Volume 2, Issue 6, June - 2024 **ISSN (E):** 2938-3811

INCREASING CYCLONE EFFICIENCY USING THE LATEST COMPUTER TECHNOLOGY

A. Sh. Adilova1
M. A. Mamadalieva 2,
R. T. Urazaliev 3
Tashkent Institute of Textile and Light Industry1,2,3

Abstract
The article discusses the creation of a new simulation model of cyclones that clean machines from dust during primary cotton processing. The results of theoretical and practical studies of ways to increase the efficiency of cyclones using the latest computer technologies and software are presented. The ratio of centrifugal force and gravity, which strikes the internal surfaces of the cyclone at an average speed and moves dusty air particles of different sizes, is compared. Theoretical studies carried out to study the composition of dusty air, which represents fibrous waste, are presented.

Keywords: dust air, cyclone, dynamic analysis, dust particles, modeling, turbulence model.

Introduction

At all cotton gin plants located in the Republic of Uzbekistan, cyclone separators are widely used to clean dust particles from various machines during the primary processing of cotton. In cyclones, the air is cleaned of dust particles larger than 50 microns ($10^{-6)}$ When the air flow inside the cyclone rotates in the form of an Archimedes spiral, centrifugal forces are created, causing dust particles to strike the outer wall and fall to the bottom of the cyclone as its speed decreases. When dust particles hit the inner surface of the cyclone, they reduce their speed and fall to the bottom of the cyclone, and the purified air rises at a lower speed and exits the cyclone into the atmosphere.

At all stages of primary processing of cotton, a large amount of dust is released, which pollutes production premises and the atmosphere. This can worsen the working conditions of workers and employees, leading them to occupational diseases, especially silicosis. The issue of dusting cotton gins is of paramount importance due to the increasing contamination of cotton picked by machines. Nowadays, machine cotton harvesting is being increasingly introduced In the cotton ginning industry, the technological process of receiving cotton, storing the crop, drying, cleaning and processing is being improved. Urgent measures should also be taken to improve dusting and air purification systems [1-4]

Research Results

The CFD method compares the forces generated on the inner surface of a cyclone when separating impurities into dusty air. In this study, air was considered as a continuous medium, and dusty air particles were considered as dispersed. All digital simulations were performed using a limited amount of CFD code.

Volume 2, Issue 6, June - 2024 ISSN (E): 2938-3811

The study contained three-dimensional, non-standard and uncompressed current transfer equations, and the Euler–Lagrange approach was used to solve these equations. RSTM and LES determined continuous turbulence values using cyclonic models.

Collisions between air dust particles and its walls in cyclones were taken into account using the recovery coefficient. Statistics on cleaning efficiency were obtained by monitoring the number of dust particles ejected from the cyclone.

The success of numerical modeling lies in the correct location of the cells in the computational domain, that is, it is necessary to correctly select each of the parameters and enter the exact optimal values. In the simulation, it is performed and monitored until the average static air pressure at the inlet and outlet surfaces becomes constant.

The study showed that the inlet velocity and υ = 15 m /s, which were used to simulate two different cyclones, were consistent with the experimental study, and the outlet velocity of the purified air was approx. υ = 2–12 m/s (Fig. 1).

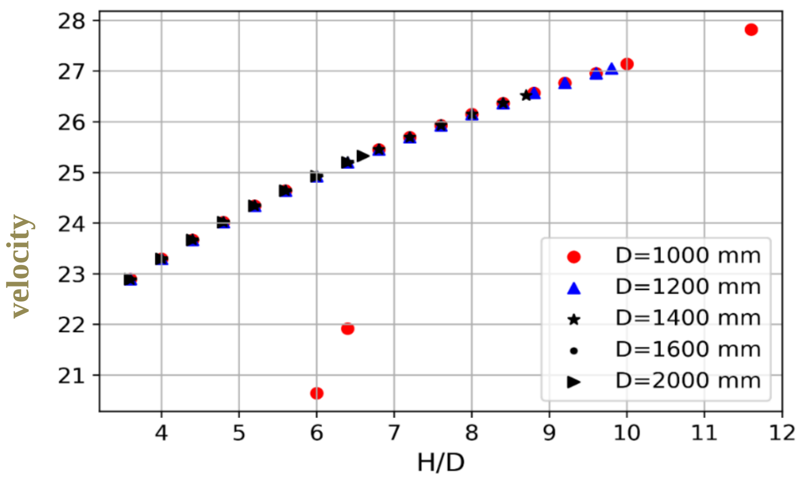

Figure 1: Dependence of the speed of the air-dust mixture at the entrance on the ratio of the height of the cyclone to its diameter.

It should be noted that the cyclone's collection efficiency on dust particle sizes increases as the particle size increases. However, the concentration of large dust particles of raw cotton is much less than the concentration of small dust particles. Therefore, the dispersion efficiency of the dust particle collection cyclone is much less than that of fine particles. The turbulent dust generated on the inner surface of the cyclone and the resulting pressure can be expressed in terms of Reynolds components. Strong stretching dust flows inside cyclones through stress tensors are associated with changes in the amount of air flows and regular changes in other dimensions [8-11].

Web of Scientists and Scholars: Journal of Multidisciplinary Research

Web of Scientists and Scholars: Journal of Multidisciplinary Research

The gradient transport hypothesis developed by Lien and Leschziner was used to model turbulence in a simplified form. The numerical solution of the problem was solved using modern programs and the results were obtained.

$$\epsilon_{ij} = \frac{2}{3}\rho\epsilon\delta_{ij}, \quad (1)$$

where the following equation is formed from the scalar propagation speed

$$\rho\frac{\partial\epsilon}{\partial t} + \rho U_j\frac{\partial\epsilon}{\partial X_j} = C_{\epsilon1}\frac{\epsilon}{k}\tau_{ij}\frac{\partial U_i}{\partial X_j} - C_{\epsilon2}\rho\frac{\epsilon^2}{k} + \frac{\partial}{\partial X_j}\left[\left(\mu+\frac{\mu_T}{\sigma_\epsilon}\right)\frac{\partial\epsilon}{\partial X_j}\right] \quad (2)$$

The viscosity of the cyclone's internal channel is equal to $\mu_T = \rho C_\mu k^2/\epsilon$turbulent $k = \frac{1}{2}\overline{u_i'u_j'}$kinetic energy.

$$\frac{\partial k}{\partial t} + \rho U_j\frac{\partial k}{\partial X_j} = \tau_{ij}\frac{\partial U_i}{\partial X_j} - \rho \in + \frac{\partial}{\partial X_j}\left[\left(\mu+\frac{\mu_T}{\sigma_k}\right)\frac{\partial k}{\partial X_j}\right] \quad (3)$$

However, if a value of turbulent kinetic energy k exists, the equation for the energy value is defined as follows:

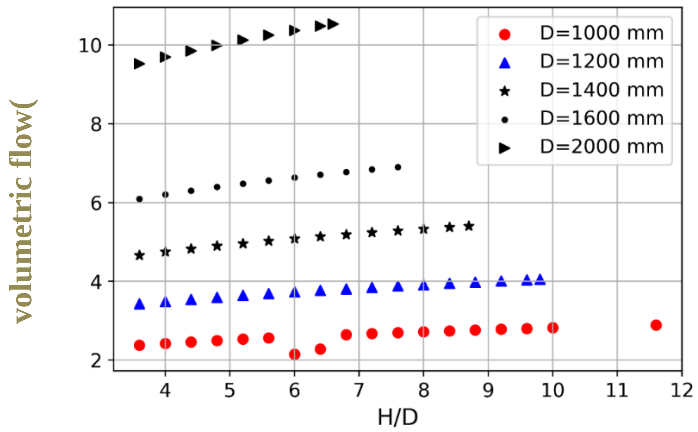

Figure 2: Dependence of the volume flow of the cyclone on the ratio of its height to its diameter

The collection efficiency and calculation of the volumetric trajectory of the cyclone can be determined by a large number of particles having different sizes (the maximum cyclone size implies the size of dust air particles, for which the cleaning efficiency is 90%). Cleaning efficiency for fine dust particles was significantly higher than RSTM estimates. The simulation results showed that accurate simulation of velocity fluctuations is a key requirement for cyclone cleaning efficiency, especially for the removal of fine dust particles [12,13].

References

1.Murodov O. J and Adilova A Sh 2021 Technical science and innovation 3(09) 79-87

2.Murodov O .J and Adilova A Sh 2021 Textile Journal of Uzbekistan 4 129-37

3.Murodov O. J and Adilova A Sh 2021 Estimation of cyclone gas flow parameters and development of new technical solutions for dust collectors Role and tasks in the development of process automation systems” Republican scientific and practical conference 36-40
4.Murodov O.J and Adilova A Sh 2021 Characteristics and efficiency of cleaning the internal field of the cyclone Materials of the Republican scientific-practical conference on the topic "Science and education - an important factor in the development of the country" 50-3
5.Cortes C 2007 Progress in Energy and Combustion Science 409-52
6.Gimbun J, Chuah, T G, Fakhru'l-Razi A and Choong T S Y 2005 Chemical engineering and Processing 44 7-12
7.Griffiths W 1996 Journal of Aerosol Science 281-304
8.Hiraiwa Y O 2013 Separation and Purification Technology 670-9
9. Kępa A 2010 Separation and Purification Technology 127-31
10.Rajabov O I, Kurbonov F A, Abrorov A S and Gafurova M Z 2021 Journal of Physics: Conference Series 1889(4) https://doi.org/10.1088/1742-6596/1889/4/042056
11.Lapple C E 1951 Chemical Engineering 58(5) 144-51
12.Wang L C 1999 ASAE Annual Meeting (Toronto: ASAE) p 4195
13.Adilova A Sh and Murodov O.J 2022 Problems of the development of modern society.