Characteristics of standing disperse medium on the filter substrate

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Abstract. In the process of gas filtration through a porous wall deposited dust is agglomerated state. Sealing layer in the accumulation of particles associated with the re-formation of aggregates. Kozeny equation Karman reflects the relationship between flow rates, porosity layer, a pressure drop, a specific surface area of the particles in the layer thickness. The specific surface area of the particles in the layer is an unknown quantity, so it is proposed to determine the ratio of Kozeny Karmana obtained from experiments on all other values. Filtering process in the experimental setup was performed on preformed compressible layers of particles of different size. Thus the filtration rate is fixed, the change in porosity, the pressure drop, the thickness of the layer. It is believed that the specific surface of the particles remains constant when implementation filtration processes similar manufacturing conditions.

1. Introduction

In systems scrubbing gas filtration through a bed of particles is the most effective means of dedusting gases. As Deduster apply flexible partitioning of tissue metal grids. Dedusting process gas is formed in the layer of the filtered particles [1]. Mechanical characteristics of the formed layer of particles is determined by the methods of regeneration of the filter walls, on which depends the efficiency, stability, dedusting, reliable operation of the filter.

2. Theoretical bases

In [2] provides an analysis of methods for determining the resistivity of the sediment. The total resistance $R_\Sigma = R_{sl} + R_f$, (1/m). For incompressible layer and filtering partition $P_\Sigma = \mu R_\Sigma W$, (Pa), where μ - the dynamic viscosity, (Pa s). The magnitude $R_{sl} = r_0 H_k$ where r_0 value of resistivity layer (1/m^2).

In [2] does not address the issue of the stresses arising in the formed on the porous layer of the septum, which depend on the pressure drop. Tension in the particulate body increases towards the septum, thus decreasing porosity layer and the resistivity increases. In [2], the resistivity of the layer height is taken averaged constant, but depends on the pressure. Defined mechanical characteristics
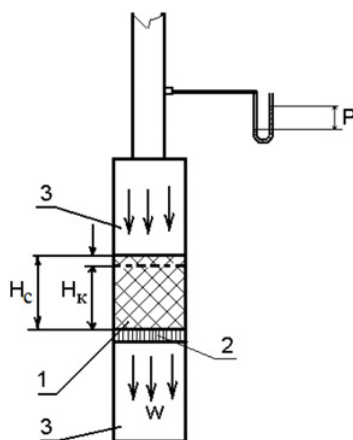
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Figure 1. Device for determining the parameters of the particulate material (1-working section, 2-filtr, 3-auxiliary section).
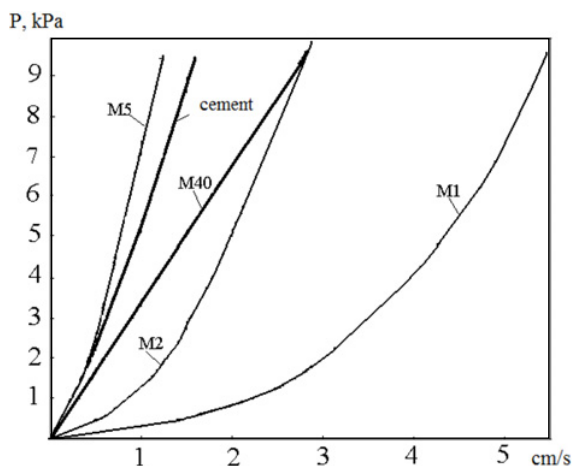

Figure 2. The air pressure to the working cylinder of height 4.8 cm from the filtration rate.

dispersed bodies formed into cylinders backfilling fine powder consisting of agglomerates of particles (Fig. 1) [3].

3. Experimental setup description

It was found that the bulk density in the cylinder is dependent on the method of preparation of a filling material, the relative humidity, the material of the cylinder, the height of the cylinder. Figures 2 and 3 show the experimental dependence of pressure change of the filtration rate and change in porosity of pressure for different powders of metal cylinder height 48 mm with one and the same filter fabric, which after each run was freed from the particle bed. The material after sieving through a sieve with a mesh of 1 mm^2 consists of agglomerated particles and after filling into the working cylinder has a bulk density which is caused autohesive interactions between the particles.
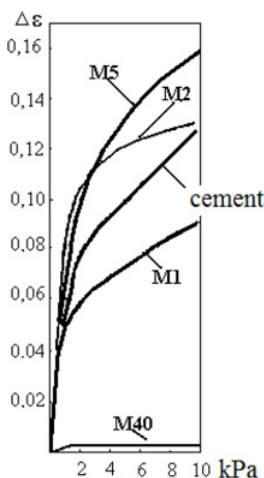
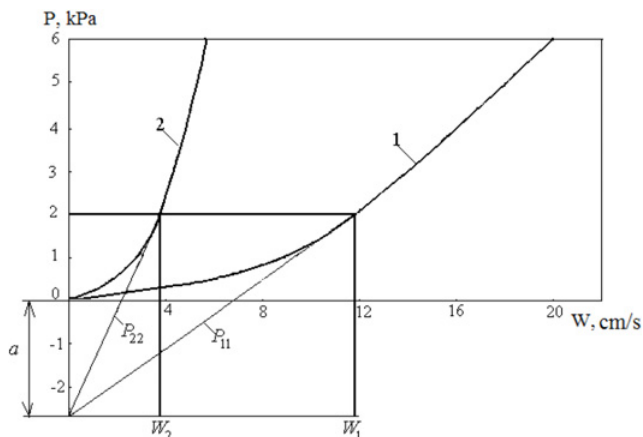**Figure 3.** Changing the average porosity of the pressure.

Figure 4. Dependence of the inlet pressure in the cylinders of the air velocity in the cylinders. P_{11}, P_{22} line pressures approximating the real changes in the range of 1.5 to 2.5 kPa, with initial coordinate point "a".

4. Experimental technique and discussion and conclusions

Assessment redistribution resistances between the filter layer and consider the example air filtration through a layer of powder M2 in the cylinders 10 and height 40 mm [3]. Figure 4 shows the curves 1 and 2, depending on the rate of pressure cylinders 10 and height 40 mm.

Curves 1 and 2 show that the compressible layer. Draw a line $P = S$ =const so that the tangent to the lines 1 and 2 at the points of intersection intersect the ordinate axis at $a_1 \approx a_2 \approx a = 2.68$ kPa (Fig. 4). Draw curve fitting in the pressure range $P = 1.5$–2.5 kPa follows:

$$\frac{dP_2}{dW}\big|_{p=s} = \mu R_{\Sigma 2} = \frac{S}{W_2} \tag{1}$$

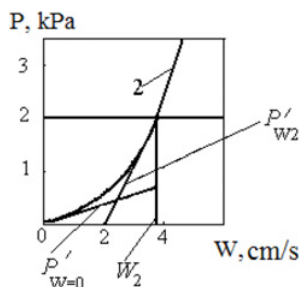$$\frac{dP_1}{dW}\big|_{p=s} = \mu R_{\Sigma 1} = \frac{S}{W_1}. \tag{2}$$

Figure 5. Detection circuit derivatives.

In the pressure range $P = 1.5$–$2.5\,\text{kPa}$, this line corresponds to the value $P = S \approx 2\,\text{kPa}$. Curves of pressure changes on the rate for incompressible layers represent linear dependencies $P_{11} = \mu R_{\Sigma 1} W$, $P_{22} = \mu R_{\Sigma 2} W$, P_{11}, P_{22} air pressure in front of a height of N_{K1} and N_{K2} with initial coordinate linear approximations of the point a, $R_{\Sigma 1}$, $R_{\Sigma 2}$ – resistance layer height H_{k1} and N_{K2}, respectively. These relations imply

$$R_{\Sigma 1} = \frac{P_{11}}{\mu W}, \ R_{\Sigma 2} = \frac{P_{22}}{\mu W}, \ r_0 = \frac{R_{\Sigma 2} - R_{\Sigma 1}}{H_{k2} - H_{k1}}, \ R_\theta = \frac{R_{\Sigma 1} H_{k2} - R_{\Sigma 2} H_{k1}}{H_{k2} - H_{k1}} \ . \tag{3}$$

We have the following data to calculate: $H_{k1} = 10 \cdot (1 - \Delta\varepsilon) \cdot 10^{-3} = 10 \cdot (1 - 0, 1) \cdot 10^{-3} = 9 \cdot 10^{-3}$, m; similarly $H_{k2} = 40 \cdot (1 - \Delta\varepsilon) \cdot 10^{-3} = 40 \cdot (1 - 0, 1) \cdot 10^{-3} = 36 \cdot 10^{-3}$, m; $\mu = 1, 8 \cdot 10^{-5}$, Pa $\cdot$ s. According to Fig. 4, we have the following parameters: $W_1 = 11.8 \cdot 10^{-2}$, m/s; $W_2 = 3.8 \cdot 10^{-2}$, m/s; $P_{22s} = (a+2) \cdot 10^3 = P_{11s} = 4.68 \cdot 10^3$, Pa. Substituting these data in the quantities appearing in the formula (1), we obtain $R_{\Sigma 1} = 2.2 \cdot 10^9$, 1/m; $R_{\Sigma 2} = 6.8 \cdot 10^9$, 1/m; $R_f = 0.67 \cdot 10^9$, 1/m; $r_0 = 1.7 \cdot 10^{11}$, 1/m². Note that pressure in the range $P = 1.5$–2.5, kPa determined by the relations $P_2 = P_{22} - 2.68$, kPa; $P_1 = P_{11} - 2.68$, kPa.

Suppose that after the filtering process dispersed body consists of compacted and uncompacted parts. To evaluate the distribution of seals and unconsolidated portions along the length of the body of dispersed use of curve 2 in Fig. 4. Denote $P'|_{W=0} = (dP/dW)|_{W=0}$, $P'|_{W2} = (dP/dW)|_{W2}$ – derivative at $W = W_2$ (Fig. 5).

We write for filtering particulate compacted and non-compacted body in the form of $P'|_{W=0} = H_k \mu r_{0H}$, $P'|_{W2} = H_k \mu r_{0y}$. The total pressure is made up of the pressure loss of the particulate unconsolidated portion of the body and the pressure loss at the portion of the seal body. $P = W_2(h_H \mu r_{0H} + (H_k - h_H)\mu r_{0y})$ or

$$P = W_2 \left[P'|_{W=0} \frac{h_H}{H_k} + P'|_{W2} \frac{H_k - h_H}{H_k} \right] \tag{4}$$

where h_H– the height of the unconsolidated particulate body, whence:

$$h_H / H_k = [P'|_{W2} - (P/W_2)]/] \, P'|_{W2} - P'|_{W=0}]. \tag{5}$$

For example in Fig. 5 should $P'|_{W2} = 2/(3.8 - 2.2) = 1.25$; $P'|_{W=0} = 0.75/4 = 0.19$; $P/W_2 = 2/3.8 = 0.52$. Substituting these values in the formula (5), we obtain $h_H/H_k = 0, 69$. Consequently, the height of the compacted particulate body is less than a third of the height of the cylinder. These data allow us to evaluate the stresses in the particle layer.

References

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