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IMPROVEMENT OF 1XK CLEANING TECHNOLOGY IN THE PROCESS OF CLEANING SEED COTTON FROM SMALL IMPURITIES

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Abstract

This article is about the national process of processing raw cotton with a variety of problems in cleaning large and small scum. In order to find solutions to this problem, it has been determined by the analysis of the effectiveness of the small-scale cotton-fertilization technology for other cotton fertilizers compared to other models.

Keywords: 1XK; cotton seed; raw material; cleaning; humidity; small and large mixtures; drying; drum with a stake.

Introduction

Today, cotton cleaning equipment of the 1XK and 6A-12M models is widely used in the cleaning departments of cotton gins. The advantage of 1XK equipment over other equipment is the high efficiency and cleaning efficiency. Also, 1XK equipment is relatively easy to service and repair.

If we take into account that the main cotton raw materials grown in our republic correspond to high varieties, and they contain 8-9% moisture, they are dried using cold air or are not passed through drying drums at all. When moisture is 9-10%, raw cotton is processed in drying drums to remove 1-2% moisture. Drying cotton with this method is very expensive. Drying cotton in this way does not meet the requirements for production today. Therefore, it is urgent to carry out the process of drying cotton raw materials with such humidity in other ways.

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The aim of the diploma project was to improve the 1XK cleaning equipment based on the drying process of cotton raw materials in the equipment for cleaning small impurities.

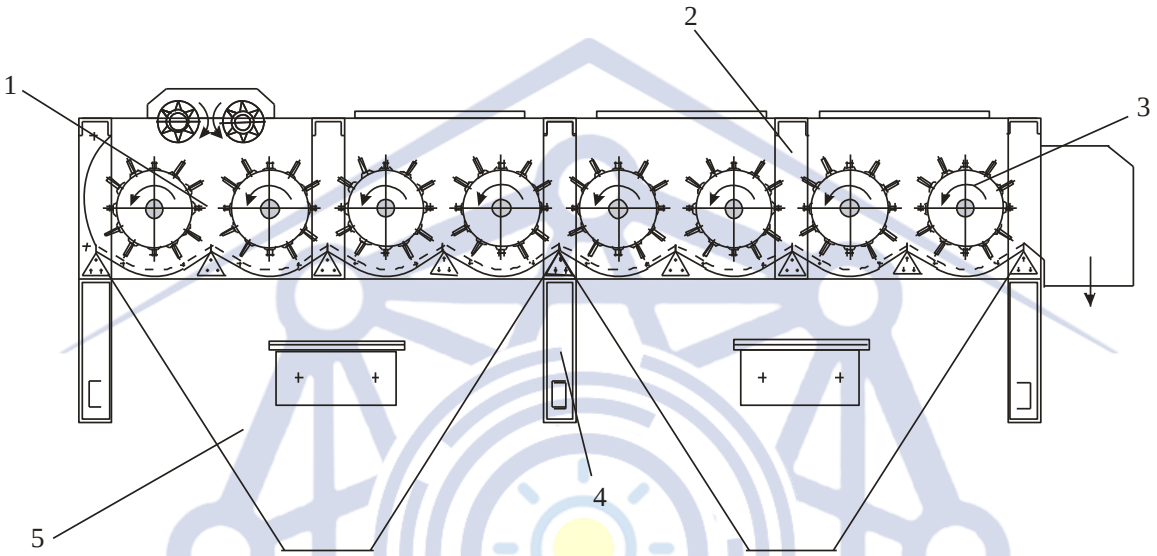

Figure 1. 1XK model cleaning from small impurities, scheme of the equipment 1- primary normalized pile section YeN. 178.01 (with supporting rollers); 2nd column; 3- standard pile section EN. 178.02; Column 4, bunker.

1XK main cleaning equipment technical indicators:

1. Productivity: 5.0 ÷7.0 t/h
2. Rotation speed:
a) supply roller: 0 ÷14 rev/min
b) drum with a pile: 480 rev/min
3. Technological distance (different surface with pile drum spacing): 14÷20 mm
4. Cleaning efficiency: 45÷50 %

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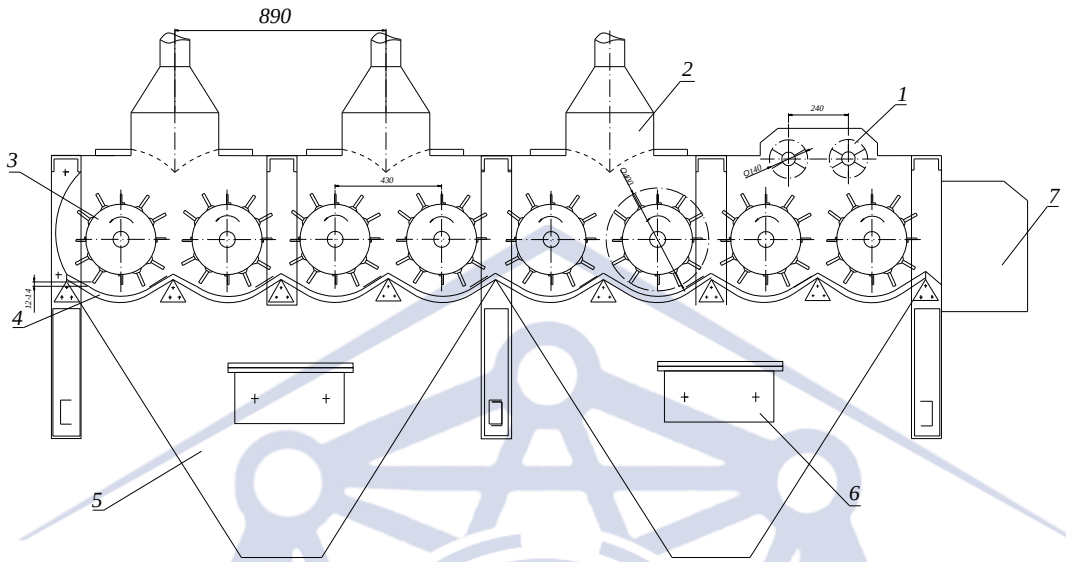

Figure 2. Cross-section diagram of 1XK equipment with proposed dry-cleaning processes
1. supply rollers, 2. hot air supply pipe, 3. pile drum, 4. mesh surface, 5. dirt hopper, 6. hole, 7. outlet throat.

I made improvements to the equipment: we proposed drying cotton with low moisture content (8-9%) by blowing hot air over pile drums of the equipment for cleaning seeded cotton from small impurities.

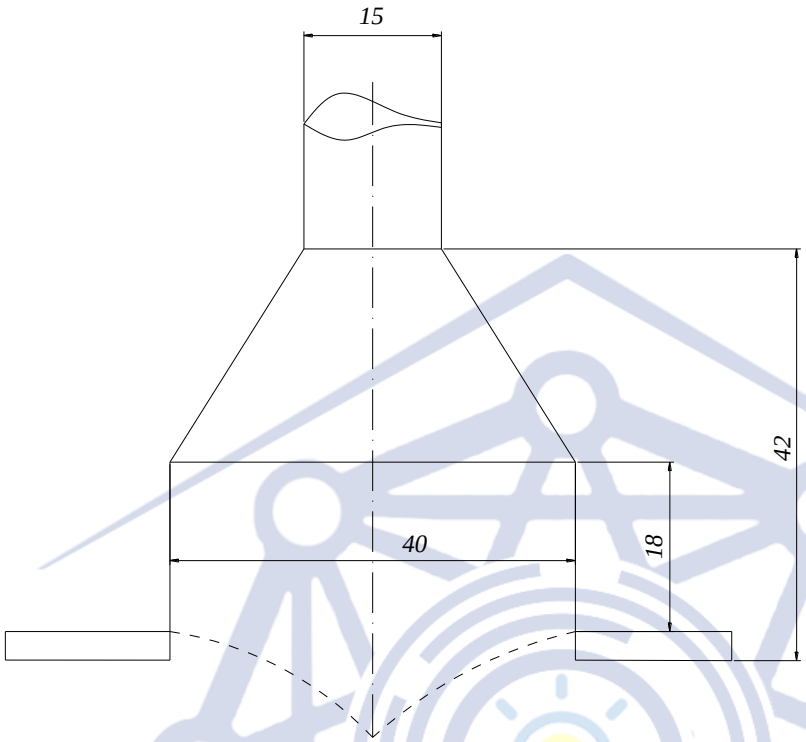

Figure 3. Scheme of the heat supply pipe to the 1XK cleaning equipment.

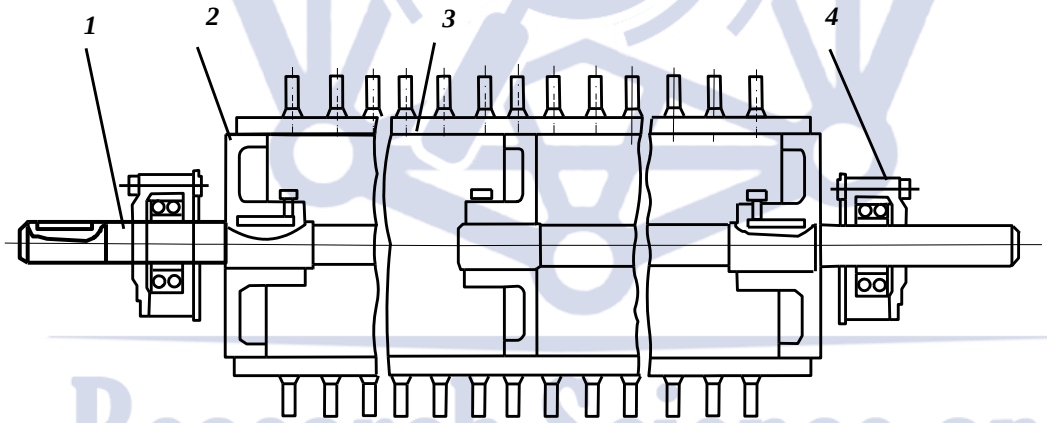

Figure 4. Cross section of an improved pile drum; clipping scheme
1st shaft; 2- basis; 3- pegs; 4- bearing.

1XK pile drum shaft strength calculation

We accept:

n=480 rpm

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N=4.0 kW (only for pile drum transmission)

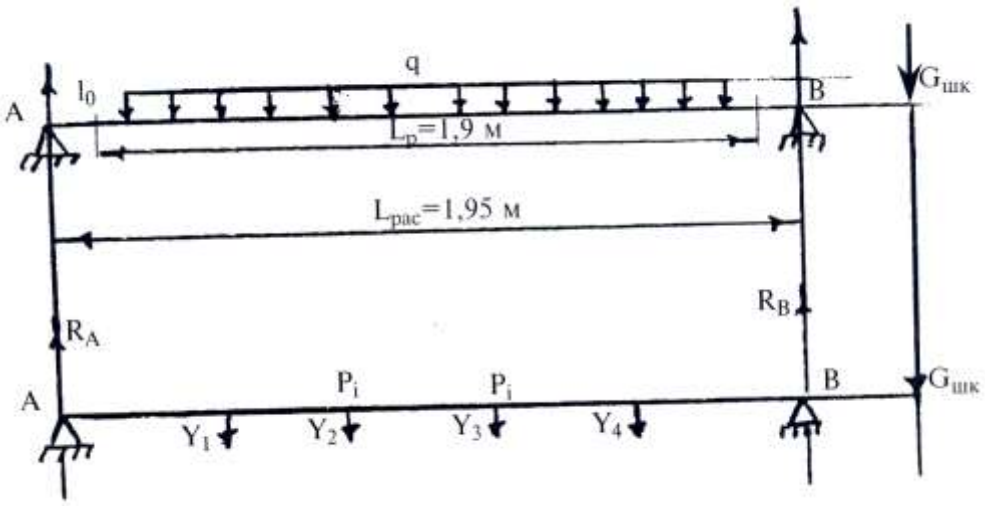

Figure 5. Calculation scheme of the drum

$G_1=G_2=G_3=G_4=430$ H

$S_1=Q_p*\sin a=20*\sin 20^0=68$ H

In the vertical plane

$$G_1 \bullet a + G_2 \bullet 2a + G_3 \bullet 3a + G_4 \bullet 4a - 5a \bullet R_в + G(5a + в) + S_1(5a + в) = 0$$

$$R_в = \frac{224460 + 448920 + 673380 + 897840 + 210730 + 19108}{2610} = 948 \ H$$

$$\sum MB = 0$$

To calculate the epura, we calculate the forces separately by parts:

1) $0 \le X_0 \le a$ part

$$M_1 = R_1 \bullet X_1 = 854 \bullet 0{,}522 = 446 \quad Нм$$

In the horizontal plane

$$Q_1 \bullet a + Q_2 \bullet 2a + Q_3 \bullet 3a + Q_4 \bullet 4a - R_в \bullet 5a + S_2(5a + в) = 0$$

$$R_в = \frac{6520 + 13050 + 19570 + 25100 + 39370}{2610} = 265 \ H$$

$$\sum MB = 0$$

$$S_2 \bullet в + Q_1 \bullet a - Q_2 \bullet 2a - Q_3 \bullet 3a - Q_4 \bullet 4a - R_a \bullet 5a = 0$$

$$R_a = \frac{65250 + 130500 + 19570 + 26100 - 250}{2610} = 249 \ H$$

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Checking account $\sum Q_i = R_a + R_в = 514 \quad H$

To make a diagram of moments of force, we calculate by parts: We determine the total bending moment:

1) $0 \le X_0 \le a$ part $M_1 = 130 \quad Нм$

2) $a \le X_2 \le 2a$ part $M_2 = 198 \quad Нм$

To build a diagram of moments of force, we calculate by parts:

$$M^{кз}_{умумий} = \sqrt{M^2_{гор} + M^2_{верт}} = \sqrt{667^2 + 98^2} = 696 \quad Нм$$

We determine the torque from the following formula:

$$M_{кр} = 0{,}7\frac{N}{n} = 0{,}74 * \frac{2{,}2 * 100}{280} = 58{,}14 \quad Нм$$

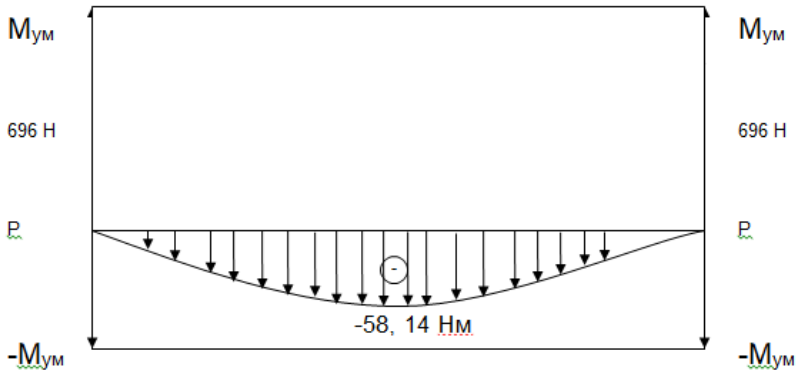

Figure 6. Kinematic calculation of the 1XK small dirt cleaning machine

Given:

R=4 kW

ndv=1368 rpm

d1=140 mm

d2=400 mm

The rotation frequency of the pile drum

$$_7 n_2 = \frac{n_{ов}}{i_1} = \frac{1368}{2{,}85} = 480 \quad айл/мин$$

n_4=0-14 rpm

Transmission number:

$$i_1 = \frac{d_2}{d_1} = \frac{400}{140} = 2{,}85$$

Pover:

$$P_1 = P_{qв} = 4кВт$$

$$p_{гб1} = P_1 * n_p = 4 * 0{,}98 = 3{,}98 \quad кВт$$

$$P_3 = 4 * 0{,}98 = 3{,}98$$

$$P_4 = 4 * 0{,}98 = 3{,}98$$

Torque of shafts

$$T_1 = 9550\sqrt{\frac{p_{дв}}{n_{дв}}} = 9550\sqrt{\frac{4}{970}} = 39{,}3 \quad Нм$$

$T_1 = T_2 = T_3 = T_4 = T_5 = T_6 = T_7 = T_8 = 39{,}3$ Nm

Improved equipment performance calculation

The productivity of supply rollers

$P = 3{,}6 \cdot 10^{-3} \cdot S_3 \cdot L \cdot p_x \cdot v_v \cdot k_e$, kg/h.

Here:

S_3 - the distance between the supply rollers, mm;

L - the length of the supply rollers, mm;

p_x - the density of seeded cotton between the supply rollers, kg/m^3;

v_v - rotation speed of supply rollers, m/sec;

k_e - the coefficient of interception of seeded cotton by bollworms.

$P = 3{,}6 \cdot 10^{-3} \cdot S_3 \cdot L \cdot p_x \cdot v_v \cdot k_e = 3{,}6 \cdot 10^{-3} \cdot 190 \cdot 200 \cdot 20 \cdot 1 = 7600$ kg/h

Calculation of the cleaning efficiency of the equipment.

The cleaning efficiency of the equipment depends on the weight of the small impurities in the seed cotton.

$k = d_{sp} / g_1 \cdot 100\ \%$

Here:

d_{sp} - the mass of small impurities released during the cleaning process, g;

g_1 - the mass of small impurities in seed cotton, g

Cleaning efficiency is determined by the following formula:

$$K = \frac{C_1 - C_2}{C_1} \cdot 100\%$$

Conclusions

In order to improve the technological processes of the 1-XK small dirt cleaning machine, scientific research work was conducted and analyzed in the conditions of production. The results showed that small impurities (soil and cotton leaf particles) mixed with air in the air flow from the first pile drum were found to move to the next sections and fall back into the cotton. In order to study these problems, a device for absorbing the air generated during the rotation of the drum on the upper part of the first pile drum was prepared and experimental tests were conducted.

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