AERODYNAMIC METHODS FOR INCREASING THE EFFICIENCY OF DUST CATCHERS IN THE PRODUCTION OF REFRACTORIES.

2. AEROHYDRODYNAMIC DESIGNING OF DUST CATCHERS

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The concept of superposition of the losses in calculating the hydraulic resistance of dust catchers used in the refractory industry is developed and substantiated. A unified method and a calculation procedure are suggested and applied for advancing the dust catcher design.

Aerohydrodynamic calculation of dust catchers is made for evaluating and predicting their hydraulic resistance, which makes it possible to determine the energy loss to dust catching and suggests optimum methods for improving the efficiency of the process. We used the principle of superposition of the losses in which the arithmetic sum of individual components gives the total resistance of the device \( \Delta P_{\text{tot}} \). The mutual effect of the components of the device positioned close to each other was taken into account.

The principle of superposition can be realized by two methods [1], i.e.,

1. by summing the absolute values of the hydraulic resistance of individual parts

\[
\Delta P_{\text{tot}} = \sum_{i=1}^{n} \Delta P_i ,
\]

where \( i \) is the number of the calculated component of the device, \( n \) is the total number of the considered components, \( \Delta P_i \) is the total resistance of the \( i \)th component determined by the formula

\[
\Delta P_i = \zeta_i \frac{\rho_i w_i^2}{2} = \zeta_i \frac{\rho_i}{F_i} \left( \frac{Q_i}{F_i} \right)^2 ,
\]

where \( \zeta_i \) is the total coefficient of hydraulic resistance of the \( i \)th component of the device reduced to the speed \( w_i \) in the cross section of this component and \( Q \) is the capacity;

2. by summing the coefficients of hydraulic resistance of individual components preliminarily reduced to the speed \( w_0 \) in the reference cross section \( F_0 \) and expressing the total resistance of the device in terms of its total resistance coefficients \( \zeta_{0, \text{tot}} \) by the formula

\[
\Delta P_{\text{tot}} = \zeta_{0, \text{tot}} \frac{\rho_0 w_0^2}{2} = \sum_{i=1}^{n} \zeta_i \left( \frac{\rho_0}{\rho_i} \right)^2 \left( \frac{F_0}{F_i} \right)^2 \frac{\rho_0}{F_0} \left( Q_0/F_0 \right)^2 .
\]

Since the temperature of the gas diminishes over the length of the device, we will use the first method of superposition of the losses, i.e., sum the absolute losses in the individual components.

Since the size of the present paper is limited, we will devote the principal attention to the most promising dust catchers though they are not widely used in the refractory industry, namely, the devices with FTsZ, ZF, and FTsGM filters and an inertial dust catcher of the PI type [2, 3]. These objects are the most favorable base models for a series of modifications used successfully for arresting dust in the production of building materials. Some devices of this series, namely, a grained cyclone filter FTsZ-6, a grained filter ZF-4M, a chain filter FTsGM and an inertial dust catcher PI-10 are presented in Figs. 1 - 4.

In the FTsZ-6 filter, the dust arrested in cyclone 1 is removed from the device through hopper 2, and the cleaned dust-and-gas flow arrives into a grained filter 3 equipped with two parallel-acting filtering cassettes 4. The filtering material consists of glass balls 2.7 - 3.2 mm in diameter. Fil-
Fig. 1. Grained cyclone filter FTsZ-6.

Fig. 2. Grained filter ZF-4M: 6) vibrator; 7) springs; the other notation is given in the text.

Fig. 3. Diagram of a chain filter FTsGM: 1) transporting device; 2) hopper (shaft); 3) inlet pipe; 4) supporting grid; 5) limiting wall; 6) chain filtering layer; 7) mobile frame; 8) casing; 9) outlet pipe; 10) drive; 11) throttle; 12) holes; 13) loading chains.

Fig. 4. Inertial dust catcher PI-10 designed by NIPIOTstrom.