KAZAN STATE POWER ENGINEERING UNIVERSITY

«Materials science, shape-generating technologies and equipment 2020»
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Collecting finely-dispersed particles from the gas flow in a centrifugal separator with coaxially arranged pipes

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Relevance

- **Wear of cleaning devices**

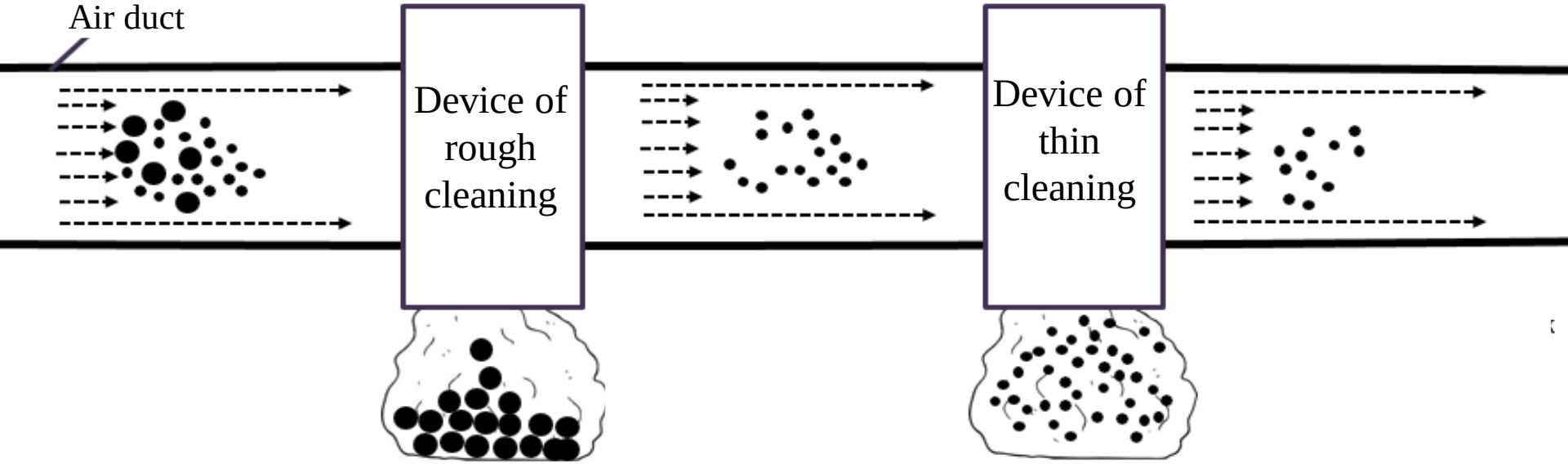
Part of the particles, which were not caught by the apparatus, partially close the outlet pipe, increasing energy consumption

- **Loss of valuable material during particle capture**
- **Growth of incidence**

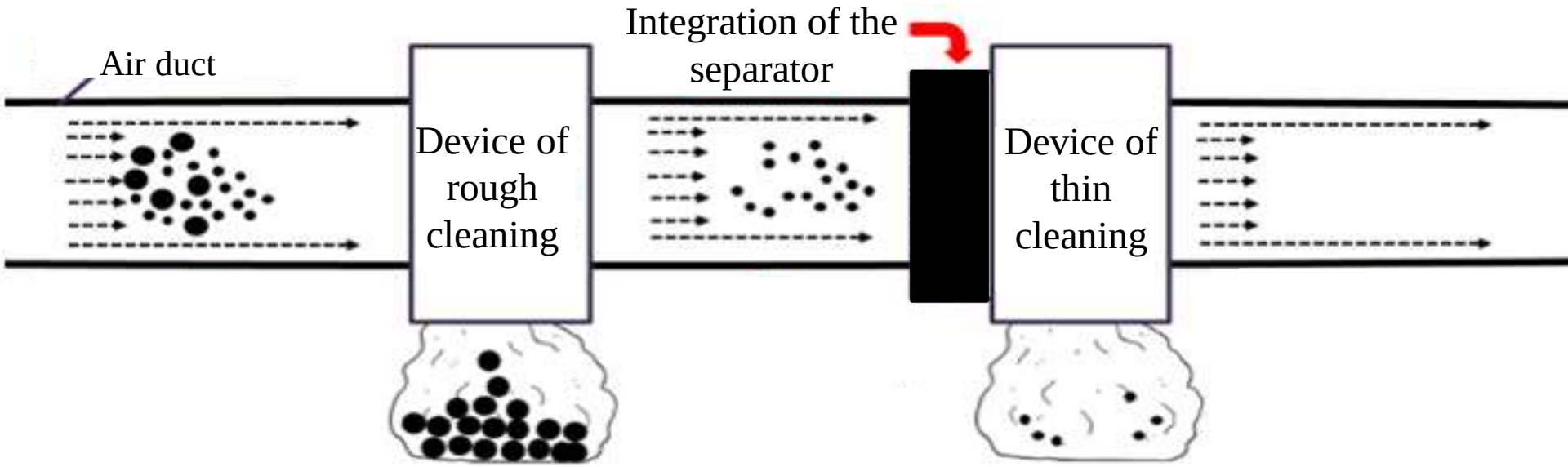
Need to capture solid fine particles of up to 10 μm from gas streams

The purpose of this work is numerical simulation of the process of gas flow dusting in centrifugal separator with coaxially arranged pipes

Process diagram of gas cleaning from dust particles



Our decision



Separator with coaxially arranged pipes

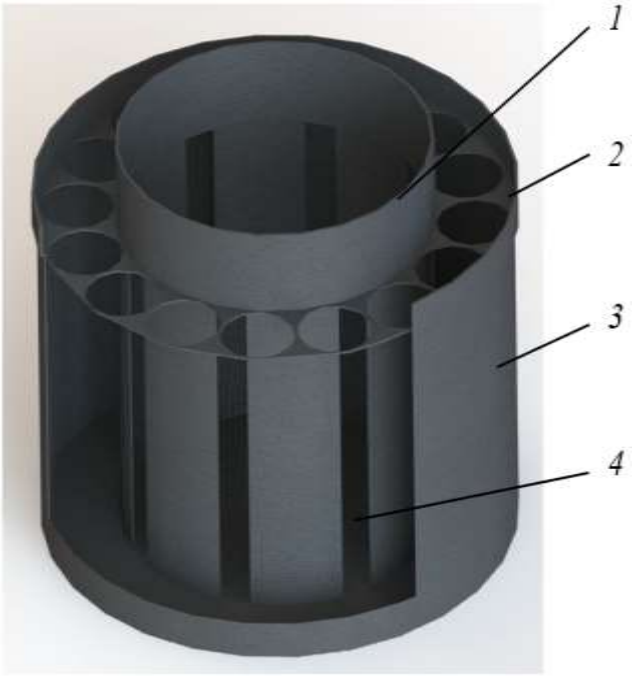


Figure 1. Three-dimensional model of centrifugal separator with coaxially arranged pipes: *1* - inlet pipe, *2* - ring with holes, *3* - housing of centrifugal separator, *4* - slots

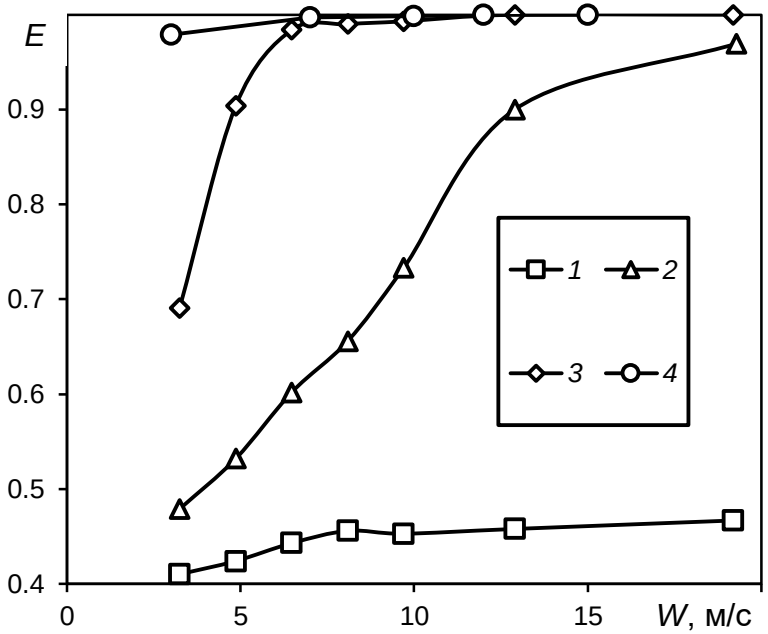


Figure 2. Dependence of change of efficiency of collection of solid particles from dust flows on inlet velocity of gas at their different size a, mcm: *1* - 1, *2* - 4, *3* - 7, *4* - 10. Numerical modelling was performed under condition of particles sticking to walls

Effectiveness of the separator

$$E = 1 - \frac{n_k}{n}, (1)$$

n_k - number of particles remaining in the gas stream after the process in the separator.

Numerical simulation performed in ANSYS Fluent

- p_{outlet} = 10^5 Pa
- W_{inlet} = 3- 15 m/s
- n = 1000
- ρ_a = 1075 kg/m^3
- a = 1 - 10 μm

p – pressure, Pa;
W - velocity flow of air, m/s;
n - number of particles in particulate gas;
ρ_a – density of particles, kg/m^3;
a = diameter of particles, μm

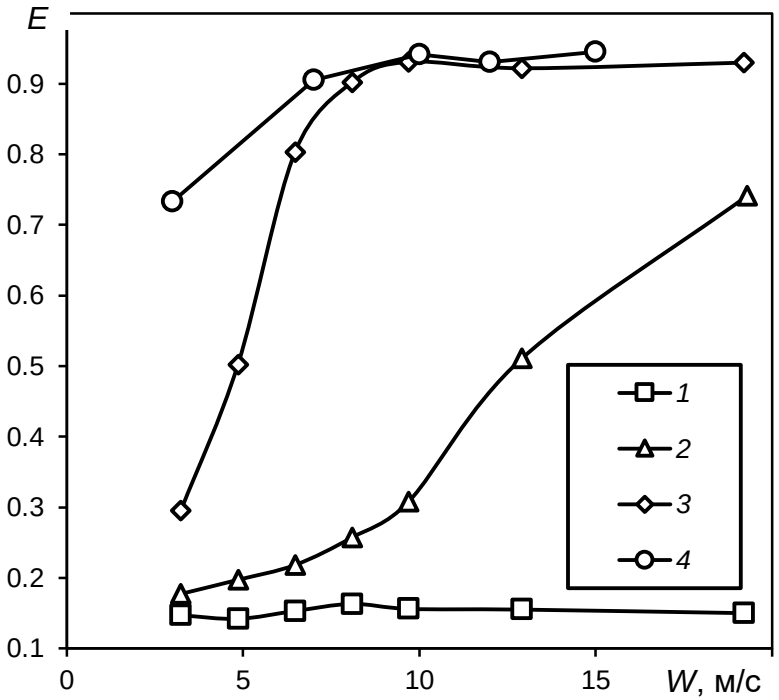


Figure 3. Dependence of change of efficiency of collection of solid particles from dust flows on inlet velocity of gas at their different size *a*, mμ: *1* - 1, *2* - 4, *3* - 7, *4* - 10. Numerical modelling was performed on condition of particles reflection from walls

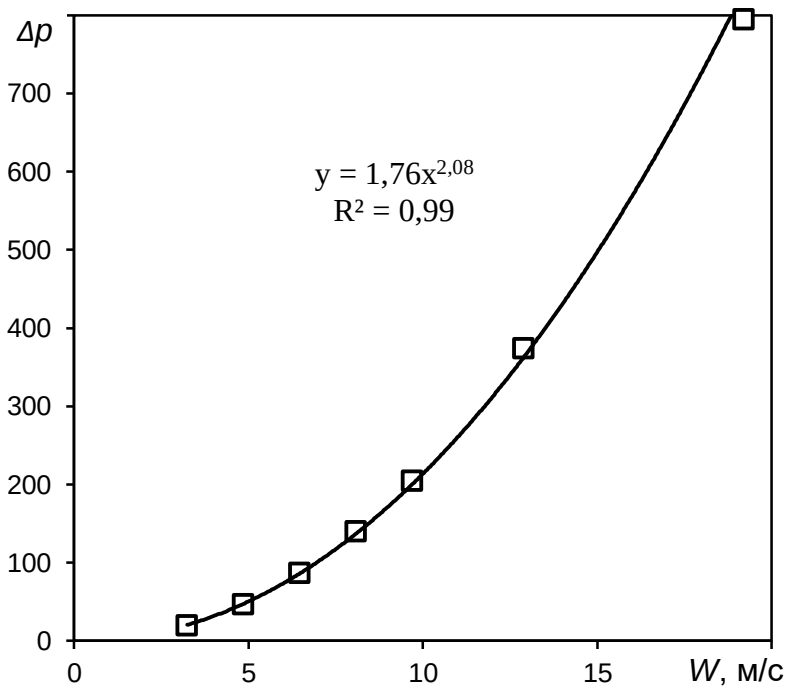


Figure 4. Dependence of pressure loss change in centrifugal separator with coaxially arranged pipes on gas inlet velocity

Conclusions

When using one centrifugal separator, the efficiency of gas dusting from fine particles is not less than 50% at its inlet speed from 3 to 19 m/s.

Application of one centrifugal separator in the process cleaning line is the most rational solution, mainly for dusting of gases from fine particles with size more than 4 mcm, since at moderate values of gas inlet speed up to 10 m/s the efficiency of dusting is 40 - 70% at pressure loss in the device not more than 205 Pa.

At gas flow rate from 10 to 19.2 m/s, efficiency of gas dusting from fine particles with size exceeding 4 mcm is 66 - 87% at pressure loss in the device not exceeding 800 Pa.

When gas is dusted from particles with size of 1 mcm, efficiency is on average 15 - 44% at its inlet speed from 3 to 19 m/s.