



IMPROVEMENT OF THE VENTILATION SYSTEM AND DUST COLLECTORS WHEN COLLECTING FINE DUST (FOR EXAMPLE COTTON CLEANING GINNERY)

Olimova Nargiz Gulamovna

Teacher, of the Jizzakh Polytechnic Institute, Department of Ecology and Environment protection
razabbekovanargiz@gmail.com

ANNOTATION

To increase the capture of fine dust particles, energy-saving dust collectors are installed. Dust collectors are installed with dust retention with small dust collectors as a second step after existing equipment. Retaining fine dust particles that have not been completely cleaned will increase dust removal efficiency and reduce the impact of dust on the environment. The use of such dust collectors for cleaning small dust particles generated in the production department. Dust emissions do not exceed the maximum permissible dust emissions (MPE).

Key words: *maximum permissible concentration, dust, pollutants, stationary sources, maximum permissible emission, atmospheric layer, dust and gas treatment plants (FOC).*

INTRODUCTION

The degree of impact of pollutants on the environment and the efficiency of cleaning emissions depend on their properties, which, in principle, can be specified by a set of physicochemical characteristics of all ingredients. However, there are significant difficulties that do not allow taking into account the entire set of processes occurring in a mixture of at least several substances. Therefore, usually only one or two mains (in terms of quantity or toxicity) pollutants and one process most characteristic for these conditions are considered. Real processes are described by simplified mathematical models. For example, dispersed emissions with a small content of suspended particles, such as air with low dust content, combustion products of gas, liquid and even low-ash grades of solid fuel, are considered homogeneous. If the presence of suspended particles has a significant effect on the properties of emissions, then the dispersed and homogeneous parts of the aerosol are considered separately, as two independent systems [1,2].

In ginnery, it is considered more efficient to introduce a two-stage cleaning process to improve the efficiency of equipment for removing fine dust particles. In such enterprises, dust is cleaned up to 85% and released into the atmosphere. As a result of the use of equipment for cleaning the dust stream together with the use of the recommended absorbent movable additional materials, a decrease in the content of pollutants in the atmosphere can be achieved by removing pollutants by 95-98% [4].

OBJECT OF STUDY

Dustlik cotton ginning plant. The enterprise includes the following workshops and departments: Cotton collection points (cotton riots), open and closed warehouses for raw cotton; cleaning shop; main building; warehouse for finished products; auxiliary departments.

Cotton raw materials are transferred to the riots using PL conveyors 16 m long, 0.62 m wide. From the riots, raw materials are transferred to the production by transshipment equipped with a VTs-12 fan. In the cleaning and drying shop, cotton raw materials are dried using generators IICH-1.9 in a drying drum 2 SB-10. After that, cotton raw materials are cleaned from large and small quarrels of the universal cotton-cleaning mechanism and the SS-15A separator. The firebox uses natural gas. When natural gas is burned, carbon monoxide, nitrogen oxide and benzopyrene are released into the atmosphere. When processing cotton raw materials, when cleaning small and large quarrels, cotton dust is formed. Cotton dust from production workshops is sucked out with the help of fans and captured by a cyclone brand C-8, after cleaning it is released into the atmosphere.

In the main building, raw materials pass through 4 DP-130 gin and 5-LP linters. The mechanisms are equipped with a VTs-10 and VTs-12 fan. The finished raw material is pressed with a DB 8237 condenser. The forming cotton dust is captured by a cyclone, grade C-6, and discharged into the atmosphere.

The research carried out and the results of calculations show that the efficiency of dust treatment plants in the aspiration network is 86.4% on average (Table 1).

Gaseous and dusty impurities are dispersed in the atmosphere by turbulent wind currents. Accordingly, the transport mechanism of impurities is twofold: convective transport by averaged motion and diffusion transport by turbulent pulsations. Impurities are usually considered passive in the sense that their presence has no noticeable effect on the kinematics and dynamics of flow motion. This assumption can be a bit harsh for large aerosol particles.

It is possible to create a device with a high degree of emission purification for a specific production process only on the basis of a full cycle of research, design and commissioning works, since the production processes and associated emissions are so diverse that existing standard solutions almost always require thorough revision.

Carrying out detailed studies in order to determine the parameters of emissions, to identify the dynamics of their change at different stages of the technological cycle is often beyond the power of the designers of treatment systems, which is why they have to use data on more or less similar processes. In order to exclude the possibility of gross errors, it is necessary to first study the features of the production facility and the technological process as a source of emissions. Among the large number of factors that should be taken into account, one can single out a number of common and necessary in the development of cleaning devices [3.4].

RESEARCH METHOD

Simple dust collectors reduce the dust flow in the existing aspiration pipe and target dust particles on the pipes, reduce dust in the air, increase dust holding efficiency by trapping dust particles.

The research method is carried out by sampling from the dust flow from the inlet and outlet of the source.

The aim of the work is to reduce the amount of dust that forms in the production hall and is released into the atmosphere. At the same time, the share of atmospheric dust in the air at the site, within the boundaries and outside the enterprise, if the settlement is close, does not exceed the permissible air throughput. Adverse effects on the environment and human health are prevented [5-8].

The calculation is carried out at source No. 7. The organized source is equipped with cyclone Ts-8, source parameters: source height $H = 11.2$ m, source diameter $D = 0.52$ m.

The operating time of the source is 7440 hours / year, the outside air temperature during the measurement is 20 °C. The atmospheric pressure during the measurement was 732 mm Hg. The pressure at the suction nozzle at the entrance to the vacuum cleaner is 5.8 mm the dust collector is designed to keep cotton dust from the universal cotton-cleaning mechanisms and separators SS-15A. Before the first cleaning process, the speed of the dust mixture was $V_1 = 15.4$ m / s, the dust concentration was $C_1 = 624.4$ mg / m³. The dust mixture consumption was determined by the following expression:

$$W_1 = \pi * D^2 / 4 * V_1 = 3.14 * 0.52^2 / 4 * 15.4 = 3.27 \text{ m}^3 / \text{s}$$

Burst per second:

$$M_{\text{sec.1}} = W_1 * C_1 * 10^{-3} = 3.27 * 624.4 * 10^{-3} = 2.04 \text{ g / s}$$

The annual dust emission was:

$$M_{\text{year.1}} = M_{\text{sec.1}} * T * 3600 * 10^{-6} = 2.04 * 7440 * 3600 * 10^{-6} = 54.64 \text{ t / year.}$$

The pressure in the first dust collector after collection is 7.6 mm. temperature 20 ° C. The speed was $V_2 = 14.6$ m / s, the dust concentration was $C_2 = 94.2$ mg / m³. We determine the consumption of the dust mixture according to the following expression:

$$W_2 = \pi * D_2^2 / 4 * V_2 = 3.14 * 0.50^2 / 4 * 14.6 = 2.86 \text{ m}^3 / \text{s}$$

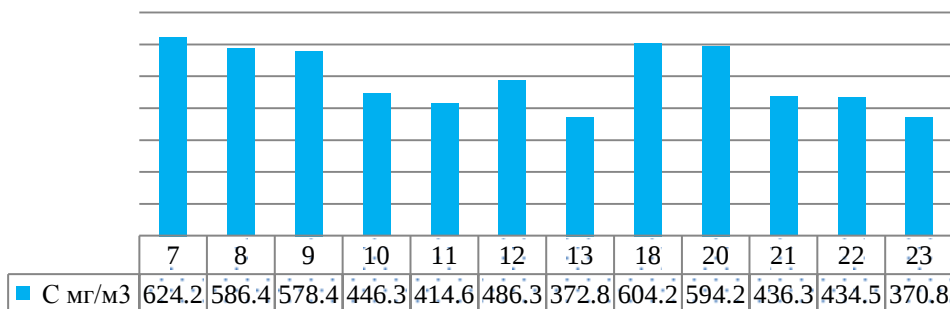
Burst per second:

$$M_{\text{sec.2}} = W_2 * C_2 * 10^{-3} = 2.86 * 94.2 * 10^{-3} = 0.269 \text{ g / s}$$

$$M_{\text{year.2}} = M_{\text{sec.2}} * T * 3600 * 10^{-6} = 0.269 * 7440 * 3600 * 10^{-6} = 7.2 \text{ t / year.}$$

The efficiency of the dust trap is:

$$\eta = (M_{\text{year.1}} - M_{\text{year.2}}) / M_{\text{year.1}} = (54.64 - 7.2) / 54.64 * 100 = 86.8\%.$$



S mg/m³

Picture 1. Concentration of cotton dust before cleaning in the production workshop.

Source # 8. The organized source is equipped with a Ts-8 cyclone, source parameters: source height $H = 11.1$ m, source diameter $D = 0.52$ m. The source operating time is 7440 h / year, the outside air temperature during the measurement is 21°C .

The dust collector is designed to retain cotton dust generated from universal cotton-cleaning mechanisms and separators SS-15A. The speed of the dust mixture is $V_1 = 15.8$ m / s, the dust concentration is $C_1 = 586.8$ mg / m³. The dust mixture consumption is determined by the following expression:

$$W_1 = \pi * D^2 / 4 * V_1 = 3.14 * 0.52^2 / 4 * 15.8 = 3.35 \text{ m}^3 / \text{s}$$

Burst per second:

$$M_{\text{sec.1}} = W_1 * C_1 * 10^{-3} = 3.35 * 586.8 * 10^{-3} = 1.96 \text{ g / s}$$

The annual dust emission was:

$$M_{\text{year.1}} = M_{\text{sec.1}} * T * 3600 * 10^{-6} = 1.96 * 7440 * 3600 * 10^{-6} = 52.50 \text{ t / year.}$$

Dust concentration graph before cleaning is shown in picture - 1.

After the catch, the speed was $V_2 = 14.7$ m / s, the dust concentration was $C_2 = 90.5$ mg / m³. We determine the consumption of the dust mixture according to the following expression:

$$W_2 = \pi * D^2 / 4 * V_2 = 3.14 * 0.52^2 / 4 * 14.7 = 3.12 \text{ m}^3 / \text{s}$$

Burst per second:

$$M_{\text{sec.2}} = W_2 * C_2 * 10^{-3} = 3.12 * 90.5 * 10^{-3} = 0.282 \text{ g / s}$$

$$M_{\text{year.2}} = M_{\text{sec.2}} * T * 3600 * 10^{-6} = 0.282 * 7440 * 3600 * 10^{-6} = 7.55 \text{ t / year.}$$

The efficiency of the dust trap is:

$$\square = (M_{\text{year.1}} - M_{\text{year.2}}) / M_{\text{year.1}} = (52.50 - 7.55) / 52.50 * 100 = 85.6\%.$$

On other sources, the calculation is carried out similarly to sources No. 7 and No. 8. The speed of the dust flow in sources No. 9-13, 18, 20-23 before cleaning, respectively, 14.9 m / s, 13.6 m / s, 13.9 m / s, 13.6 m / s, 12.8 m / s, 13.6 m / s, 14.3 m / s, 13.8 m / s, 13.6 m / s, 12.7 m / s. The concentration of cotton dust is 578.4 mg / m³, 446.3 mg / m³, 414.6 mg / m³, 486.3 mg / m³, 372.8 mg / m³, 604.2 mg / m³, 594.2 mg / m³, 436.3 mg / m³, 434.9 mg / m³, 370.8 mg / m³ (table No. 1).

Velocity, flow rate, dust flow volume before and after dust retention and dust retention efficiency

Table 1.

Source No.	Dust flow rate, m / s	Dust flow rate, m ³ / s	Dust concentration before cleaning, mg / m ³	Dust concentration after cleaning, mg / m ³	Dust amount, t / year	Efficiency of dust collector, %
7	14,2	2,86	624,2	94,2	7,20	86,8
8	14,7	3,12	586,4	90,5	7,55	85,6
9	14,9	3,16	578,4	90,5	7,66	84,7
10	13,6	2,89	446,3	70,4	5,43	85,5
11	13,9	2,95	414,6	72,3	5,70	82,8
12	13,6	2,89	486,3	72,4	5,60	86,7
13	12,8	2,72	372,8	56,6	4,12	86,0
18	13,6	3,04	604,2	84,2	4,62	86,8
20	14,3	3,03	594,2	84,2	6,72	87,1
21	13,8	2,93	436,3	68,8	5,30	85,4
22	13,6	2,89	434,5	72,6	5,53	84,1
23	12,7	2,69	370,8	57,6	4,08	85,5

If a second stage dust collecting unit is installed after the existing ones, the cleaning efficiency reaches 96-98 percent. The amount of dust and the efficiency of a simple fine-grained dust-retaining, energy-saving dust collector is calculated as follows [5.8].

The operating time of the source is 7440 hours / year. Initial parameters: height $H = 11.8$ m, cross-sectional area $D = 0.45$ m. The atmospheric pressure during measurement was 732 mm Hg. The pressure at the suction pump at the entrance to the dust of the trap is 5.8 mm Hg. temperature 22°C .

The device retains incomplete caught dust in dust collectors of the Ts-8 type. The velocity of the dust mixture when entering the dust collector x was $V_3 = 13.7$ m / s, the dust concentration was $C_3 = 92.6$ mg / m³. We determine the consumption of the mixture by the following expression:

$$W_3 = \pi * D^2 / 4 * V_1 = 3.14 * 0.45^2 / 4 * 13.7 = 2.18 \text{ m}^3 / \text{s}$$

Burst per second:

$$M_{\text{sec } 3} = W_3 * C_3 * 10^{-3} = 2.18 * 92.6 * 10^{-3} = 0.202 \text{ g / s}$$

The annual emission is:

$$M_{\text{year.3}} = M_{\text{sec.3}} * T * 3600 * 10^{-6} = 0.202 * 7440 * 3600 * 10^{-6} = 5.41 \text{ t / year.}$$

After the treatment plant, the pressure is 7.6 mm.r.s. temperature 21 0C. The flow velocity is $V_4 = 11.8$ m / s, the dust concentration is $C_4 = 24.4$ mg / m³. We define the dust consumption by the following expression:

$$W_4 = \pi * D^2 / 4 * V_4 = 3.14 * 0.45^2 * 11.8 = 1.88 \text{ m}^3 / \text{s}$$

Burst per second:

$$M_{\text{sec } 4} = W_4 * C_4 * 10^{-3} = 1.88 * 24.4 * 10^{-3} = 0.046 \text{ g / s}$$

The annual emission is:

$$M_{\text{year},4} = M_{\text{sec},3} * T * 3600 * 10^{-6} = 0.046 * 7440 * 3600 * 10^{-6} = 1.23 \text{ t / year.}$$

The efficiency of the dust trap is:

$$\eta = (M_{\text{year},1} - M_{\text{year},4}) / M_{\text{year},1} = (52.50 - 1.23) / 52.50 * 100 = 97.7\%.$$

CONCLUSIONS

One of the most advanced methods of cleaning the dust stream is filtration through porous partitions. This method provides a higher degree of purification than dry or wet dust collection, and stable operation over a wide range of temperatures, physicochemical properties of captured particles and gas flow rate.

The impact of manufacturing and industrial enterprises on the environment is not positive, even if the ecological state of manufacturing and industrial enterprises is considered satisfactory. Smoke and dust, nitrogen and carbon monoxide generated from them cannot be considered within or within the permissible limits even after passing through the treatment plant.

Therefore, it is considered more efficient to implement a two-stage cleaning process to improve the efficiency of dust removal equipment. In industrial plants, dust is cleaned up to 85% and emitted into the atmosphere. The use of reducing the content of pollutants in the atmosphere for cleaning gases using the recommended absorbent mobile materials can be achieved by removing pollutants by 95-98%.

If a simple type energy-saving dust collector is installed to retain dust with dispersing fine particles in the production workshops of cotton processing plants, it will reduce the dust flow in the aspiration pipe, the amount of dust in the air, and increase the dust removal efficiency by trapping fine solid particles. Thereafter, the emission of dust and other pollutants does not exceed the maximum permissible concentration (MPC).

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