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Theoretical Principles of Seeded Cotton Drying

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Annotation: In the process of drying raw cotton, it is necessary to analyze such factors as preserving the natural properties of raw cotton, preventing its miscegenation, reducing whiteness, high productivity of equipment, and selecting the main parameters of new equipment for drying top-grade cotton.

Keywords: humid air, energy, raw cotton, heat, productivity, mechanical growth, cleaning quality, dirt, fiber, drum, grade.

INTRODUCTION

In order to maintain the natural quality indicators of cotton fiber, it is necessary to equip cotton ginning enterprises with new, improved, low-energy techniques and technologies based on science. Currently, 80-85 percent of the cotton raw material grown in our Republic of Uzbekistan is high-grade cotton. This, in turn, is one of the urgent issues of drying and cleaning of high-grade cotton in special new modern low-energy drying and cleaning equipment while maintaining the natural quality indicators. Drying of high-grade cotton in currently used 2SB-10, SBT, SBO drying drums is one of the main reasons for burning of cotton fiber, resulting in 25% mechanical damage of fibers and high energy consumption in subsequent technological processes, discoloration of cotton, and smelling. Therefore, it is considered an urgent issue to study the main factors affecting the high efficiency of drying and cleaning of high-grade cotton raw materials in special new equipment.

I. We will perform an analytical calculation of heat consumption in the proposed drying equipment as follows

1. Productivity for wet seed cotton, G1 1 = 2000 kt/hour
2. Initial moisture content of seed cotton W1=12 %
3. Moisture content of dried seed cotton, W2=8,0 %
4. The temperature of the outside air. t0 =20 oS
5. Initial moisture content of the air supplied to the drying drum.
6. The heat of the air supplied to the dryer. t1=160oS, t1=80oS
7. The moisture content of the air leaving the drying drum is d2q30 gr/kg. dry the air
8. The temperature of seeded cotton fed to the drum. θ1 =20 oC
9. The temperature of the dry cotton coming out of the drum is θ2 =50 oS
10. Initial impurity content of seed cotton Z=12% Solving:

   1. Weight of moisture evaporated from the dryer in one hour

$$W_{вл} = G_1 \cdot \frac{W_1 - W_2}{100 + W_1};. W_{вл} = G_1 \cdot \frac{W_1 - W_2}{100 + W_1};.$$

Kg/ soat

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$$W_{вл} = G_1 \cdot \frac{W_1 - W_2}{100 + W_1} = 12000 \cdot \frac{12 - 8,0}{100 + 12,0} = 428,6$$

2. Dry cotton weight leaving the dryer

$$G_{цфл} = \frac{G_1 \cdot 3 \cdot K}{10000} = \frac{12000 \cdot 12 \cdot 20}{10000} = 288 \text{ кг/соат}$$

$$G_2 = G_1 \cdot \frac{100 + W_2}{100 + W_1} - G_{цфл} = 12000 \frac{100 + 8,0}{100 + 12,0} - 288 = 11283,4 \text{ кг} \quad G_2 = G_1 * \cdot \frac{100 + W_2}{100 + W_1} - G_{цфл}$$

3. Dry air consumption to evaporate 1 kg of moisture is calculated using the following formula.

$$l = \frac{10000}{d_2 - d_1} \qquad l = \frac{10000}{d_2 - d_0} = \frac{10000}{30 - 5} = 40$$ kg/kg humidity

.

4. Total consumption of dry air

$$L = l \cdot Wвв = 40 \cdot 428,6 = 17142,86$$ Kg/hour

5. Volume of moist air.

m3/hour

where: - to calculate.

6. Specific heat used to evaporate 1 kg of moisture, (Jj/kg)

, kj/kg

$$q_1 = (i_n^{©©} - C_B \cdot \theta_1)$$

$$q_1 = (i_n^{©©} - C_B \cdot \theta_1) = (2609080 - 4187 \cdot 20) = 2564,7$$

where ip q 2491•103+1968• t2=2491000+1968•60=2648440 J/kg

7. Amount of heat needed to evaporate moisture, J/soat:

$$Q_1 = Wвв \cdot q_1 = 2564.7 \cdot 428.6 = 1099157,1$$ kJj/kg

8. Comparative heat consumption, (J/kg)

$$q_2 = L \cdot (944,83 + 1.97 \cdot d_2) \cdot (t_2 + t_c) = 40 \cdot (944.83 - 1.97 \cdot 30) \cdot (40 - 20) = 708,6$$

kJj /kg

where:

(944.83 $+1.97 \cdot d_2$) - heat capacity of the outside air. (J/kg·grad)

L_{chiq} - exhaust air consumption, kg/soat

9. The heat used to combine with the drying agent,(J/kg).

$$Q = W_{вл} \cdot q_2 = 468.6 \cdot 708,6 = 303678,9$$ kJ/soat

10. Comparative heat consumption, (J/kg)

$$q_3 = \frac{G_2 \cdot C_2 \cdot (\theta_2 - \theta_1)}{W_{by}}.$$

In this: S_s =1,6 kJ/kg.grad. S_v =4,19 Jj /kg. grad.

in that case.

$$q_3 = \frac{G_2 \cdot C_2 \cdot (\theta_2 - \theta_1)}{W_{by}} = \frac{11283.4 \cdot 1.792}{428.6} \cdot (50 - 20) = 1415{,}3 \quad \text{kJj /kg}$$

$$c_2 = \frac{100 \cdot C_c + W_2 \cdot C_в}{100 + W_2} = \frac{100 \cdot 1.6 + 8.0 \cdot 4.19}{100 + 8.0} = 1{,}792 \quad \text{kJj /kg grad.}$$

where: S_2 - heat capacity of loaded cotton, (J/kg. grad)

θ_1, θ_2 – Temperature of seeded cotton entering and exiting the drying drum, ^oS

11. Heat consumption of cotton entering the drum, (J/kg)

$$Q_3 = W_{вл} \cdot q_3 = 428.6 \cdot 1451.4 = 622028{,}6 \quad \text{Kj/soat}$$

13. Comparative heat consumption, (J/kg)

$$q_5 = \frac{K \cdot F \cdot (t_1 - t_t)}{W_{by}}$$

Kj/kg

$$q_5 = \frac{K \cdot F \cdot (t_1 - t_t)}{W_{by}} = \frac{160{,}5 \cdot 3{,}36 \cdot (160 - 40)}{428.6} = 151{,}0$$

where: o‘ - separate surface of the dryer's barrier areas, m^2

t_{ichk} - air temperature in the dryer, ^oS

t_{tash} - ambient temperature in the workshop, ^oS

K - coefficient of heat transfer through individual surfaces,(J/m^2* coat grad)

14. Heat loss to the environment surrounding the drum, (J/soat)

$$Q_5 = W_{вл} \cdot q_5 = 428.6 \cdot 151{,}0 = 64713{,}6 \quad \text{Kj/ kg}$$

15. Total heat consumption

$$\sum Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5$$

$$\sum Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5 = 1099157.1 + 911036.6 + 606547 + 0 + 64713{,}6 = 2040359$$

16. The sum of heat loss is equal to the following:

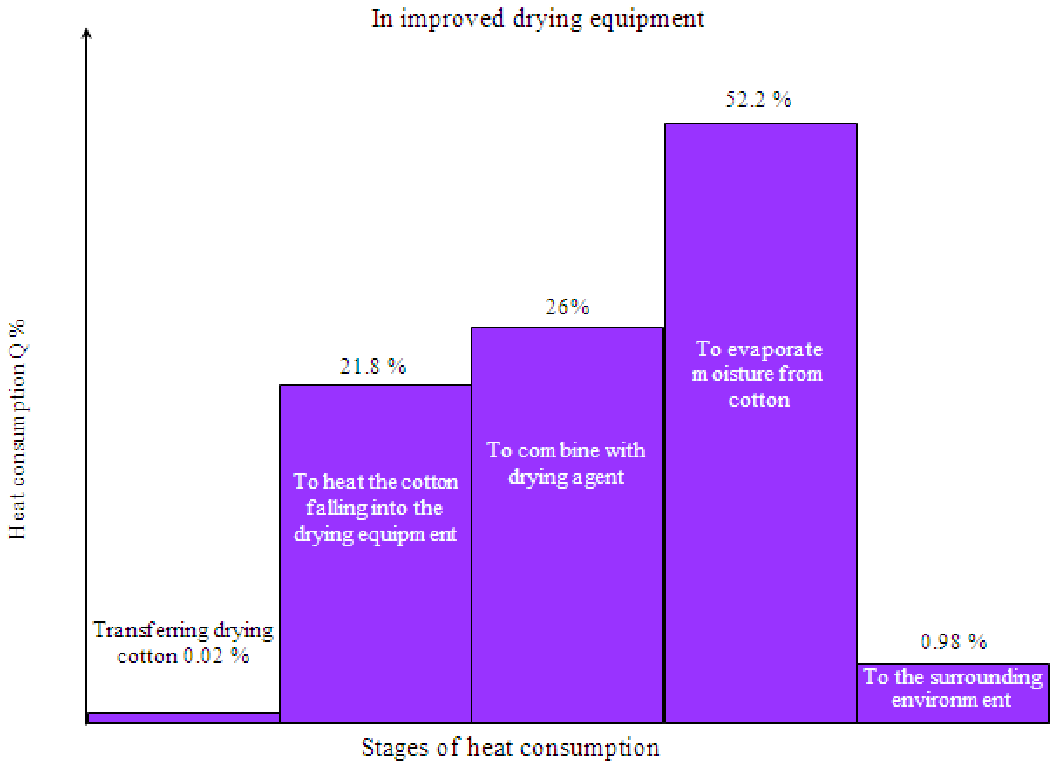
$$\sum q = q_1 + q_2 + q_3 + q_4 + q_5 \text{ kj/kg}$$

$$\sum q = q_1 + q_2 + q_3 + q_4 + q_5 = 2564.7 + 2125.8 + 1415.3 + 0 + 151.2 = 4760.8$$

17. Useful efficiency of the drying drum.

$$\eta = \frac{Q_1}{\sum Q} \cdot 100\% = \frac{1099157.1}{2040359} \cdot 100 = 52.2\%$$

$$\eta = \frac{q_1}{\sum q} \cdot 100\% = \frac{2564.7}{4760.8} \cdot 100 = 52.2\%$$



1-picture. Stages of heat consumption in new drying equipment

One of the factors affecting the performance of equipment and technology during the processing of seed cotton is its humidity. An increase in humidity leads to a decrease in dryer performance, humidity is less controllable, depending on the metrological conditions and condition of the seed cotton harvest.

Seed cotton moisture can fluctuate over a large range, making it difficult to maintain uniform moisture during initial preparation.

Low performance of drying drums in terms of material and humidity, insufficient heat supplied to them due to high initial moisture does not give the expected effect.

As we know, if the temperature of the material is lower than 500C, it will mainly have a diffusion character.

The upper part of the equipment was developed from theoretical and experimental research. It is attached (hinged) to the top of the mine guide with a spade separator. This forward and reverse movement is carried out by a motor reducer. Two 6 mm gaps are left for free swing of the shovel guide, length 1890 mm, height 250 mm. The blade guide is made of 3x4 mm steel sheet.

The middle part is the main part of the equipment. Its height is 4000 mm, length is 2000 mm. The width of the air chamber is 2200 mm, it has two parallel working air chambers. In addition, periodically alternating rollers and a mesh surface are installed at a certain distance (2-4 mm). The two sides of the mesh surface are curved and attached to the side walls. The diameter of the hole of the mesh surface is 5.5 mm, the intersection of the axes is 33%. The rollers are made of a tube with a diameter of 72 mm and bearings are installed on both sides. To get the movement, 4 rollers are installed in the form of stars at every meter of the height of the working camera, and these rollers can work separately to get a differential variable speed. As a result, it ensures uniform density of cotton according to the height of the working chamber of the equipment. The uniformity of the density ensures that the passage of air through the layers of the working chamber ensures the uniform extraction of moisture from the cotton.

At the bottom of the equipment, a drum with a separate pile and a mesh surface were installed for each working chamber to clean it from small impurities. The pile drum and mesh surface work the same way as the PD feeder. The drying agent enters between the cotton through the pipe of the air chamber from IICh-1.9. Air distribution and air velocity are determined in the working chamber by means of an anemometer with a coil. The average speed of air in the working chamber is equal to 1.5 m/s, air consumption Q=0000 m3/h.

The optimal mode and parameters of the equipment in checking the performance of the work are based on mathematical methods obtained in the experiments. The mode of operation of the equipment should ensure that the free moisture of seed cotton is ignited without heating, which depends on many factors and their interaction. Therefore, it is necessary to obtain additional experimental data for the optimal option of heating.

Currently, the mathematical planning method is used. It uses minimal time and money and helps to draw conclusions close to optimal solutions. In order to conduct experiments, first of all, it is necessary to determine the main factors and their level of vibration. In the filtration process of seed cotton, its moisture content, thickness of the layer and other factors were previously studied. It is necessary to study which of these has a greater effect on seed cotton during the same heating process.

Therefore, the most important factors obtained on the basis of theoretical experiments were determined, which must be included in the experimental plan. The width of the working chamber Δ mm determines the thickness of the seed cotton in the working chamber, and the faster heating in this place is faster if there is less layer of seed cotton, on the contrary, it is slower. The accepted upper level of 300 mm ensures uninterrupted operation of the equipment, the lower level is accepted as 150 mm. This was obtained from a technical point of view and on the basis of experiments. This ensures uniform heating of the seeded cotton layer. It is known from the results of the experiment that the initial moisture content of seed cotton significantly affects the progress of heating and moisture absorption of the dryer. Therefore, the initial moisture content of seed cotton was recognized as an important factor, and the fluctuation range was set at 9 to 12%. These levels take into account that seed cotton is picked by machine and by hand, and is produced under poor metrological conditions. It is necessary to prepare seed cotton in this interval for quick and intensive drying.

The accepted lower level ts.a=800C is equal to the maximum temperature of the heat carrier, in which the quality of seeded cotton does not deviate from the requirements set by the State Standards. The highest level received is ts.a=1600C.

One of the main operating characteristics of the equipment is its performance. From the results of the experiment, it was found that the productivity of pile drums is directly proportional to the frequency of rotation of pile drums, inversely proportional to the time spent in the working chamber of seeded cotton, which affects the technological parameters.

GENERAL CONCLUSIONS

1. The advantages of the existing methods and technical technologies for drying seeded cotton and the changes in the natural parameters of drying seeded cotton in one or more drying drums and the

excessive consumption of electricity were analyzed and the optimal options for the air temperature supplied to the new drying equipment were proposed.

2. In the process of drying cotton, its presence in working chambers and its effect on quality parameters were studied.
3. During the drying process of cotton, depending on its amount, the absorption of moisture and its effect on the process were determined.
4. The technical and technological parameters of the drying preparation equipment for drying high-grade seed cotton when the moisture content is 9-12% were recommended.
5. In order to protect labor in the dry-cleaning workshop, the safety of the equipment in the dry-cleaning department of PTK was ensured and measures for safe use were developed.

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