Study of operating parameters of drum dust cleaning device.

Xomidov Xushnudbek Rapiqjon o'g'li
Assistant professor, Kokand branch Tashkent State Technical University
Uzbekistan
xomidovxushnudbek207@gmail.com

Siddiqov Rasuljon O'ktamovich o'g'li
PhD, Kokand branch Tashkent State Technical University
Uzbekistan
xomidovxushnudbek207@gmail.com

Yo'ldoshev Bilol Iqboljon o'g'li
Assistant professor, Kokand branch Tashkent State Technical University
Uzbekistan
bilolxonyuldashev462@gmail.com

Nurmatov Sardorbek Xasanboy o'g'li
Assistant professor, Kokand branch Tashkent State Technical University
Uzbekistan
sardornurmatov51@gmail.com

O'lmasov Farrux Yorqinjon o'g'li
Assistant professor, Kokand branch Tashkent State Technical University
Uzbekistan
tmjfarruxulmasov@gmail.com

ABSTRACT

In this article, the operating parameters of the drum dust collector are studied.

Keywords: ***resistance coefficient, dusty gas, conical grid, local resistance***

Introduction

Experimental studies were conducted in three stages. In the first stage, the consumption, speed, resistance coefficient, and hydraulic resistance of the working bodies of the device were organized. In the second stage, the resistance coefficients of the nozzle holes were determined depending on the consumption and speed of the working fluid supplied to the device. In the third stage, laboratory analyses of dust samples were canceled and median sizes were determined.

To calculate the total pressure lost in the apparatus, it is necessary to determine the local resistance of the apparatus and the coefficients of resistance of metal grids with different hole sizes that are installed on the base cone, which is the main working body of the apparatus. Therefore, GOST 3826-82, 12X18N10T brands made of stainless steel with 3 different sizes of square holes were selected in experimental studies.

The theoretical total resistance coefficient of the device is equal to the following [3].

$$\xi_{ум} = \xi_к + \xi_б + \xi_ч; \quad (1.1)$$

In this ξ_k - when transferring dusty air to the device through a pipe, the coefficient of internal friction is determined as follows [5,6,7].

$$\xi_к = \left(\lambda_1 \frac{2l_1}{D + d_1} \right) \quad (1.2)$$

In this λ_1-coefficient of friction with the pipe wall introducing dusty gas into the device, l-the length of the pipe through which the dusty gas is moving, m; D-section cone base diameter, m; d is the diameter of the truncated part of the cone.

ξ_s – is the resistance coefficient of the drum mesh and is determined as follows. From Fig. 3.1 and 3.2, the total resistance coefficient of the truncated conical grid on the A-A section is determined as follows, depending on the total surface of the grid that blows dusty air and the diameter of the wire of the grid and the dimensions of the square holes of the grid as follows [3,4] m^2;

$$\xi_c = \Delta k \left[\pi (R + r) \cdot l_c \cdot \frac{\delta}{a} \right] \quad (1.3)$$

In this Δk is the correction coefficient and is determined through experiments,R- the base radius of the conical mesh, m; r-the radius of the cut part of the conical mesh, m -the l_c -the average value of the length of the circumference of the mesh base and the length of the circumference of the cut part, m; δ-mesh wire diameter, m; a mesh square hole dimensions, m.

ξ_{ch}- when dusty air is discharged from the device through a pipe, the coefficient of internal friction is determined as follows[5,6,7].

$$\xi_ч = \lambda_2 \cdot \frac{l}{d}; \quad (1.4)$$

In this λ_2 – coefficient of friction in the pipe for removing the cleaned air from the device; d-pipe diameter, m;

If we add the values of formulas 2, 3, and 4 to the above-mentioned formula 1, it will look like this.

$$\xi_{ум} = \left(\lambda_1 \frac{2l_1}{D + d_1} \right) + \Delta k \left[\pi (R + r) \cdot l_c \cdot \frac{\delta}{a} \right] + \lambda_2 \cdot \frac{l}{d}; \quad (1.5)$$

Through this equation, the total resistance coefficients of the apparatus are determined.

At the initial stage of the experiments, a damper (moving shutter) was installed on the gas suction part of the fan that transmits the dust gas to the apparatus. The damper was changed in the range of $30 \div 90^0$ (with 15^0 steps), and the gas velocities coming out of the fan and the gas consumption were determined. When Shiber opens to 30^0against him Q_g=170m^3/t, 45^0 when opened to Q_g=340m^3/t, 60^0 opened to Q_g=510m^3/t, 75^0 opened to Q_g=680m^3/t, 90^0 when opened to Q_g=850m^3/t organized. In the next process of experiments, a fan was installed in the apparatus body, and the gas consumption determined above was given as Q=$17^0 \div 85^0$m3/hour (with a step of 17^0 m3/hour), and the gas consumption was determined by the gas velocities coming out of the apparatus. In this case, when the Shiber is opened to 30^0, Qg=107m^3/hour, when it is opened to 45^0 Q_g=220m^3/hour, 60^0 Q_g=318m^3/hour when it opens to75^0 Q_g=438m^3/hour when it opens to 90^0 it organizes Q_g=512m^3/hour. The local resistance coefficient of the device was determined from the difference in gas consumption. Anemometer VA06TROTEC electronic device was used in all stages of experiments to determine these differences. The average local resistance coefficient of the device is ξ=0.6. At the next stage of the experiments, cones with a square hole size a=1.1, 1.3, 1.6 mm were successively inserted into the apparatus body.

Q=170÷850 m^3/hour (with a step of 170 m^3/hour) was supplied to each gas drum installed in the apparatus. Experimental studies were carried out separately for each cone grid. In experiments, gas density ρ_g=1,29 kg/m^3 (for air) were selected in the values.

According to the results, the mesh square hole size a=1.1mm, mesh wire thickness δ=0,16mm resistance coefficient ξ_s=2,6; hole size a=1.3mm, mesh wire thickness, when it is δ=0,18 mm ξ_s =2,5; hole size a=1.6mm, wire mesh thickness when it is δ=0,2 mm, it organizes ξ_s=2,2. These determined resistance coefficients are the total resistance coefficient of the apparatus, combined with the local resistance coefficients of the apparatus. If we subtract the local resistances from these values, the resistance coefficients of the grids are derived. The local resistance coefficient is determined as follows.

$$\xi_м = (\xi_к + \xi_ч) \qquad (1.6)$$

$$\xi_с = \xi_{ум} - (\xi_к + \xi_ч) \qquad (1.7)$$

1. a=1.1mm, when the mesh wire thickness is δ=0.16mm; $\xi_s=\xi_{um}-\xi_m$=2,6-0,6=2
2. a=1.3mm, when the mesh wire thickness is δ=0.18mm; $\xi_s=\xi_{um}-\xi_m$=2,5-0,6=1,9
3. a=1.6 mm, when the mesh wire thickness is δ=0.2 mm; $\xi_s=\xi_{um}-\xi_m$=2,2-0,6=1,6

The obtained experimental results were processed on the basis of a computer program and a graph of dependence was built (Fig. 3.3)..

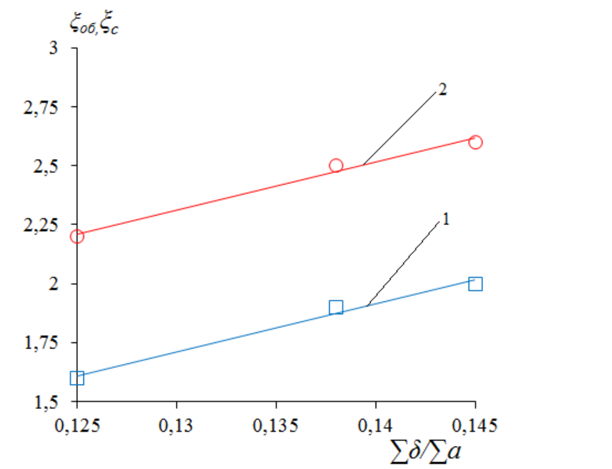


Figure 1.1. Σδ/Σa resistance coefficient depending on ξ_{ob} and ξ_s
graph of the change of

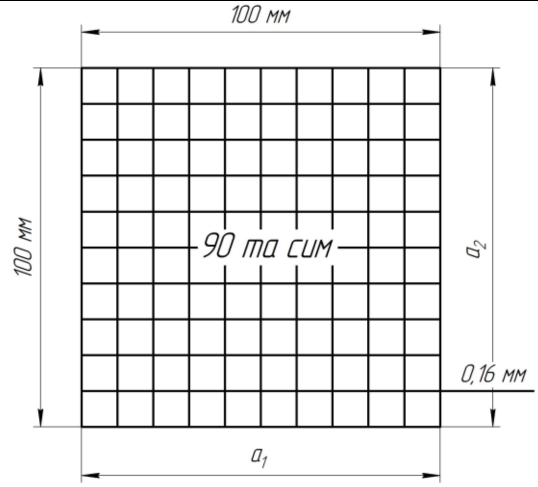
View of the resulting regression equation

1.y = 20,388x - 0,9395 R^2 = 0,9881
2.y = 20,388x - 0,3395 R^2 = 0,9881

Correction coefficient depending on the resistance coefficient of the grids recommended based on experimental studies Δk
research work aimed at determining the values of The relative resistance coefficients of the selected grids. Below is the calculation method.

1- calculation of a truncated conical grid. Wire thickness- $\delta = 0,16мм$, Hole size $k = 1,(1)$.

First of all, we take a square shape with sides of 10 cm by 10 cm as a sample.



$$S_{сим}^{10} = S_{сим} + S_{кат} \qquad (1.8)$$

$S_{ён} = 0,95 м^2$; $S_{сим}^{10} = 10000 мм^2 = S_{сим} + S_{кат}$; $a_1 = 0,16 \cdot 90 = 14,4 мм$; $a_2 = 0,16 \cdot 90 = 14,4 мм.$

$$S_{сим}^{10} = (a_1 + a_2) \cdot 100 мм = (14,4 + 14,4) \cdot 100 мм = 2880 мм^2.$$

$S_{10} = \frac{S_{ён}}{S_{\square}} = \frac{950000 мм^2}{10000 мм^2} = 95$. There are 95 cells in total.

There: $S_{ён}$ -side surface of a truncated cone covered with mesh, $S_{сим}^{10}$ -10 cm. surface covered with wires at a distance of 10 cm, $S_{сим}^{10}$ - A surface covered with wires at a distance of 10 cm by 10 cm and covered with head cells, a_1 - the total thickness of the wires on one side of the isolated mesh sample, a_2 - the total thickness of the wires on the second side of the isolated mesh sample, $S_{сим}$ -the wire-coated surface of the extracted sample, $S_{кат}$ -is the sum of the cell surface areas of the extracted sample.

95 pieces to find the surface covered by the total wire in the set $S_{сим}^{10}$ -(that is, we multiply it by the size on the surface of 10 cm by 10 cm:

$$S_{сим.ум} = S_{сим}^{10} \cdot S_{10} \qquad (1.9)$$

$$S_{сим.ум} = S_{сим}^{10} \cdot S_{10} = 2880 \cdot 95 = 273600 мм^2.$$

To find the surface occupied by the total head cells $S_{ён}$ from the surface $S_{сим.ум}$ -we subtract the total surface covered by the wire: i.e :

$$S_{кат.ум} = S_{ён} - S_{сим.ум} = 950000 мм^2 - 273600 мм^2 = 676000 мм^2$$

.

So: $S_{кат.ум} = 676000 мм^2$; $S_{сим.ум} = 273600 мм^2$; $S_{ён} = 950000 мм^2$.

Here: $S_{кат.ум}$ -The surface occupied by the total number of cells in the grid wrapped around the side surface of the truncated cone (wireless part).

$S_{сим.ум}$ - A common surface covered with wire mesh wrapped around the side surface of a truncated cone.

$S_{ён}$ -side surface of a truncated cone covered with mesh.

We find the relative resistance coefficient of the set:

$$\xi_н = \frac{S_{сим.ум}}{S_{кат.ум}} \qquad (1.10)$$

Here $\xi_н$ - is the relative resistance coefficient of the set, $S_{сим.ум}$ - The general surface covered with a mesh wire wrapped around the side surface of a truncated cone $S_{кат.ум}$ -We determine the ratio of the total head cells in the grid wrapped around the side surface of the truncated cone to the surface area (wireless part):

$$\xi_н = \frac{S_{сим.ум}}{S_{кат.ум}} = \frac{273600}{676400} = 0,40449$$

We define correction coefficient ΔK .

$$\Delta K = \frac{\xi}{\xi_н} \qquad (1.11)$$

For this, the coefficient of resistance found through experiments ξis the relative resistance coefficient we devide ξ_n .

$$\Delta K = \frac{\xi}{\xi_н} = \frac{2}{0,4} = 5$$

The correction coefficients for the subsequent grid sizes were determined in the same way. The size of the square hole of the mesh is a=1.3mm. When the thickness of the mesh wire is δ=0.18 mm. It is equal to ΔK=5,1 . The size of the square hole of the mesh is a=1.6 mm. When the thickness of the grid wire is δ=0.2 mm, the correction coefficient is equal to ΔK=5. Correction factor for selected grid sizes ΔK=(5-5,1) It is recommended to take it at intervals.

To simplify calculations, the coefficient of local resistance in the inlet and outlet pipe of dusty air to the device ξ_m=0,6 established In that case, the 5th formula for calculating the total resistance of the device will look like this.

$$\xi_{ум} = 0,6 + \Delta k \left[\pi (R + r) \cdot l_c \cdot \frac{\delta}{a} \right]; \qquad (1.12)$$

Summary

As a result of experimental studies, the local resistances of the arrarat and the resistance coefficients of selected three-dimensional meshes were determined in the condition that the device was not sprinkled with water, at variable values of gas consumption. According to the results of the research, the values of the correction coefficients for calculating the resistance coefficient of the selected grids were determined. As a result, it was possible to calculate the total lost pressure depending on the total resistance coefficient in the contact devices of the apparatus.

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