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RESEARCH OF RESISTANCES AFFECTING THE WORKING FLUID IN A ROTOR-FILTER DEVICE

Siddikov Rasuljon Uktamovich
Tashkent State Named After Islam Karimov Technical University Kokan Branch Head of the Department Technical Sciences Doctor of Philosophy (PhD)

Ergashev Nasimbek Akhmadjonovich
Researcher Fergana Polytechnic Institute
n.ergashev@ferpi.uz

Isomidinov Azizjon Salomidinovich
Technical Sciences, PhD Fergana Polytechnic Institute
The Republic of Uzbekistan
a.s.isomidinov@ferpi.uz

Ummatov Rustambek Bektoshevich
Tashkent state named after Islam Karimov
Senior Teacher of Kokan Branch
of Technical University

Madaliyev Akhrorbek Niyzonidin ogli
Tashkent State Named After Islam Karimov
Technical University, Kokan Branch, Assistant Teachers

Abstract
The article presents the results of a study to determine the coefficient of resistance of the working fluid flow, speed and diameter of the nozzle hole fed to the rotor-filter device for wet cleaning of dust gases. A S32-412 nozzle with a hole diameter d_{sh} = 1; 2; 3 mm was used in the study. The coefficient of resistance of the nozzle to the working fluid flow is determined by the ratio of the hole thickness to the diameter. Standard methods were used in conducting the experiments.
Keywords: rotor-filter, resistance coefficient, nozzle, dusty gas, liquid flow, speed, wet method, filter mesh material, diffuser, confusor.

Аннотация

Мақолада чангли газларни ҳўл усулда тозаловчи ротор-фильтрли қурилмага берилаётган ишчи суюқлик сарфи, тезлиги ва штуцер тешиги диаметрининг қаршилик коэффициентини аниқлаш бўйича ўтказилган тадқиқот натижалари келтирилган. Тадқиқотларни ўтказишда тешигининг диаметри $d_ш$=1;2;3 мм бўлган **S32-412** маркали штуцердан фойдаланилган. Штуцернинг ишчи суюқлик оқимига кўрсатадиган қаршилик коэффициенти тешик қалинлигининг диаметрига нисбати бўйича аниқланган. Тажрибаларни ўтказишда стандарт услублардан фойдаланилган.

Калит сўзлар: ротор-фильтр, қаршилик коэффициенти, штуцер, чангли газ, суюқлик сарфи, тезлик, ҳўл усул, фильтрловчи тўрли материал, диффузор, конфузор.

Introduction:

Currently, there is a tendency to use wet processing devices for cleaning dust from industrial enterprises and neutralization of secondary gases. the use of this type of devices is special due to its efficiency and good effect in cleaning small-sized (up to 0.1 μm) dusts and washing secondary gases [1,2]. However, using such a method also has its own disadvantages. for example, the high liquid consumption of wet gas cleaning and the problems of retreatment of the resulting sludge increase the total energy consumption of the process. In addition, the overall hydraulic resistance of the device increases and reduces the performance. therefore, it is urgent to create methods and devices that allow high cleaning with low energy consumption and small hydraulic resistance and to apply it to industry.

Research method and object:based on the above, the constructions and operating parameters of the wet gas cleaning device were systematically analyzed. based on the results of the analysis, a structural diagram of the rotor-filter device and a laboratory copy were developed [3,4,5]. Figure 1 shows the structural scheme of the device

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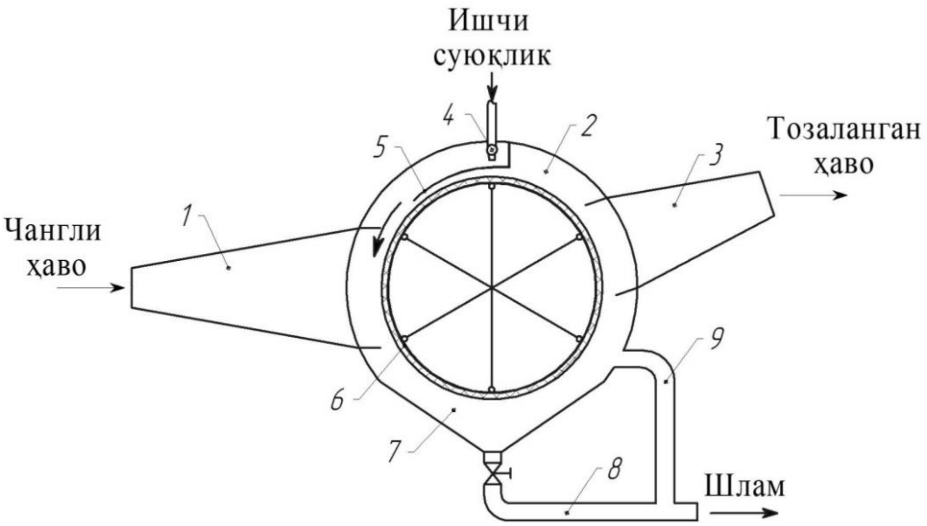

1 – diffuser; 2 – cylindrical body; 3 – confusor; 4 – working fluid nozzle; 5 – probe; 6 – rotor-filter; 7 – liquid bath; 8 – slurry pipe; 9 – straightening pipe.

Figure 1. Construction scheme of the rotor-filter device

The device consists of a rotating rotor and a filtering mesh material covered on its upper part, a diffuser that directs the dusty gas stream perpendicular to the surface of the mesh material, a nozzle that scatters the liquid by the ejection method, a screen that evenly spreads the liquid on the surface of the filter, a bath where the working liquid is collected andIt consists of a cylindrical body equipped with a slurry pipe and a confusor that emits purified air into the atmosphere. When the dusty gas flow moves through the diffuser and hits the filter surface perpendicularly, the gas and dust particles form in the liquid film on the working surface of the filteris cleaned.purified gas is released into the atmosphere through the condenser.The main advantage of the rotor-filter device over the existing wet dust cleaning devices is that, firstly, due to the rotation of its rotor, the working surface changes quickly and provides an increase in the contact surface of the filter, and secondly, the flow of dusty gas moving through the diffusercleaning of the filter on the outer A and inner B working surfaces, this situation serves to improve the efficiency of dust removal in the device. However, insufficient research has been conducted on the operating parameters of devices similar to this device, including achieving high cleaning efficiency with low fluid consumption and minimizing energy consumption

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Research Results

In this research work, experiments were conducted to determine the working fluid consumption and resistance coefficient supplied to the rotor-filter device.

S32-412 nozzle (hole diameter dsh = 1;2;3 mm, 3 pieces corresponding to the width of the device rotor-filter) was installed to form a film by evenly spraying the liquid on the surface of the rotor-filter in the devicethe installation interval was set to 25 mm corresponding to the liquid spraying angle α. Figures 2 and 3 show the installation and general view of the nozzles. a filter (5) that evenly spreads the liquid on the surface of the filter (length Lz=700 mm along the diameter of the rotor-filter and width Bz=150 mm along the length of the spread), a centrifugal pump (Qmax=40l/min; Ndv=0.37kW; hmax=38m ; V=220V; nayl=3000 ayl/min according to GOST-2757030-91), rotometer (RS-5; scale indicators 0÷100between; according to GOST-13045-81) and a beaker (full volume 3.2 liters) was selected for taring. fluid flow rate and hole diameter dsh=1; 2 and 3 mm were determined using the volumetric method. For this purpose, the filling time of the beaker was determined according to the 0÷90 indicators of the rotometer [1,2].

а – $d_ш$=1mm; б – $d_ш$=2mm; в – $d_ш$=3mm.

Figure 2. The appearance of the nozzles

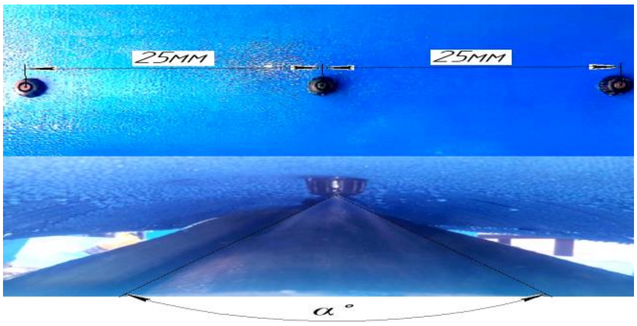

Figure 3. Installation of nozzles on the cover and liquid spray angle

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In the experimental determination of liquid consumption, each experiment was repeated 5 times, and the square dimensions of each point and the resulting errors were determined. when the rotometer scale indicators changed from 0÷90, the liquid consumption changed to Q=0.068÷0.360 m3/h. The consumption change in each indicator increased in steps of 0.044 m3/h. Table 1 shows the results of the experiment.

1-table

Rш / view name	0	10	20	30	40	50	60	70	80	90
Indicators of the total consumption of the rotometer										
tўр Min	2.45	1.53	1.26	1.07	0.56	0.48	0.42	0.37	0.32	0.30
Q L/hour	73	117.64	142.85	168.2	200	225	257	295	339	360
Q m^3/hour	0.073	0.117	0.142	0.168	0.200	0.225	0.257	0.295	0.339	0.360
$d_ш$=1mm										
tўр Min	2.65	2.11	1.45	1.27	1.12	1.05	0.55	0.50	0.45	-
Q L/hour	68.1	85.3	124.7	141.7	160.7	171.48	197.8	216.86	240.1	-
Q m^3/hour	0.068	0.085	0.124	0.141	0.160	0.171	0.197	0.216	0.240	-
$d_ш$=2mm										
tўр Min	2.52	2.07	1.38	1.22	1.07	0.57	0.49	0.44	0.40	-
Q л/hour	71	86.95	130.45	147.54	168.2	189.47	222.2	246.57	272.7	-
Q m^3/hour	0.071	0.086	0.130	0.147	0.168	0.189	0.222	0.246	0.272	-
$d_ш$=3mm										
tўр Min	2.50	2.01	1.33	1.18	1.01	0.53	0.45	0.40	0.36	0.33
Q L/hour	72	89.55	135.33	152.5	178.2	204.5	240.5	272.5	300	327.27
Q m^3/hour	0.072	0.089	0.135	0.152	0.178	0.204	0.240	0.272	0.300	0.327

The coefficient of resistance of the nozzle hole to liquid flow was determined according to the graph of dependence of the thickness of the nozzle hole on the ratio of the diameter of the hole shown in Figure 4, recommended by B.A. Alimatov and I.T. Karimov [8]. conducted experiments RD 34.20.519-97 "Ispytaniya hidravlicheskogo soprotivleniya truborovodov. Mashiny i apparatus dlya izmereniya rashoda gasov i davleniya. It was determined according to Programma i metody ispytaniy" [9,10].

Figure 4 shows the dependence of the orifice resistance coefficient on the ratio of orifice thickness to diameter

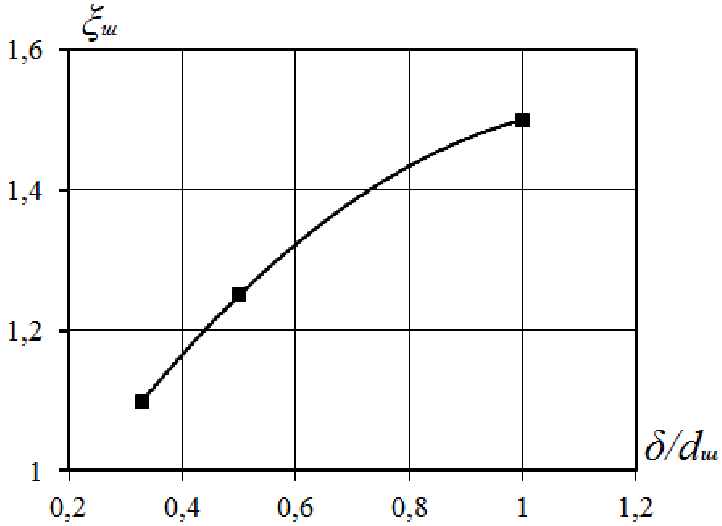

Figure 4. Dependence of the nozzle hole resistance coefficient xsh on the ratio of the thickness of the nozzle hole to the diameter d/dsh

From the data given in Figure 4, it can be seen that when the nozzle hole dsh = 1 mm, the total consumption of liquid is Q=0.240 m3/h and its speed ωs=84.92 m/s. when the nozzle hole dsh =2 mm, the total consumption of liquid Q=0, 272m3/h and its speed ωs=24.72 m/s, and when the nozzle hole dsh =3 mmtotal consumption of liquid was Q=0.360 m3/h and its speed was ωs=13.08 m/s.The following empirical formula was obtained using the method of least squares for the dependences presented in Figure 4 [6,7].
xsh = -0.57072 d/dsh + 1.356 d/dsh + 0.7147 R^2 = 0.9981 (4)

Summary:
An increase in the diameter of the nozzle hole reduces the range of influence of the hole on the working fluid. but it causes a decrease in the angle of scattering (injection) of the liquid. This, in turn, reduces the limit of covering the surface of the filter material with a liquid film

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