E CONF SERIES
International Conference on Modern Science and Scientific Studies
Hosted online from Madrid, Spain
Website: econfseries.com 20th March, 2025

THE EFFECT OF AIR FLOW ON A COTTON BALL IN A SEPARATOR DEVICE

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Abstract

This article discusses issues related to improving methods for effectively separating cotton from air streams during the cotton cleaning process. Factors influencing separator efficiency have been analyzed, and structural solutions are proposed that ensure safe and high-quality cotton separation. Research outcomes significantly contribute to increasing separator efficiency and reducing energy consumption.

Keywords: cotton separator, airflow, cotton separation, separator efficiency, structural solutions.

In the technology of primary cotton processing, the separation process is one of the important factors. Because the transportation of cotton in bundles to the ginning process is carried out using a high-speed air flow. At a certain distance, cotton pieces are separated from the air gap using a separator. In existing separators, cotton pieces entering the working chamber with air hit the mesh surfaces, blocking the air exits, as a result of which the work efficiency decreases. At the same time, damage to the fiber and seeds is observed in the working chamber of the separator as a result of the impact of cotton pieces with seeds on the working parts and walls of the chamber.

First of all, we will provide information about the forces acting on objects by air flow. The properties of air flow, their interaction forces with objects, have been thoroughly studied in the science of hydrodynamics. Under the influence of the flow, an aerodynamic force is created on the object depending on the flow velocity. If the flow velocity is not high, the value of this force is usually proportional to the air and object velocities. Let us assume that the trajectory equation of the object in a two-dimensional system under the influence of the air flow is $y = y(x)$ and BC Let the current move in a curved line (figure). The velocity vector of the current $\vec{V}_0 = \{V_{0x}, V_{0y}\}$, particle velocity vector $\vec{V} = \{V_x, V_y\}$ We denote by . $\vec{V}_0$ If we determine the angle formed by the vector with the OAX, then using the image

$$V_{0x} = |\vec{V}_0| \cos\alpha_0 \ , \ V_{0y} = -|\vec{V}_0| \sin\alpha_0 \qquad (1)$$

we form the equations. The air resistance force vector $\vec{F}(V_{0x} - V_x, V_{0y} - V_y)$ The relative velocity of a particle according to the law of aerodynamics $\vec{V}_0 - \vec{V}$ is directed along the vector. If the modulus of this force is $|\vec{F}(V_{0x} - F_x, V_{0y} - V_y)|$,

$$|\vec{V}_0 - \vec{V}| = \sqrt{(V_{0x} - V_x)^2 + (V_{0y} - V_y)^2}$$

If we define it as , then the force exerted by the air flow can be written as the following vector

$$\vec{F}(V_{0x} - V_x, V_{0y} - V_y) = |\vec{F}(V_{0x} - F_x, V_{0y} - V_y)| [\frac{V_{0x} - V_v}{|\vec{V}_0 - \vec{V}|} \vec{i} + \frac{V_{0y} - V_y}{|\vec{V}_0 - \vec{V}|} \vec{j}]$$

$(\vec{i}, \vec{j})\, OX$ va OY oare unit vectors directed along the axes. Thus, the force exerted by the air flow on the axes and are expressed by the following formulas

$$F_x = |\vec{F}(V_{0x} - F_x, V_{0y} - V_y)| \frac{V_{0x} - V_v}{|\vec{V}_0 - \vec{V}|},$$

$$F_y = |\vec{F}(V_{0x} - F_x, V_{0y} - V_y)| \frac{V_{0y} - V_y}{|\vec{V}_0 - \vec{V}|} \qquad (2)$$

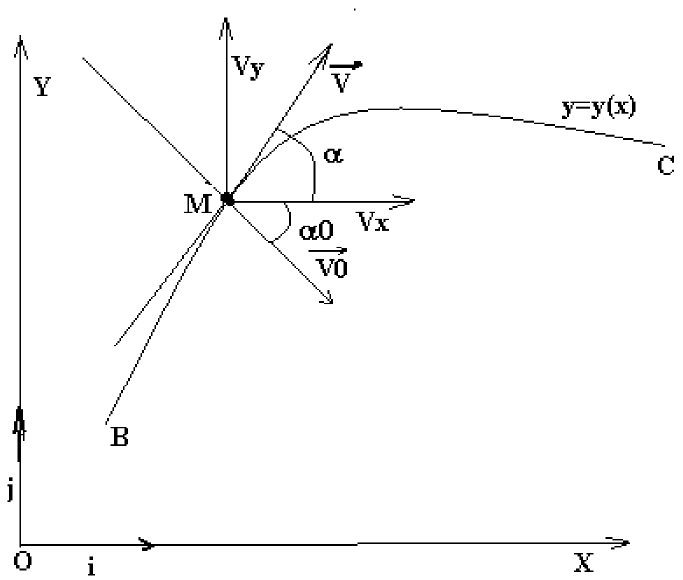

Diagram of the movement of a cotton ball under the influence of air flow

Let us assume that air resistance is proportional to relative velocity, then the law of force vector dependence on relative velocity is as follows:

$$\vec{F}(V_{0x}-V_x,V_{0y}-V_y)=C_0(\vec{V}_0-\vec{V})$$

C_0 - coefficient determined by experiment.

The modulus of this force is given by this formula $\left|\vec{F}(V_{0x}-F_x,V_{0y}-V_y)\right|=C_0$

$$\sqrt{(V_{0x}-V_x)^2+(V_{0y}-V_y)^2}$$

is expressed by , and its projections on the coordinate axes are as follows $F_x = C_0$

$$\sqrt{(V_{0x}-V_x)^2+(V_{0y}-V_y)^2}\,\frac{V_{0x}-V_v}{\left|\vec{V}_0-\vec{V}\right|}=C_0(V_{0x}-V_x) \qquad (3)$$

$$F_y = C_0\sqrt{(V_{0x}-V_x)^2+(V_{0y}-V_y)^2}\,\frac{V_{0y}-V_y}{\left|\vec{V}_0-\vec{V}\right|}=C_0(V_{0y}-V_y) \qquad (4)$$

(3) and(4) formulas can be used in practice when the speed of the air flow is small. Now let's assume that the force of the air flow is proportional to the square of the relative speed, that is,

$$\vec{F}(V_{0x}-V_x,V_{0y}-V_y)=C_1(\vec{V}_0-\vec{V})^2$$

Here C_1- coefficient found through experience.

We find the vector modulus using the square property

$$\vec{F}(V_{0x}-V_x,V_{0y}-V_y)=C_1[(V_{0x}-V_x)^2+(V_{0y}-V_y)^2]$$

(2) The formula, in this case, takes the following form:

$$F_x = C_1[(V_{0x}-V_x)^2+(V_{0y}-V_y)^2]\frac{V_{0x}-V_v}{\sqrt{(V_{0x}-V_x)^2+(V_{0y}-V_y)}}=$$

$$=C_1(V_{0x}-V_x)\sqrt{(V_{0x}-V_x)^2+(V_{0y}-V_y)^2}\,, \qquad (5)$$

$$F_y = C_1[(V_{0x}-V_x)^2+(V_{0y}-V_y)^2]\frac{V_{0y}-V_y}{\sqrt{(V_{0x}-V_x)^2+(V_{0y}-V_y)}}=$$

$$=C_1(V_{0y}-V_y)\sqrt{(V_{0x}-V_x)^2+(V_{0y}-V_y)^2} \qquad (6)$$

(5) va (6) The formulas are valid for high-velocity flows.

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