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# GAS CLEANING SYSTEM WITH A PRE-UNLOADING FLOW

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**Abstract.** The analysis of the causes and mechanisms reduce the efficiency of processes separation in cyclone devices, the results of field surveys of industrial cyclone. It offers an alternative solution to clean the flue gases from the boiler KE-10/14.

## 1 Introduction

One of the problems of environmental protection is protection against excessive pollution. Therefore, the development of new processes should be balanced with the development of technology to limit emissions to acceptable levels.

A number of modern technological processes gives, at first glance, the small amount of pollutants, but due to their ability to accumulate over time in the various components of the environment, the risk of contamination increases sharply.

Existing systems dedusting gas production of energy, chemical, metallurgy, construction, food and other products designed to improve the sanitary conditions of air, to improve working conditions.

The most common methods of dust control can be divided into mechanical, wet electrostatic. The choice of equipment depends on the properties of the particles of ash and dust, composition, temperature, humidity, flow, modes of technological object. In this critical role played by layout decisions, economic issues.

Wet dedusting additionally requires solving problems of cleaning you-marching out of the water to prevent sediment blockage tract, corrosion of surfaces of equipment.

Electrostatic dust removal requires the maintenance of uniformly distributed gas-bution cleansed of all elements, the maintenance of the ionization of the gas, the formation of agglomerates, and their removal. Electrostatic dust removal requires the use of expensive, cumbersome equipment and a qualified service. The efficiency of electrostatic cleaning sieve-dependence of the electrical resistance of the particles, their adhesion and autohesion ha tics, the thermodynamic properties of the purge stream.

## 2 Theoretical bases

Operating experience of the industrial group or the battery cyclone showed low efficiency dedusting gas [1].

Efficiency cyclone on the boiler bed firing fuel co-constitutes 69%, the efficiency of the new vortex scrubber 95%, pneumatic and hydraulic resistance up to 1500 Pa.

Visual inspection is in the cyclone showed the absence of the final phase of the formation of the bulk layer of fine particles. Due to the lack of necessary for the normal operation of the device environment in general collected dust collection chamber there is a “dust storm” that promotes inter-element cross-flow of dusty gas, complicates the process of normal dust-deposition and formation of the bulk layer of trapped fine particles.

## 3 Research method

We have developed an industrial dust collector with pre-swirl discharge flow of boiler installed boiler KE 10/14 “Mine Nina” (Polysaevo city, Kemerovo region). [2]

Fig. 1 shows a layout diagram of the dust collector.

The dust-laden gas stream enters the discharger-dust-concentrator equipped with its own dust collection hopper, which is carried out preliminary discharge flow from the coarse dust. Do not the separated in the dust-bin discharger-dust-concentrator particles to flow concentrated on the wall and appear in remote cyclone discharger-dust-concentrator. Feed cleared of large particles in the discharger-dust-concentrator enters the discharger-dust-concentrator. Here, the fine dust is concentrated and displayed in remote cyclone. Purified in remote cyclone stream joins the main stream, purified dust-concentrator. Thus, it carried out a three-stage purification of air flow, which received the original twist in the discharger-dust-concentrator. Let us compare the

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effectiveness of various dust collectors operating in optimal conditions inherent in these devices, according to the standard procedure [3]:

$$\eta_i = \Phi(X_\delta); \tag{1}$$

$$\eta_\Sigma = \Phi(X_\Sigma); \tag{2}$$

$$\Phi(X) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} exp\left(-\frac{x^2}{2}\right) dx; \tag{3}$$

$$X_\delta = \frac{lg(\delta / \delta_{50})}{lg\,\sigma_\eta}; \tag{4}$$

$$X_\Sigma = \frac{lg(\delta_m / \delta_{50})}{\sqrt{lg^2\,\sigma_\eta + lg^2\,\sigma_h}}; \tag{5}$$

$$\sigma_\eta = \delta_{84} / \delta_{50}. \tag{6}$$

Symbols in the table and formulas: H - the height of the device, D - diameter of the apparatus, $\delta_{50}$ - the size of particles captured with an efficiency of 50%, $\sigma\eta$ - fractional efficiency dispersion device; $\delta$, $\delta m$ - current diameter and the median particle diameter in weight distribution $\sigma ч$ - weighted variance of particle size distribution.

Results of calculating the efficiency of separation of particles in different dusters (percentage) as an example of the test gas and dust with parameters $\delta_m = 40$, $\sigma_h=3$, $\rho =1.1$ kg/m3, $\rho_\delta=2200$ kg/m3, $\mu=22.2*10\text{-}6$ Pa*c are given in Table 1.

Analysis of the data shows that the developed vortex dust-concentrator outperforms similar inertial dust-concentrator and high-performance efficiency approaching art dust-concentrator devices, such as electrostatic precipitator, scrubber, baghouse.

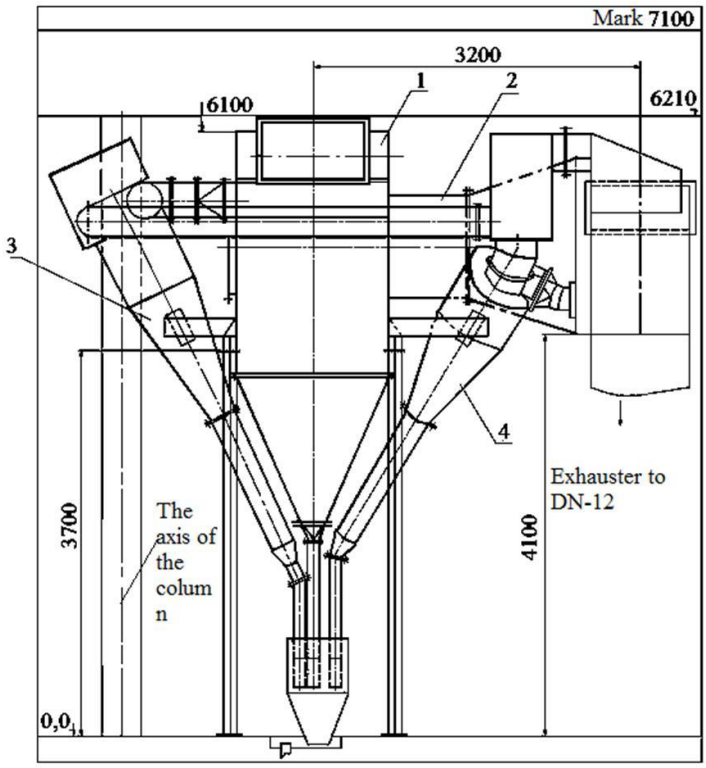


**Figure 1.** Gas cleaning system with a pre-discharge stream.

**Table 1.** Results of calculating the efficiency of particle separation in a variety of dust-concentrator.

| Type of device | $Q$ (th. m3 / h) | $\Delta P$ (kPa) | $H$ (m) | $\delta_{50}$ (micron) | $\eta_{\Sigma}$ |
|---|---|---|---|---|---|
| BC-2-6x(4+3) | 36 | 0,8 | 3,5 | - | 76 |
| Line BC | 4,8 | 0,8 | - | 12 | 83 |
| Line cyclone D=2600 мм | 110 | 0,85 | 7,3 | 20 | 71 |
| DP-12 | 35 | - | 3,5 | 6,5 | 89 |
| Electrostatic EDG-2-128-9-6-4-200-5 | 5205 | 0,5 | 40 | 2 | 99,38 |
| Bag filter | 2000 | 2 | - | - | 99,99 |
| Scrubber with a pipe inside the MB | 325 | 3 | - | 1 | 99,53 |
| Swirling dust-concentrator | 45 | 1,5 | 5 | 4,2 | 94,8 |

Analysis of the data shows that the developed vortex dust-concentrator outperforms similar inertial dust collectors and high-performance efficiency approaching art dust-concentrator devices, such as electrostatic precipitator, scrubber, baghouse dust collector but the manufacturing cost and the cost of cleaning the unit volume of gas is significantly lower than the above-mentioned devices.

## 4 Conclusion

The analysis of the causes and mechanisms of reducing the effectiveness of separation processes in the cyclone devices, the results of field surveys of industrial cyclone. It offers an alternative solution for flue gas cleaning - a vortex dust-concentrator. This design dust collector can be used in low-power, as well as in all industries related to transportation, storage and processing of particulate materials and other processes leading to the release of large amounts of dust into the air.

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