dust content of exhaust air emitted by the main technological equipment are given in Table 2.

The amount and dust content of air emitted from the main process equipment:

Table 2. The amount of air and dust emitted from the main technological machines.

№	Equipment	Amount of air released into the atmosphere, m³/s	Air dust content, mg/m³
1.	Fan of pneumatic conveyor unit	4.5 – 7.0	4000-12000
2.	Battery condenser for two gins	3.2	500-2000
3.	Battery condenser for four gins	6.4	500-1500
4.	Condenser		
	for five linters	5.0	800-2000
	for six linters	6.0	800-2000
	for seven linters	7.0	800-2000

Each dust removal installation of local suction is characterized by a dust retention effect, which is determined by the formula (%):

$$\eta = \frac{G_1}{G_2} \times 100$$

G_1– total mass of dust in the exhaust air;

G_2 – mass of dust retained by the dust removal installation.

The dust retention effect can also be determined by the difference in dust content of the air (mg/m3) entering and exiting the dust collector (%):

Then

$$\eta = \frac{d_1 - d_2}{d_1} \times 100$$

here: d_1 – dustiness of the air entering the dust collector;

d_2 – dustiness of the air leaving the dust collector.

Dust-laden and contaminated air sucked from dust sources, as well as air exhausted in pneumatic conveying installations, must be cleared of dust before it is released into the atmosphere. Cleaning it can be coarse, medium and fine.

During rough cleaning of dusty air, the air is cleared of dust larger than 100 μ; the dust content of the air after such cleaning can be more than 150 mg/m³. During average cleaning, dust with a size of 10 μ and above is released; the dust content of the air after cleaning should not exceed 150 mg/m³. Such air can be released into the atmosphere. During fine cleaning, dust with a size of less than 10 μ is captured, and the residual dust content in the air should not exceed 2-3 mg/m³. To clean dust-laden air before releasing it into the atmosphere, centrifugal dust collectors-cyclones are widely used. Centrifugal dust collectors-cyclones clean dust-laden air from large dust. With an increase in air speed at the entrance to the cyclone, the dust-retaining effect increases.

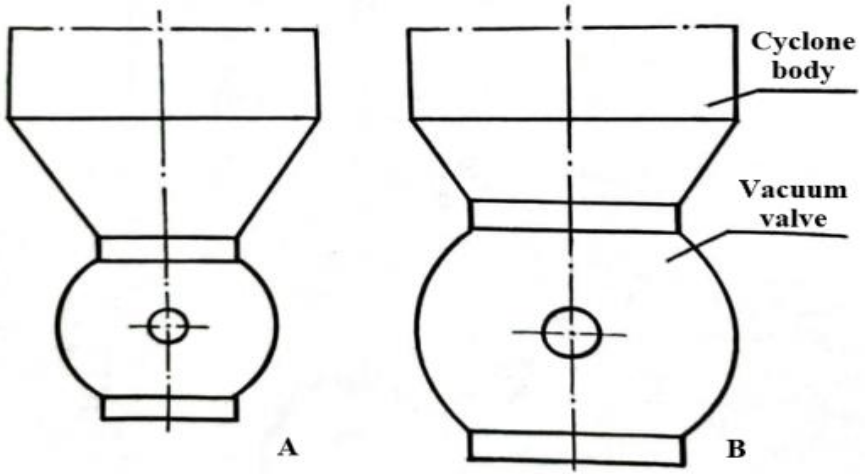
Complete elimination of suction in the cyclone is achieved by sealing the dust pipe, as well as by installing a bunker or sluice gate.

Two-stage six-cyclone installation This installation is used to purify the air leaving the pneumatic transport system of raw cotton before releasing it into the atmosphere.

Despite the provision of the necessary dust removal equipment, many problems and unresolved issues remain.

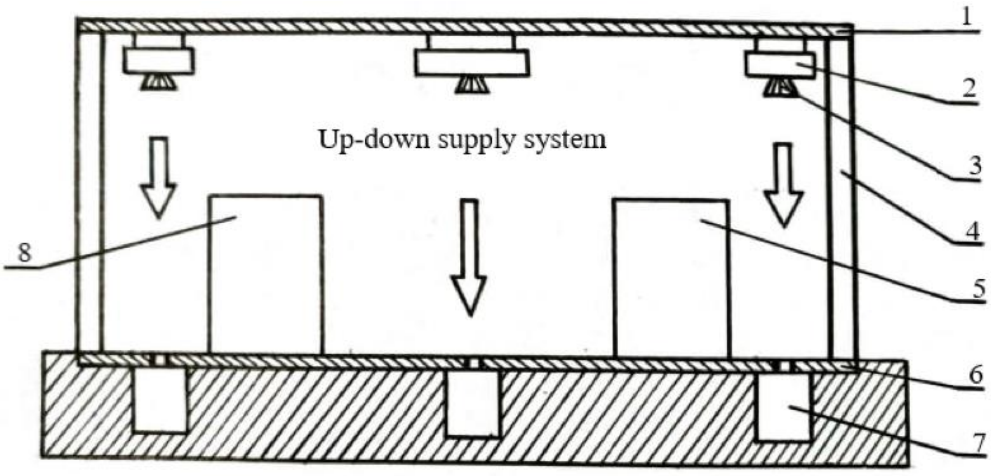
To improve dust removal at cotton ginning plants, innovative solutions are proposed for the reconstruction of the VZP-1200 cyclone and a new project for a supply and exhaust line for cotton ginning shops.

For normal operation of the VZP-1200 cyclone, we increase the dimensions of the vacuum valve 1.5 times. In this way, in practice, a high result in dust removal of workshops, as well as the territory of a cotton factory, was obtained.



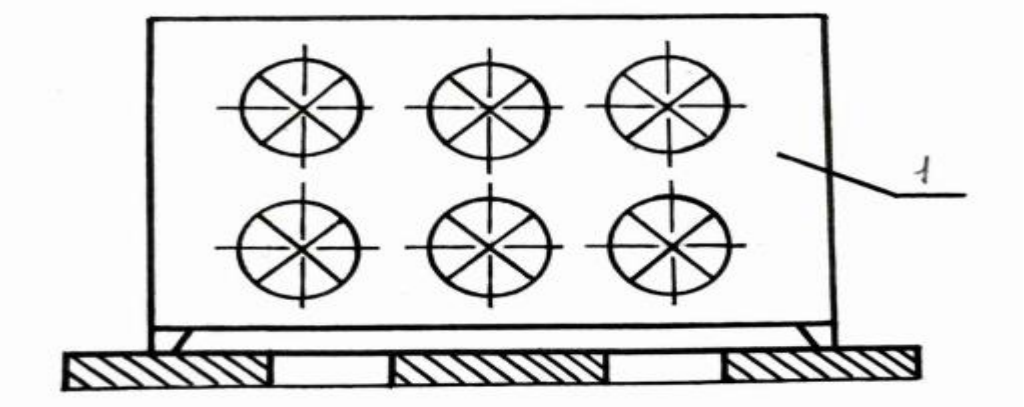
A) Existing cyclone vacuum valve. B) New enlarged cyclone vacuum valve.

Figure 1. Vacuum valve of the VZP-1200 cyclone.



1-floor, 2-supply line (box), 3-blinds, 4-workshop wall, 5-gin 4DP-130, 6-floor, 7-exhaust line (underfloor channel), 8-linter 5LP.

Figure 2. Main building of the cotton factory.



1-air conditioner, for supplying moist and clean air to the workshop through supply lines.

Figure 3. Air conditioning.

Normal operation of cyclones ensures, when processing low grade raw cotton, air purification after linter condensers up to 76 mg/m^3 with a dust retention effect of 95-97%. When cleaning the air after gin condensers, the same dust retention effect of 94-97% is achieved.

High-quality dust removal of cotton gin enterprises very positively negates the work of the new, created pneumomechanical gin for the production of high-quality seeds and cotton fiber.

Conclusions:

1. To improve dust removal at cotton ginning enterprises, it is necessary to reconstruct the VZP-1200 brand cyclone and introduce supply and exhaust lines for the cotton ginning shops, as well as for the main building.

2. After the reconstruction of cyclones and the introduction of supply and exhaust lines, the required norm (6-10 mg/m^3) for dust content in the air in the production premises of the cotton gin plant is achieved.

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