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CAUSES OF DAMAGE TO THE RAW COTTON IN THE PNEUMATIC TRANSPORT SYSTEM AND WAYS TO REDUCE IT

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ABSTRACT

This article examines the occurrence of seed damage during the transportation of raw cotton to the production shops and the occurrence of defects that affect the quality of fiber on these indicators, and conducted research to reduce the increase in fiber defects.

KEYWORDS: *Fiber, Product, Quality, Damage, Defect, Warehouse, Raw Material, Coating, Elastic Sheet, Vacuum Valve, Cotton Swab, Separator, Pneumatic Conveyor, Pipeline, Working Chamber.*

INTRODUCTION

The process of transportation of raw cotton in ginneries is carried out using a pneumatic transport device. In addition to the process of transporting the pneumatic transport device, cleaning of heavy mixtures and separation of air-transported cotton from the air is also carried out. A piece of cotton enters the working chamber of the CC-15A separator through a horizontal pipeline along with the air, then loses its speed due to volumetric expansion and the raw material is separated from the air. Cotton pieces moving at a certain speed hit the back wall of the separator working chamber, partially damaging the cotton fiber and seeds, and the defects in the fiber content increase.

The main cause of seed breakage and fiber damage is the large angle of rotation (150°) of the rear wall of the separation chamber and the radius of curvature R Fig. 1. The presence of a maximum bending angle (90°) at the bends of the conduit has a strong effect on fiber damage and seed breakage. In this study, the problem of reducing the force of impact is solved on the basis of theoretical conclusions and is found in the following formula.

$P = m \bullet W$ (1)

Here:

m - is the mass of the raw cotton;

W - is the acceleration of the cotton raw material.

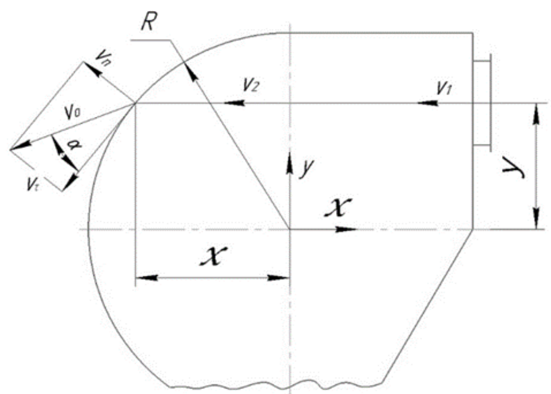

Figure 1. A directional diagram representing the rate of collision of cotton with the inner surface of the separator working chamber.

Acceleration is defined by the following expression.

$W=\frac{V_2-V_1}{\tau}$ (2)

Here:

V_1 - is the velocity of the raw cotton at the entrance to the separator;

V_2 - is the velocity flow of the raw cotton after it is released from the air;

τ - is the time of movement of the raw cotton from the entrance to the impact.

Once the raw cotton is released from the air stream when it collides with the surface, its velocity is formed from the components of the velocities V_n (normal) and V_r (touch). The figure shows the equality of these components.

$V_n = V_0 \bullet \sin\alpha$, (3)

$V_r = V_0 \bullet \cos\alpha$, (4)

Here:

V_0 - is the absolute velocity separator after the cotton raw material hits the inner wall surface;

α - is the angle between the resulting angle of contact.

After hitting the raw cotton surface, its condition depends on the magnitude of the impact force. The impact force is directly proportional to the normal component of the velocity of the raw cotton.

Thus, to reduce the force of impact, it is necessary to reduce the angle α between the tangential component and the resulting A, the change in angle α depends on the distance X and Y, i.e., as the distance X decreases, as Y increases, α decreases. In the future, we recommend that this pattern be taken into account when designing separators.

At ginneries, one of the main types of transportation of cotton from the gin to the production shops and between shops is pneumatic transport. In addition to the many advantages of pneumatic transport over other modes of transport, there are also some disadvantages in the separation of air from the air transporting raw cotton by air transport.

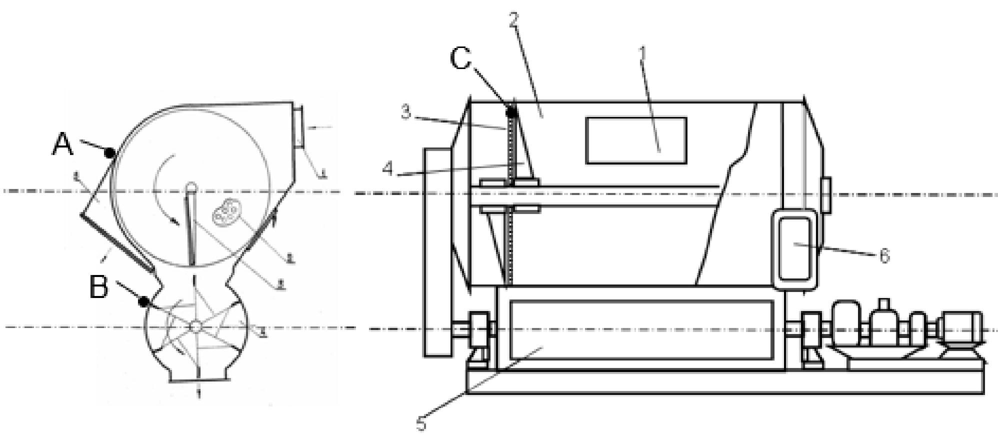

Figure 2. 1 inlet short pipe, 2 isolating chamber, 3 mesh surface, 4 nozzles, 5 vacuum valves and 6 air ducts.

When the separator is running, the main part of the cotton that enters the raw material chamber moves by inertia and falls into the vacuum valve, and a part of it hits the mesh surfaces of the discs mounted on the sides of the chamber and sticks to it. The raw material is cleaned from the mesh surface with the help of elastic scrapers. The raw material of cotton enters the gap between the elastic blade of the drum and the steel surface of the coating through the outlet network of the separator vacuum valve.

ACADEMICIA

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The blades of a vacuum valve drum rotating at a certain speed hit the raw cotton surface on the coating surface, resulting in the seed being crushed or broken, as well as the fibers being damaged and the defects in the composition increasing.

The main cause of seed and fiber damage is the coating profile of the vacuum valve located at an angle α to the horizontal axis of the drum. In this paper, on the basis of theoretical considerations, the interaction of the cotton raw material with the drum blade and the steel surface of the separator vacuum valve is investigated.

The following forces affect the movement of cotton during unloading (Figure. 3).

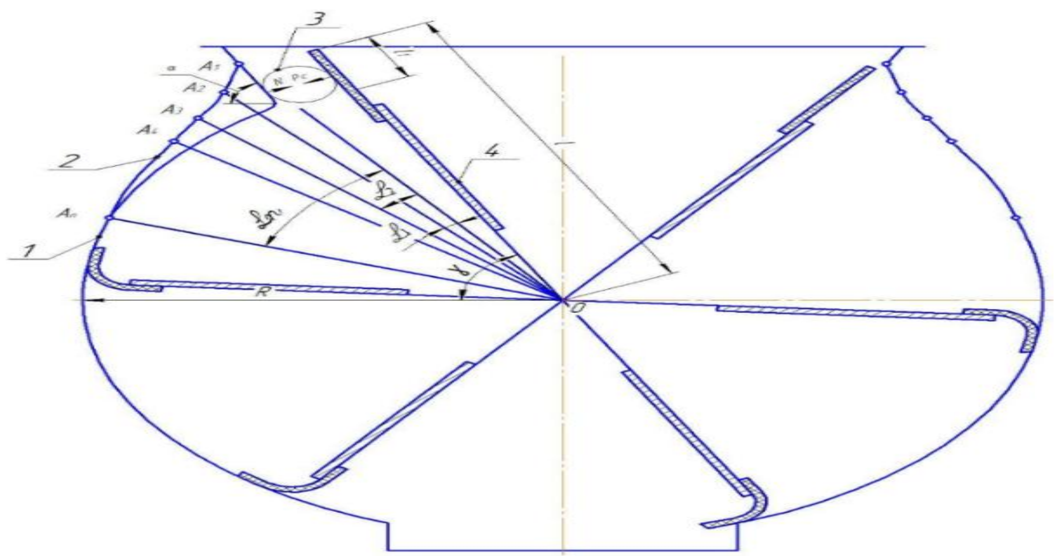

Figure 3. Vacuum valves

1 vacuum valve cover; 2 parabolic profile; 3 a piece of cotton; 4 vacuum valve blades.

We design all the moving forces on the horizontal axis,

$\Sigma_X = N \cdot \sin\alpha - P_c \cdot \sin\gamma = O$,

Here:

α- **is the angle between the vacuum valve cover and the horizontal axis of the drum;**

γ - **is the angle between the blades and the horizontal axis of the drum;**

N - **is the reactive force acting on a piece of cotton raw material on the coating surface;**

P_c **- is the force acting on the cotton swab by the vacuum valve blade.**

From this equation we determine the reactive power

$$N = \frac{P_c \cdot sin\gamma}{sin\alpha}.$$

It can be seen that the force Pc and the angle of its inclination to the horizontal axis of the drum affect the magnitude of the reaction force on the body surface of the vacuum valve.

The force acting on a piece of cotton

$P_c = F \cdot f$,

Here:

F- is the force acting on the vacuum valve blade per unit of contact area;

f - is the contact area of the blades with the body of the vacuum valve during forging.

As the contact area decreases, the force acting on the *f* cotton raw material decreases.

To reduce the contact area *f*, a parabolic shape of the curved part of the vacuum valve cover is recommended. The working vacuum valve blade length of the separator.

$l = R + l_1$

Here:

R - is the coating radius of the vacuum valve;

l_1 - is the length of the blades that interact with the surface of the vacuum valve cover.

The high point of the parabolic profile is defined by the expression A_1

$OA_1 = R + l_1$

The next points are at a distance of 1°.

$\alpha_n = 10°$ in $OA_n = R$

By linking the points found, we obtain a parabolic profile.

It is assumed that no contact area is formed when the tip of the vacuum valve leaf approaches the surface of the parabolic coating. As a result, the cotton material does not fall between the drum blades and the coating of the vacuum valve on the steel surface.

Thus, the results of theoretical research can be used to improve the vacuum valve.

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