3DESA - PROGRESSIVE TECHNOLOGY FOR DUST COLLECTION WITH BAG FILTERS

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It is possible to understand the mechanic of the dust sedimentation by theoretical study microprocess of interaction microparticles with the fibers of the filter media. The force or the resistant of the gas layer between dust particle and the body was determinate by solution of the Bolzman aquation and by construction gas-kinetic theory of the lubrication [1]. This theoretical study show clear that the general dust filtration spring from the surface of the fibers of filter media.

Experimental tested of this thesis was make by microscope analyze of the cuttings the filter bags with cement dust [2].

$$\frac{h^2\eta}{3}\Delta v - \frac{h}{2}(\eta+1)\left[\frac{\partial}{\partial x}\left(h\frac{\partial v}{\partial x}\right)+\frac{\partial}{\partial y}\left(h\frac{\partial v}{\partial y}\right)\right]= \quad (1.10)$$

$$=\frac{V'}{1+\eta^{-1}}\frac{\partial h}{\partial y}+\frac{U_2'-U_1'}{1+\eta^{-1}}\frac{\partial h}{\partial x}+2(W_1'-W_2'), \qquad \eta=\frac{h}{2\lambda}$$

Это уравнение является уравнением газокинетической теории смазки без учета сжимаемости газа.

Such a theoretical study clearly shows that the main dust collection occurs on the fibers of the material.

The solution of equation (1.10) for a sphere deposited in air gives the time t of deposition of an aerosol of radius r under the action of a force P from a distance d on a body, for example, a fiber

$$t = 6\pi\mu r^2 [3/2+2\ln(6Kn^{-1})]/P,$$

where μ is the viscosity of the gas, Kn=λ/d is the Knudsen number calculated from the free path of the molecules λ. In particular, a speck of alumina from a height of 15 microns radius of 100 microns will settle in 0.01 seconds, and a radius of 10 microns – in 0.1 seconds.

This thesis has been confirmed experimentally by analyzing of the cross sections the filter bag dusted with cement dust [2].

Fig. 1 Front side

Fig. 2 Inside out

In many industries use bag filters (fabric filters), in that try to have maximal filtering square in the minimal volume. We solve this problem by the way to goffered the filter media [3].

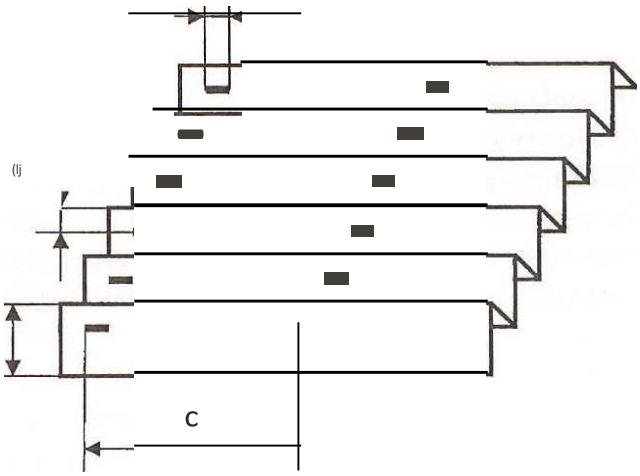

Fig. 4

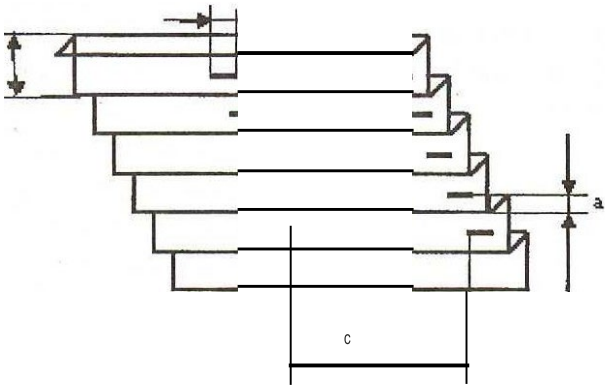

Fig.5

The engineers of RUSAL ITC Co. ltd [4] was one of the first who was see the perspective of the wide industrial applications goffered filter bags in the Russia.

"UC RUSAL" has expanded the field of research by installing on one of the three CGO 19-1 filter modules corrugated filter sleeves of a domestic company equipped with filter material from an imported manufacturer and a Russian factory, one of the leaders in the production of non-woven materials in the Russian Federation. According to the results of 6-month tests, the throughput of the CGO increased by 20% with a decrease in the current load on the smoke extraction plants. (Table 1).

Comparative data on the operation of GO 19-1

Table 1

	Filter No. 1	Filter No.2	**Filter No.3 (corrugated)**	Filter No.3 (cylindrical)
Temperature, C^0	57	55	**58**	54
Speed, m/s	18.2	15.6	**22.4**	18.9
Volumetric flow rate, nm3/h	50280	43490	**61610**	53220

This 3D textile solution was open new opportunity for constructions new different types of the filter bags.

At the same time this many variants bring the problem to elect determinate parameters of the flow in the filter house. We find 5 dimensionless parameters [5].

Criteria for the similarity of currents in a bag filter

The variety of bag filter designs and various ways of their modernization poses

the task of formulating clear criteria for the similarity of flows in bag filters. It is necessary to determine the minimum set of parameters that do not depend on the dimensions of the installation, which determine the flow of the dust and gas flow in the bag filter. To do this, it is convenient to apply the Π -theorem.

Parameters determining the flow in the bag filter

Cv-input dustiness;

C-output dustiness;

Q-gas flow;

SF-filtration area;

Fp-inter-bags area;

Vbit - the sedimentation speed of the dust;

dPvent-differential pressure on the filter;

QPM-breathability of filter material;

dPumn-pulse pressure (in receiver);

w-pulse frequency of compressed air;

D is the average size of the dust particles.

In dimensionless parameters:

C / Cv = C-degree of purification;

Cv Q qfm / dPvent SF = Gof-dust resistance of bag set (change dust resistance

filtering material loads Cv Q / SF related to change in pressure on sleeve material

dPvent / QPM);

SF / Fp = Sof-the degree of compactness of the filter;

Q/ Fp Vbit = V can - number of inter bags speed;

Cv w QPM D/ dPumn = Bag-dust pressure on the bags in relation to the pulse pressure;

SF D w / Q = Reg-the regeneration rate of the filtering material (regeneration rate D w

relative to the filtration rate Q/ SF).

Five criteria for the similarity of currents in bag pulse filters:

Gof = Cv Q qfm / dPvent SF = item (1)

Sof = SF / Fp = item (2)

V can = Q/ Fp Vbit = item (3)

Bag = Cv w qfm D/ dPumn = item (4)

Reg = SF D w / Q = item (5)

The results of right use of the technology 3DESA (3D Economical System of Aspiration) are impress as in in constructions new filter house that in the reconstruction that:

increase the volume of gas, increase the live time and so... [6]

For example, at one of the aluminum plants, the filter elements "3DESA-

filtratron" with a length of 5 m (total 5376 pcs.) were equipped with a GO of 14 filters. Usually, on smooth filter bags, the pulse interval on this GO is 50 seconds. After completing all 14 filters with new bags, the pulse interval increased to 600 s for bags with a "3DES filter patrone". It's so unexpected that the maintenance service has turned off 2 filters. For the remaining 12 filters, the pulse interval was up to (on average) 200 seconds or more (fig. 3).

The sleeves have worked for 4 years,

An example of upgrading a bag filter using 3DESA technology [3]. Its composition and initial operating conditions in the production of mineral powder were as follows:

• smoke ventilator DN-12.5 with a capacity of 75 kW, 1500 rpm;

• cyclone group – 6 units with a capacity of 35-40 thousand m3/h;

• relative humidity of raw materials – 4-12 %;

• the temperature at the outlet of the drying drum is 160-200 °C;

• cylindrical filter sleeves (length – 2000 mm, diameter – 160 mm, distance between bags – 70 mm). There are 80 bags in total. Filtration area – 90 m2;

• gas consumption – 25-40 thousand m3/h. Gas load – 5-9 m/min;

• inter bags speed - 3.64 m/s;

• Pulse pressure – 12 atm.

The problems were that the bags were torn, the smoke ventilator was working at maximum

capacity, the burner was burning at half its capacity, and the pulse interval was only 12 seconds. As a result, the filter was overloaded and production stopped. …

After modernization, the filtration area increased from 90 to 320 m2 (!) with the same number of hoses and gas consumption (25-40 thousand m3/h) (Fig. 6). The gas load decreased (from 5.0–9.0 to 1.3–2.0 m/min) and the inter bags speed (from 3.64 to 2.1–3.4 m/s). As a result, production started at full capacity (the burner was at maximum), and at the same time the smoke pump coped with its task, working only at half of its maximum productivity.

Fig. 6. Bag filter after modernization

Conclusion:

An industrial progressive dust extraction technology with bag filters has been developed, which ensures import substitution in this industry.

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