AMERICAN JOURNALS
Open Access,
Peer Reviewed Journals

American Journal of Pedagogical and Educational Research
ISSN (E): 2832-9791| Volume 29, | October - 2024

RESEARCH OF THE AERODYNAMIC MODE OF THE DRYER DRUM OF THE CLEANING SECTION

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ABSTRACT

The article gives the results of a theoretical study of the aerodynamic regime of pneumatic systems, providing a combination of drying and cleaning processes in cotton dryer drums, increasing the cleaning effect on fine litter and dust.

The movement of two phases (debris and air) into the systems for removing contaminated air from the drying chamber was studied.

The main task was to determine the angle of curvature of the pipe of the main channel, as well as other mechanical and geometric shapes of the side channels and flow.

A scheme has been drawn up for the development of analytical formulas for determining the hydroaerodynamic and other parameters of a mixture of litter and air.

When solving the problem, to ensure the uniformity of the distribution of litter and air in the channels, use the theory of a complex variable.

Formulas for determining the geometric dimensions of pneumatic pipes are obtained.

KEYWORDS

Litter, dust potential flow, complex variable function, phase velocities, canonical domain.

Introduction

The high level of contamination and defects in the fiber produced at ginneries has a negative impact on the sustainable implementation of technological processes in the spinning process and the quality of yarn.

The high impurity of machine-picked cotton and its stronger adhesion to the fiber make it difficult to clean.

The frequency of cleaning cotton from fine and coarse contaminants in ginneries is carried out at the level of maximum mechanical impact on cotton [1]. Improving the cleaning efficiency by installing additional cleaners to the technological processes increases the amount of defects in the fiber.

Therefore, the cleaning efficiency of cotton in the initial processing can be increased by finding the internal capacity of existing cleaners and creating new ones without additional mechanical impact on the cotton.

In this direction, a number of researchers [2, 3, 4, 5, 6] have made recommendations for cleaning cotton in drying drums, and the last part of the drum has been replaced by a different surface to create an SBO drying drum. Experience of using this drum in production conditions has shown that it is possible to improve the cleaning efficiency by improving it [7, 8, 9].

During the process of unloading the cotton from the shovels of the drying drum with a diameter of 3.2 meters, fine dirt and dust from the fiber are released into the air. He then encounters the next pieces of cotton falling from the top and mixes them up.

An aerodynamic system was developed to remove small contaminants and dust from the air inside the drying drum, and the need arose to determine the aerodynamic regimes and geometric dimensions of the pipes in the contaminant transfer pipes. In this case, the mesh surface of the drying drum should be evenly distributed along the length of the mesh, and the air in the pneumatic system should not be chaotic, rotational movements, and the air speed should allow a stable transfer of impurities.

To accomplish this task, a diagram showing the movement of two media (dust-air mixture) along right-angled or twisted-shaped horizontal pipes assembled with the following several side channels (pipes) was considered. The main task is to determine the bending angles xp of the horizontal main channel pipeline and to determine the 2π angles of assembly of the side channels (pipes and other mechanical and geometric forms of flow). This work was performed on the basis of an incompressible fluid model using complex variable function methods [2]. It is recommended to consider the secondary flow i.e. the potential flow and assume that the movement of the mixture is stationary.

There are scientific studies [11, 12] on the theory and local solution of cotton mixture drop-style reading. Analytical formulas have been formulated to determine the basic hydroaerodynamic and other parameters of the liquid phase mixtures produced in the production of single-phase zone without exporting phase changes to participate in the production process of droplet variables [13, 14].

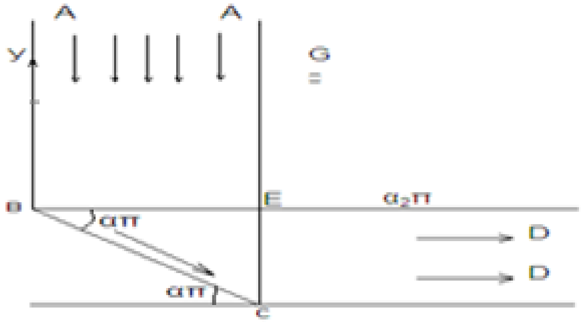

Figure 1. Leakage area

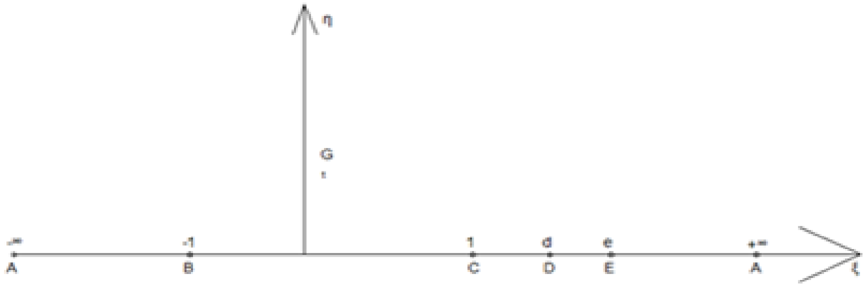

Figure 2. Canonical area

By a special method, we determine the secondary measurement of the liquid mixture (two media) droplet flow according to the scheme shown in Figure 1.

The theory of stable liquid droplets is used, using the theory of complex change function [10] to ensure equal distribution of the two media (dust-air mixture) down the vertical channel (Fig. 1 on the BE parameter). This is done in a parametric form. In the center of the auxiliary field, the above C_t (Figure 2) is taken $t = \xi_{ti\eta}$ variable parameter.

This task is performed using the reflection of the field C_t (Fig. 2) at the complex potential $+W_{(t)} = \varphi + i\psi$ and using the Zhukovsky function.

$\omega_{n(t)} = \tau + i\theta$ or $\omega_{n(t)} = \ln F(\rho_{n1} \upsilon_n)\, e^{i\theta}$

$i = \ln \frac{V_{n0}}{V_n} = \ln F(\rho_{n1}\, \upsilon_n)$ $\theta_{(t)}$- vector angle φ - velocity potential,

ψ- current function.

$$F(\rho_{n1}\upsilon_n) = \sqrt{\frac{\rho_1 V_{10}^2 + \rho_2 V_{20}^2}{\rho_1 V_1^2 + \rho_2 V_2^2}} = \frac{V_{n0}}{V_n}$$

$$\left(n = \overrightarrow{1,2}\right)$$

In the single-phase (single-plane) liquid state $\omega(t) = \ln \frac{V_0}{V} + i\theta, m, e$ that is

$F = (\rho_n, V_n) = \frac{V_0}{V}.$ $V_0 = const.$

In this case $V_n(t)$ the product of the function on *t* is as follows

$$\frac{dW_n}{dt} = -\frac{q_n}{\pi(t-d)} \qquad (3)$$

$\omega_n(t)$ Using the finite values of the Zhukovsky function, we obtain:

$$J_m\omega_n(t) = \begin{cases} -\infty < \xi < -1, \eta = 0;\ -\frac{\pi}{2} \text{conditions} \\ -1 < \xi < 1, \quad \eta = 0;\ -\alpha\pi \text{ conditions} \\ 1 < \xi < d, d < \xi < e, \eta = 0;\ 0 \text{ conditions} \\ e < \xi < \infty, \eta = 0;\ -\frac{\pi}{2} \text{ conditions} \end{cases}$$

From here we obtain the following according to the Schwartz integral formula [4] for each phase velocity. $\omega_n(t) = \frac{1}{\pi}\int_{-\infty}^{+\infty} \frac{J_m\omega_n(t)}{\xi - t}$

In the spread view

$$\omega_n(t) = \frac{1}{\pi}\left[-\frac{\pi}{2}\int_{-\infty}^{-1} \frac{d\xi}{\xi - t} - \alpha\pi \int_{-1}^{1} \frac{d\xi}{\xi - t} - \frac{\pi}{2}\int_{e}^{\infty} \frac{d\xi}{\xi - t}\right]$$

The complex velocity expression that is reflected at that time will have the following appearance.

$$V_n = V_{n0}\frac{(t-1)^{\alpha}(t+1)^{\frac{1}{2}-\alpha}}{\sqrt{t-e}} \qquad (4)$$

For geometry using (3) and (4)

$$\frac{dz}{dt} = -\frac{F}{\pi} * \frac{\sqrt{t-e}}{(t-1)^{\alpha}(t+1)^{\frac{1}{2}-\alpha}} * \frac{L_A}{t-d} = -\frac{F}{\pi}\sqrt{\frac{t-e}{t+1}} * \left(\frac{t+1}{t-1}\right)^{\alpha} * \frac{L_A}{t-d} \qquad (5)$$

$F = \frac{V_n}{V_{n0}} = \sqrt{\frac{\rho_1 q_1^2 + \rho_2 q_2^2}{\rho_1 V_{10}^2 + \rho_2 V_{20}^2}}$ especially at the beginning of the channel $F = L_A =$ H conditions if $q_n = HV_{n0}f_n$, at that time

$$F = H\sqrt{\frac{(1-f_2)^2+f_2^2 g}{1+g}} \qquad (6)$$

V_{10}, V_{20} - (AA) at the beginning of the channel (Figure 1) phase velocity.
Here H=L_A- width of vertical channel (Figure 1)

$g = \frac{\rho_2}{\rho_1}\left(\frac{V_{20}}{V_{10}}\right)^2$ $f_1 + f_2 = 1,\ f_1, f_2$- phase concentration:

Formula (5) for geometric recommendations of flow and we will have a spreadsheet using from $dt = dx + idy = c_1 f(\xi, \eta) * (d\xi + id\eta)$

$$dx + idy = c_1 \frac{[(\xi - e) + i\eta]^{\frac{1}{2}}[(\xi - d) + i\eta]^{-1}}{[(\xi - 1) + i\eta]^{\alpha}[(\xi + 1) + i\eta]^{\frac{1}{2}-\alpha}} * (d\xi + id\eta)$$

From (5) we obtain the following view based on the connection between the flexible BC wall and the BE channel width:

$L_{BE} = L_{BC}\cos\alpha\pi,\ L_{BE} = |L_{BE}|,\ \ L_{BC} = |L_{BC}|$ (8)

$L_{A=}\ L_{BE} = const$ (c 3m)

It is then important to determine the reflection parameters d, e and α and check the velocities of the parts along the vertical walls along the lengths AB and EA. They should be the same at any point in the interval. -∞ $< t < -1$ along the AB length (axis) and e$< t < +\infty$ along the EA length (axis). In particular, in the case where $t = -1{,}5$ EA along the length (axis) of AB is assumed to be $t = 1{,}2$ along the length (axis), $V_{BA}(-1.5) = V_{EA}(1.2)$ at these points. Only in this case the mixture is absorbed evenly across the width of the vertical channel (BE=AA).

Conclusion

Formulas for determining the geometric dimensions of pneumatic pipes have been developed, which allow to absorb the same amount of dirt and dusty air along the length of the cleaning section of the drying drum.

They can be used to design a system that absorbs dirt and dust from the drum. This requires a series of experiments to determine the size of the fraction of pollutants in the air and their aerodynamic parameters.

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