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# DETERMINATION OF THE DISPERSION COMPOSITION OF DUST PARTICLES IN A DUSTY AIR FLOW

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**ABSTRACT**

*The article describes a new simulation, that is, dust generated by machines during the primary processing of cotton. The cyclone can move centrifugal and gravitational forces and dust particles of various sizes acting on internal surfaces at medium speeds. The data of scientific and laboratory analyzes of dust dispersion and fractional composition are presented.*

The air environment over cities and large industrial centers requires continuous monitoring. A slight change in the composition of the air can lead to irreparable consequences. The continuously growing industrial production entails the use of various raw materials and fuels. In turn, this increases the emission of gases and dust into the atmosphere, complicates the ecological situation in the regions, and increases the number of respiratory diseases in humans. A dispersed system is a combination of two or more phases (bodies) that practically do not mix and do not chemically react with each other.

Dust is a dispersed system in which the carrier medium is a gas, in particular air, and the dispersed phase is solid or liquid particles. The smallest (fine) dust particles are close in size to large molecules, while the largest ones have the largest size determined by their ability to stay in suspension for a long time.

The average size of dust particles is 1–5 μm. Dusts are dispersed aerosols with solid particles, regardless of dispersion. Fog is understood as a gaseous medium with liquid particles, both condensation and dispersion, regardless of their dispersion. Large particles settle faster. Particles 0.1–1 μm in size are affected by air heat flows and Brownian motion, and they remain in suspension for much longer, which makes it much more difficult to capture them with inertial devices. Conventionally, the dispersed composition of particles is divided into three groups: 1) particles with a radius of more than 10 μm (coarse dust), which can be examined under a microscope at low magnification;

2) microscopic particles with a radius of 1–10 μm, distinguishable by conventional microscopy methods;

3) ultramicroscopic particles with a radius of less than 1 μm, visible in an ultramicroscope or in an electron microscope.

When particles move in a gas, they collide, while individual particles of fine dust combine (coagulate) into larger particles, which increases their mass and allows them to settle faster due to gravity. If the dispersed composition of the tested ash (dust) is unknown, it must be captured and analyzed. The diameter of a particle can be determined by the speed of its soaring, or falling, in still air. The finer the dust, the more complex and expensive the devices designed to capture it. Dispersed (fractional) composition, density, wettability, electric charge of particles, resistivity of particle layers, etc.

Cyclones are the most widely used in dust cleaning systems [2]. In practice, a particle trapping system is created by imparting a swirling or rotational motion to the dusty flow, limited by cylindrical walls. Particles are deposited when thrown onto the walls. Such a device is called a cyclone. A particle moving along a circular trajectory along a radius with a tangential velocity is subject to the centrifugal force $\frac{\boldsymbol{mv^2}}{\boldsymbol{r}}$

Cyclone devices (cyclones) are most common in all areas of production. They have an ideal ratio of cost and effectiveness. Cyclones are very easy to use and are able to capture dust fractions of about 15 microns, which is often sufficient.

Dusty gases are fed into cyclones through tangential or axial swirlers and perform a complex rotational translational movement inside the apparatus, the characteristics of which have not yet been studied enough. Particles suspended in the flow inside the cyclone are affected by the force of inertia, which tends to displace them from the curvilinear streamlines along the tangents directed at some angle downwards and to the housing wall. Particles in contact with the inner surface of the wall under the action of gravity, inertia and the descending gas flow slide down and fall into the dust collector (bunker). Particles that have not reached the wall continue to move along curvilinear streamlines and can be carried out of the cyclone by a gas flow, which can also capture a certain amount of particles settled into the hopper. Simplistically assuming that the trajectories of motion of suspended particles are close to circles, it is possible to take the magnitude of the resulting inertial force proportional to the square of the tangential velocity, the mass of the particles, and inversely proportional to the radius of rotation.

For an incompressible fluid flow, the equations of continuity and momentum balance have the form [3]:

$$\frac{d\overline{u_\iota}}{dx_i} = 0, (1)$$

$$\frac{d\overline{u_\iota}}{dt} + \bar{u}\frac{d\overline{u_\iota}}{dx_j} = \frac{1}{\rho}\frac{\partial \bar{P}}{dx_i} + \gamma\frac{d^2\bar{u}_i}{dx_j dx_j} - \frac{\partial}{dx_i}R_{ij} \ (2)$$

Where $\overline{u_\iota}$ is the average velocity, $x_i$ is the position, P is the average pressure, gas density, is the kinematic viscosity of the gas, $R_{ij} = \overline{u_j' u_j'} -$ is the Reynolds stress tensor. Here, $u_i' = u_i - \bar{u}_i -$ is the pulsating component of the velocity.

The Reynolds turbulence model provides differential transport equations for estimating turbulence stress components.

$$\frac{\partial}{\partial t}R_{ij} + \bar{u}_k\frac{\partial}{\partial x_k}R_{ij} = \frac{\partial}{\partial x_k}\left(\frac{\gamma_t}{\sigma^k}\frac{\partial}{\partial x_k}R_{ij}\right) - \left[R_{ik}\frac{\partial\overline{u_J}}{\partial x_k} + R_{ik}\frac{\partial\overline{u_\iota}}{\partial x_k}\right] - C_1\frac{\varepsilon}{K}\left[R_{ij} - \frac{2}{3}\delta_{ij}K\right] - C_2\left[P_{ij} - \frac{2}{3}\delta_{ij}P\right] - \frac{2}{3}\delta_{ij}\varepsilon, (3)$$

where the turbulence production conditions Pij are defined as:

$$P_{ij} = -\left[R_{ik}\frac{d\overline{u}_J}{dx_k}\right] + R_{ik}\frac{d\overline{u}_J}{dx_k}, \quad P = \frac{1}{2}P_{ij}$$

Where P is the fluctuating production of kinetic energy. – turbulent (turbulent) viscosity; 6k = 1, $C_1$ = 1.8, $C_2$ = 0.6 are empirical constants The transport equation for the turbulence dissipation rate, , is defined as [2]:

$$\frac{\partial \varepsilon}{\partial t} + \bar{u}_j\frac{\partial \varepsilon}{\partial x_j} = \frac{\partial}{\partial x_j}\left[\left(v + \frac{\gamma_t}{\sigma^{\varepsilon}}\right)\frac{\partial \varepsilon}{\partial x_j}\right] - C^{\varepsilon 1}\frac{\varepsilon}{K}R_{ij}\frac{\partial \overline{u}_\iota}{\partial x_j} - C^{\varepsilon 2}\frac{\varepsilon^2}{K}.$$

In equation (1), $K = \frac{1}{2}u_i'u_i'$ is the fluctuating kinetic energy, and is the turbulence dissipation rate. The values of the constants $\sigma^{\varepsilon} = 1.3, C^{\varepsilon 1} = 1.44$ and $C^{\varepsilon 2} = 1.92$.

Capture or separation efficiency is best determined for a given particle size. As already mentioned, fractional efficiency is defined as the proportion of particles of a certain size collected in the cyclone compared to particles of this size entering the cyclone.

The technological process of primary processing of cotton is accompanied by a significant release of dust from technological and transporting machines into production facilities and the atmosphere. The norm of dust content in the air in the industrial premises of the cotton ginning plant is not more than 10 mg/m3, and the exhaust air emitted into the atmosphere is 150 mg/$m^3$ [3,4].

Currently, many scientific organizations have a lot of outdated equipment for scanning electron microscopy and local X-ray spectral analysis.

To carry out x-ray spectral analysis and process its results on old devices, PDP-11 class computers were used, morally and physically obsolete and in most cases out of order. The insufficient performance of these computers did not allow the use of images obtained in the characteristic radiation of the selected element for processing, and therefore such images could not be used to obtain quantitative information.

An important drawback of old scanning microscopes, which manifested itself in the analysis of the obtained samples, was the impossibility of recording images in the frame averaging mode, which made it difficult to obtain high-quality images due to overheating of the sample.

Viewing images and obtaining elemental analysis of composite materials and coatings were carried out on a Zeiss SEM EVO MA (10) scanning electron microscope with an x-act X-ray detector (Oxford Instrument Nano Analysys).

The SEM consists of three main parts: a power supply, an electron optical column with a sample chamber and an electron collector, and an image display system[4,5].

*Rice. 1, 2.* The results were also checked with the SEM EVO MA microscope. We can see this through the picture and the table given in the article.

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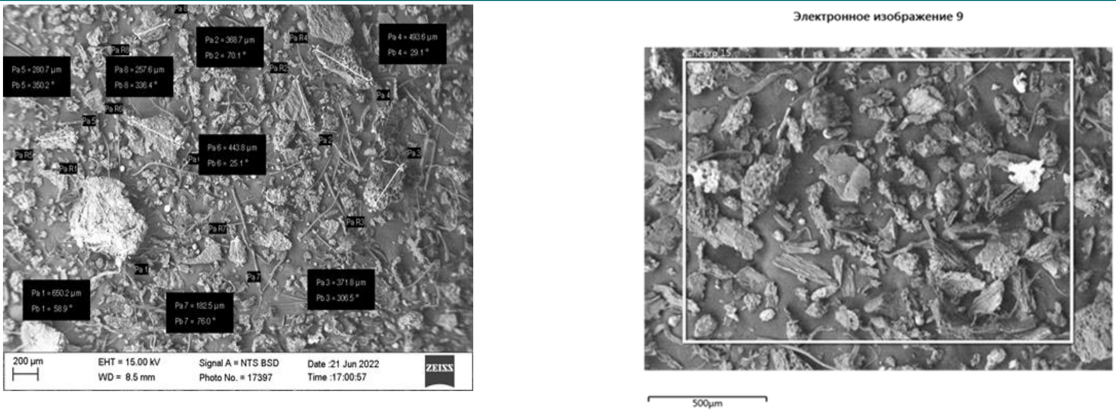
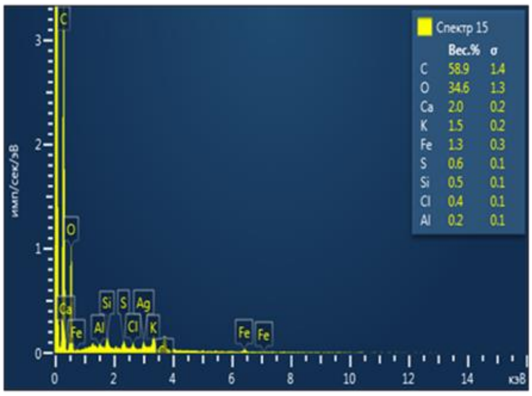



**Rice.1.**The results of the experiments carried out are summarized.




**Rice. 2.** The image below shows the spectral composition of the dust.

| *Element* | *line type* | *Conditional concentration* | *Ratio k* | *The weight %* | *Sigma Weight. %* | *Standard name* | *Preset reference* | *Target calibration date* |
|---|---|---|---|---|---|---|---|---|
| C | K series | 1.07 | 0.01069 | 58.86 | 1.35 | C Vit | + | |
| O | K series | 0.57 | 0.00191 | 34.58 | 1.31 | SiO2 | + | |
| Al | K series | 0.01 | 0.00005 | 0.20 | 0.08 | Al2O3 | + | |
| Si | K series | 0.02 | 0.00014 | 0.55 | 0.09 | SiO2 | + | |
| S | K series | 0.02 | 0.00016 | 0.56 | 0.10 | FeS2 | + | |
| Cl | K series | 0.01 | 0.00012 | 0.42 | 0.10 | NaCl | + | |
| K | K series | 0.05 | 0.00043 | 1.53 | 0.16 | KBr | + | |
| Ca | K series | 0.06 | 0.00056 | 2.00 | 0.18 | Wollastonit e | + | |
| Fe | K series | 0.03 | 0.00033 | 1.29 | 0.28 | Fe | + | |
| Sum: | | | | 100.00 | | | | |

**CONCLUSION.** At this stage of the study, the Navier–Stokes equation was compiled taking into account the Reynolds stress turbulence model. This equation requires solving transport equations for each of the Reynolds stress components. This gives an accurate prediction of the swirling flow pattern, axial velocity, tangential velocity, cut-off diameter, and pressure drop in a cyclone simulation.

## References:

1. Muradov O.J., A.Sh. Adilova "MNOGOTSELEVAYA OPTIMIZATSIYa GEOMETRI- CHESKHI RAZMEROV Tsiklon Dlya OChISTKI ChASTITS PYLI" "Scientific Journal of Mechanics and Technology" 3 (8), 2022 (185-193 st)

2. Murodov O.J., Adilova A.Sh., "IZUCHENIE VLIYANIYa SKOROSTI VHODYashchEGO POTOKA NA EFFEKTIVNOST Tsiklonov" scientific magazine "Science and innovative development" of the Ministry of Innovative Development of the Republic of Uzbekistan pp. 28-34

3. Murodov O.J., Adilova A.Sh., Saidova N.A. "Analysis of influence and change of effectiveness of cleaning geometrical parameters Tsiklonov —MOLODEJ I NAUKA: SHAG K USPEXU: Sbornik nauchnykh statey 6-y Vserossiyskoy nauchnoy konferentsiii perspectivnykh razrabotok molodyx uchenyx (24-25 times in 2024), v 3-x tomax,

4. 4.Casal, J., Martinez-Benet J.M., A better way to calculate cyclone pressure drop, Chemical Engineering 90 (2) (1983) 99–100.

5. Murodov O.J., Adilova A.Sh., "NATIONAL AND FOREIGN EXPERIENCES IN TRAINING HIGHLY QUALIFIED PERSONNEL FOR INDUSTRY ENTERPRISES" on October 26-27, 2022, dedicated to the 90th anniversary of the Tashkent Textile and Light Industry Institute.