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MEASURES TO REDUCE POLLUTANTS DISCHARGED INTO THE ENVIRONMENT IN INDUSTRIAL ENTERPRISES

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The rapid development of the industry leads to the fact that the emission of pollutants into the atmosphere and hydrosphere increases continuously. The total volume of industrial, agricultural and communal waste is estimated at billion tons per year on the scale of the entire planet.

It is important to improve technological processes, hermetically seal pipelines, install closed transfer devices and equipment for trapping small particles of dust in industrial enterprises in order to reduce atmospheric air pollution by dust and other pollutants.

Dust flow parameters include (density, fluidity, wettability, edge and slope angle). They are used in calculations of dust collection equipment, fittings, bunkers and auxiliary equipment, as well as disposal of captured dust, economic efficiency evaluation [1].

The size of dust particles is its main parameter. Because the dispersed composition of captured dust particles in the dust-gas mixture is important in determining the dust absorber. Industrial dust particles can be of different shapes (shanks, rods, plates, dragonflies, fiber-like, etc.). Dust particles can often combine to form agglomerates, so the concept of dust particle size is relative. In this case, the particle sedimentation rate is the main indicator in dust removal. The settling speed of a dust particle can differ depending on its shape even when its mass is the same. The closer the shape of the particle is to the sphere, the faster it sinks [2].

In general, mechanical capture is based on the settling of solid particles in the air stream, either by gravity or energy, or by a combination of these forces. If the weight of particles plays a decisive role in gravity devices, in inertial coolers, a change in the direction of the gas flow is ensured, in which the gravitational mass of particles separates from the flow and causes it to move under the influence of inertial forces.

Filtering the dust stream through a porous barrier is one of the most effective ways to capture small particles of solid pollutants. The high technology of the method determines the wide nomenclature of textile, fiber and granular filters produced in the industry, which provides a purification level of up to 95.5%.

Two types of dust capture equipment are used to reduce dust emitted into the atmosphere in the production industry: sleeve filters and cyclones.

When choosing constructions of dust cleaning equipment, their convenience, high cleaning efficiency, low cost and reliability are taken into account.

Dependence of dust flow particle capture efficiency in cyclones on cyclone diameter and dust particle size Table 1

Cyclone		Dust retention rate (%) for particle sizes		
Type	diameter, mm	5	10	15
SN-15	800	50	85	97,5
	600	55	87	98,0
	400	69	89	98,5
	200	77	93	99,0
SN-15u	800	40	81	97,0
	200	70	91	97,0
SN-24	1000	30	70	96,0
	500	41	79	97,0
SN-11	800	65	90	98,0
	100	86	97	99,8

The efficiency of existing vacuum cleaners in industrial enterprises is 86-90%, which causes the dust in the atmosphere to exceed the norm. One of the important measures is to achieve not to increase the permissible limit of dust content in atmospheric air by increasing the efficiency of the retention of incompletely cleaned small particle dust in the production workshops of the enterprise.

The amount of pollutants released into the atmosphere is considered on the example of a RFG sleeve filter. The working time of the resource is 290 days/year or 6380 hours/year. Pollutants released into the atmosphere were determined by measurement method.

Source 1. Source parameters: height N = 12.4 m, cross section D = 0.45 m. Air pressure P = 735 mm, temperature T = 20 0C, correction factor q = 0.96. Before the cleaning process, micromonometer readings ΔR = 92, 85, 82. Having determined the micromonometer readings, we determine the speed of the powder mixture using the following expression:

$V_1 = \sqrt{92} * 1,70 = 16,3$ m/s

$V_2 = \sqrt{85} * 1,70 = 15,7$ m/s

$V_3 = \sqrt{82} * 1,70 = 15,4$ m/s

$V_{medium} = 15,8$ m/s

The source cross-sectional area is equal to:

$F = \frac{\pi * Д^2}{4} = \frac{3,14*0,45^2}{4} = 0,159$ m²

We determine the volume of the dust mixture discharged from the pipe as follows:

$Q = V_{medium} * F * 0,96 = 15,8 * 0,159 * 0,96 = 2,42$ m³/s

Using an aspirator, we determine the percentage of dust in the air and its amount per unit of time:

$V_{ch} = 10$ l/min * 5 min = 50 litr = 0,05 m³

$V_0 = 0,05 * 0,96 = 0,048$ m³

$S = \frac{\Delta Q}{V_0}$, mg/m³ $S_1 = \frac{28,05}{0,048} = 584,4$ mg/m³

$S_2 = \frac{27,76}{0,048} = 578,7$ mg/m³ $S_3 = \frac{27,73}{0,048} = 577,8$ mg/m³

$S_{o‘rt} = 580,3$ mg/m³

V = 580,3 * 2,42* 0,001 = 1,40 g/s

After cleaning, micromonometer readings ΔR = 83, 82, 81.

Having determined the indicators of the micromonometer, we determine the speed of the powder mixture using the following expression:

$V_1 = \sqrt{83} * 1,70 = 15,5$ m/s

$V_1 = \sqrt{82} * 1,70 = 15,4$ m/s

$V_1 = \sqrt{81} * 1,70 = 15,3$ m/s

$V_{o‘rt} = 15,4$ m/s

The source cross-sectional area is equal to:

$F = \frac{\pi * Д^2}{4} = \frac{3,14*0,45^2}{4} = 0,159$ m²

We determine the volume of the dust mixture discharged from the pipe as follows:

$Q = V_{o‘rt} * F * 0,96 = 15,4 * 0,159 * 0,96 = 2,35$ m³/s

Using an aspirator, we determine the percentage of dust in the air and its amount per unit of time:

V_{ch} = 10 l/min * 5 min = 50 litr = 0,05 m^3

V_0 = 0,05 * 0,96 = 0,048 m^3

$S = \frac{\Delta Q}{V_0}$, mg/m^3 $S_1 = \frac{3{,}56}{0{,}048} = 74{,}2$ mg/m^3

$S_2 = \frac{3{,}55}{0{,}048} = 73{,}9$ mg/m^3 $S_3 = \frac{3{,}52}{0{,}048} = 73{,}3$ mg/m^3

$S_{o‘rt}$ = 73,8 mg/m^3

V = 73,8 * 2,35* 0,001 = 0,173 g/s

$\eta = \frac{1{,}4-0{,}173}{1{,}4} * 100 = 87{,}6$ %

Source 2. Source parameters: height N = 12.4 m, cross section D = 0.45 m. Air pressure P = 735 mm, temperature T = 20 0C, correction factor q = 0.96. Before the purification process, micromonometer readings ΔR = 88.4; 83.5; 80.6.

Having determined the indicators of the micromonometer, we determine the speed of the powder mixture using the following expression:

$V_1 = \sqrt{88{,}4} * 1{,}70 = 15{,}95$ m/s

$V_1 = \sqrt{83{,}5} * 1{,}70 = 15{,}54$ m/s

$V_1 = \sqrt{80{,}6} * 1{,}70 = 15{,}25$ m/s

$V_{o‘rt}$ = 15,58 m/s

The source cross-sectional area is equal to:

$F = \frac{\pi * Д^2}{4} = \frac{3{,}14*0{,}45^2}{4} = 0{,}159$ m^2

We determine the volume of the dust mixture discharged from the pipe as follows:

$Q = V_{o‘rt} * F * K_{to‘g‘.}$ = 15,58 * 0,159 * 0,96 = 2,38 m^3/s

Using an aspirator, we determine the percentage of dust in the air and its amount per unit of time:

V_{ch} = 10 l/min * 5 min = 50 litr = 0,05 m^3

V_0 = 0,05 * 0,96 = 0,048 m^3

$S = \frac{\Delta Q}{V_0}$, mg/m^3 $S_1 = \frac{24{,}6}{0{,}048} = 510{,}2$ mg/m^3

$S_2 = \frac{24{,}42}{0{,}048} = 508{,}8$ mg/m^3 $S_3 = \frac{24{,}30}{0{,}048} = 506{,}2$ mg/m^3

$S_{o‘rt}$ = 508,4 mg/m^3

V = 508,4 * 2,38* 0,001 = 1,21 g/s

After cleaning, micromonometer readings ΔR = 78.6; 74.8; 72.7. Having determined the indicators of the micromonometer, we determine the speed of the powder mixture using the following expression:

$V_1 = \sqrt{78{,}6} * 1{,}70 = 15{,}1$ m/s

$V_1 = \sqrt{74{,}8} * 1{,}70 = 14{,}7$ m/s

$V_1 = \sqrt{72{,}7} * 1{,}70 = 14{,}4$ m/s

$V_{o‘rt}$ = 14,7 m/s

The source cross-sectional area is equal to:

$F = \frac{\pi * Д^2}{4} = \frac{3{,}14*0{,}45^2}{4} = 0{,}159$ m^2

We determine the volume of the dust mixture discharged from the pipe as follows:

$Q = V_{o‘rt}$ * F * 0,96 = 14,7 * 0,159 * 0,96 = 2,24 m^3/s

Using an aspirator, we determine the percentage of dust in the air and its amount per unit of time:

V_{ch} = 10 l/min * 5 min = 50 litr = 0,05 m^3

V_0 = 0,05 * 0,96 = 0,048 m^3

$S = \frac{\Delta Q}{V_0}$, mg/m^3 $S_1 = \frac{0,788}{0,048}$ = 16,2 mg/m^3

$S_2 = \frac{0,734}{0,048}$ = 15,3 mg/m^3 $S_3 = \frac{0,677}{0,048}$ = 14,1 mg/m^3

$S_{o'rt}$ = 15,2 mg/m^3

V = 15,2 * 2,24 * 0,001 = 0,034 g/s

$\eta = \frac{1,21-0,034}{1,21}$ * 100 = 97,2 %

The study of gas flow parameters will find solutions to the following issues:

a) organization and conduct of pneumometric measurements;

b) determining the total amount of particles;

c) assessment of the composition of aerosol particles;

g) monitoring the flow of dust released and released into the atmosphere.

In the course of research, the important properties of dust collectors were studied: particle capture efficiency, hydraulic resistance, duration of work before regeneration, efficiency of dynamic renewal.

Summary. The effect of trapping dust particles is directly proportional to the velocity of the gas and inversely proportional to its diameter. It is advisable to carry out the process in a cyclone at a high speed and with a small diameter. But increasing the speed causes small particles to come out with the dust mixture during the cleaning process. Therefore, it is more effective to reduce the diameter of the device to increase the cleaning efficiency. The optimal ratio of cyclone height and diameter is N/D_{ts} = 2 - 3.

Along with this, vacuum cleaners with piles are also used in industry. Unlike a cyclone, this vacuum cleaner has an additional device that rotates the dust gas flow. In the device, under the influence of centrifugal force, dust particles hit the wall and are directed downwards with the help of secondary air. Atmospheric air or dust gas can be used as secondary air. When dust gas is used, the efficiency of the device increases by 40-65%. As with the cyclone, the effectiveness of drum vacuum cleaners decreases as the diameter of the device increases.

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