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Improving the transfer network of raw cotton to the drying drum.

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ABSTRACT: This article presents the results of scientific research on the study of the processes of drying raw cotton and considers the main problems existing in cotton processing enterprises. The influence of these technological parameters on the intensity of moisture extraction in the raw material and, as a consequence, the reduction in the duration of its drying has beyen investigated. A new design of the screw-type opener feeder is proposed.

KEY WORDS: Rawcotton, material, fiber, seeds, capilar, convective, drying agent, drying drum.

I. INTRODUCTION

Raw cotton is a material made up of three different components that are not identical in composition. These components include fibers, seed husks and pith. Cotton fiber and bark are capillary-perforated materials. The fiber is located along the surface of the seeds and is 97% cellulose. Depending on the type and variety, the fiber length is on average 25-50 mm, the thickness is 15-25 microns, and the thickness of the seeds is within 0.25-0.4 mm. In terms of chemical composition, the bark consists of 40-45% cellulose, 20-25% lignin, 28-30% lectazone, up to 3% protein, 2-3% dust (ash). The nucleus is composed mainly of fats and proteins. It contains carbohydrates, crystalline and colloidal sugars, pectin in a colloidal dispersed state. Seeds, by their nature, are colloidal materials, and by their composition, they are capillary-perforated materials. Raw cotton is a capillary perforated colloidal material intended for drying.

II. SYSTEM ANALYSIS

Due to the fact that the components of raw cotton are morphologically different, the moisture content in them is also different. When wet, raw cotton each of its components has a moisture content in accordance with its physical properties.

Scientists and specialists of PS "Pakhtasanoatilm" have determined the balance of moisture distribution between the components of raw cotton when stored in jars. As can be seen from Table 1, the relative amount of moisture corresponding to the fiber does not exceed 30% of the total moisture content in the raw cotton [1-2].

The nature of the mechanism of action of moisture depends mainly on the form of its contact with the components of cotton raw materials. Cotton fiber has mutual adsorption-capillary and mechanically bound moisture.

Table 1

Moisture among the components of raw cotton distribution,%

Raw cotton	Fiber	Nucleus	Pod
10	6.9	8.1	17.1
15	10.4	14.1	23.2
20	13.8	20.5	28.9
30	20.5	34.7	38.3

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The seed core contains mainly physicochemical bound moisture, which is transported by moist materials in the form of vapor or liquid. This moisture loss is slow and depends on many factors.

Table 2 shows the thermal and physical properties of the components of raw cotton. As can be seen from Table 2, the thermophysical properties of the seed kernel are much higher than that of other components of cotton raw materials. It can be seen that a small amount of heat is required to raise the internal temperature. This is very important when drying raw cotton. This condition makes it difficult to transfer heat to the seeds and negatively affects the loss of moisture in the seeds.

Table 2
Thermophysical properties of raw cotton components

Indicators name	Unit of measurement	Fiber	Pod	Nucleus
Balanced humidity	%	7.1	11.9	8.4
Relative weight	kg / m	1.52	0.38	1.62
Heat capacity	Kdj / kS	1.8	1.67	1.55
Heat capacity coefficient	W / mS	0.06	0.24	0.35
Moisture transfer coefficient	10 m / 2	0.90	1.3	0.035

When moisture is lost from the components of raw cotton, irreversible physico-colloidal and biomechanical changes occur. Therefore, the main issue when drying cotton is the preservation of the technological properties of the material. The moisture retention properties of raw cotton have a great impact on production and processing. Reducing humidity is achieved through the use of high temperatures in production and depends on the complexity of control. On the basis of experimental studies on the use of air (combined) drying of cotton seeds with hot air and short waves, a technological chart of temperature control has been theoretically developed and proposed for use in production [3].

A. I. Kulagin, N. A. Arifovoy According to research, the heating temperature of industrial seeds should not exceed 75°S, since an increase in temperature leads to a change in the protein content of seeds. Heating of cotton fiber should not exceed 105°S, exceeding the temperature leads to deterioration of its composition and deterioration of the viscosity and technological properties of the fiber. From the point of view of the drying process, cotton raw material is a complex material, since seeds with a humidity of more than 65% have a lot of conductive properties when heated low. The surface layer of seeds consists of heat-sensitive pulp that passes low temperatures, the quality of which is the criterion of the drying process. The effect of temperature on the drying rate was studied at temperatures of 20,35,50,75,100,120 and 130°S. After a few hours, the metabolic activity of moisture loss was observed. In addition, during the drying process, the moisture change of the fiber is faster because the fiber is in direct contact with the hot air, the husk change is slightly slower, the husk is protected by the fiber layer, slower in the seed core because it does not directly collide with the drying agent. Low moisture fiber with a large evaporation surface dries faster than seeds. Therefore, in the design of existing cotton dryers, moisture from fibers and seeds is not lost evenly. During the drying process, the fibers dry out, while the seeds do not dry out properly. As a result, during the subsequent processing, which cleans the raw cotton, overdried fiber breaks and insufficiently dried seeds are broken into pieces. This is reflected in the final output of the cotton factories. Thus, a uniform loss of moisture from raw cotton components is an important condition for the working conditions of modern dryers.

III. INPUT DESIGN

Theoretical and practical study and analysis of the patterns of movement of cotton seeds, as well as the results of experimental study and generalization of other operations for processing raw cotton and the results of analytical and experimental studies of technological parameters requires.

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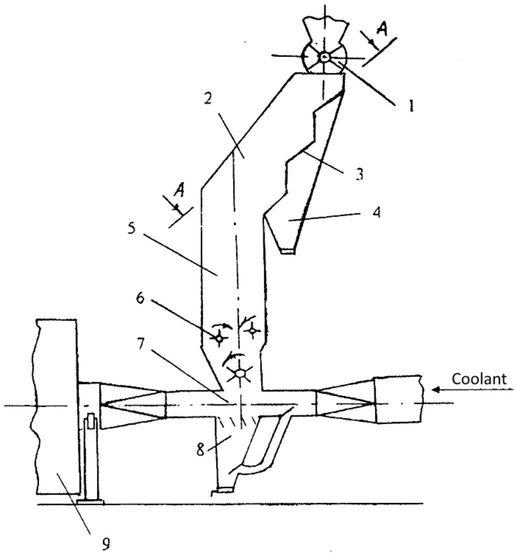

Figure 1. Schematic diagram of a cotton gin in a cotton seed dryer

Of course, there is a lot of research going on in this area. In fig. 1 shows a diagram of the feeding of a cotton gin to a cotton dryer. This device works in the following order. Through the rod for loading cotton seeds 1, the sieve 3 of the screw auger 1 is lowered to its original position. At this point, the angle of inclination provides a natural sliding from top to bottom, and the seed moves to the next step due to the inertia of the cotton. As you move from one step to the next, the cotton seeds are rolled with the tip of the step and the initial tick. By moving the cotton seeds through the ends of the stems, this stepwise trajectory helps to loosen the binding force of the raw cotton to the fine impurities released as possible particles. As a result, under the action of inertial and gravitational forces, impurities are released in small groups, which enter chamber 4 through the distance between the ridges. The process of separating the seeds from the mixture continues until the entire area of the cotton sieve is covered from top to bottom.Then the raw cotton is sent to the shaft 5, and the feeding drum 6 is transferred to the aspiration channel 7 in the initially defrosted position, where it is separated from the heavy compounds that enter the hopper 8. The fibrous cotton is suspended by the heat carrier flow directed to the drying drum, where the process takes place drying.

Table 3

The number of defects and impurities in the fiber when using a dryer with a screw feeder,%

Indicators	Number of experiments					Mean
	1	2	3	4	5	
Large species	0,72	0,71	0,51	0,51	0,57	0,63
Minor dirt	0,5	0,5	0,5	0,5	0,4	0,48
Fiber of cotton seed sowing	1,34	1,29	1,49	1,5	1,29	1,38
Links merged	-	-	-	-	-	-
Die	0,36	0,69	0,77	0,71	0,69	0,64
Burns	0,07	-	0,008	0,007	0,04	0,031
Number of defective and dirty impurities	3,0	3,20	3,29	3,22	3,0	3,14

Table 4

The number of defects and impurities in the fiber when using a vibrating body dryer

Indicators	Number of experiments					Mean
	1	2	3	4	5	
Large species	0,49	0,39	0,36	0,41	0,36	0,40
Minor dirt	0,50	0,30	0,40	0,30	0,30	0,40
Fiber of cotton seed	1,18	1,40	1,21	1,53	1,63	1,39

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sowing						
Links merged	-	-	-	-	-	-
Die	0,59	0,52	0,59	0,37	0,38	0,49
Burns	-	0,009	0,002	0,02	0,03	0,012
Number of defective and dirty impurities	2,76	2,61	2,64	2,63	2,70	2,66

The cotton cotton is then directed to the drum surface by centrifugal and gravitational forces and fills the space between the paddles. After that, the drying agent moves along the line, repeatedly crossing the trajectory of the cotton seeds from the dryers and pushing them into the drum. This eliminates the drying agent drum through the empty drum parts without touching the cotton.

Due to the technical complexity of the proposed device, its use is limited.

It is important to note that the proposed design does not allow efficient use of the hot air flow in the channel, thereby reducing the volume of falling cotton and accelerating the drying process at the beginning of the drum. To eliminate these shortcomings, a study was carried out to create a new transmission network that can successfully solve many technical solutions, and as a result, constructive solutions were found.

A cotton drum is known to receive heat from the following components:

- directly from the drying agent during disassembly;
- cotton cotton with the outer surface, lying in the bag and in the shoulder blades;
- from parts and casings of more heated drum sets.

Drum drop zone utilization is very low - from 39% to 49% depending on the characteristics of the cotton. As you know, the average clap time on a drum is 5-6 minutes. At the same time, the total residence time in the cotton zone is 1.0-1.2 minutes. The remaining 4.0-4.8 minutes are spent on a cotton pad and a shovel, which are not used to effectively heat the cotton.

Based on theoretical and experimental studies and analysis of drum dryers, improvements to the drum dryer have been made by heating the drum shell, increasing the amount of fibers in the drop zone, and maximizing the drum surface for fast heat transfer with thermal conductivity.

IV. OUTPUT DESIGN

The dryer works as follows. Heat from the heat generator to the pipes up to 10,000 m3 / h is transferred to the dryer and the air chamber, respectively. Hot air enters the drum body and heats it up and then enters the drum through the surface. The hot air from the pipes prevents cotton from entering the beginning of the drum.

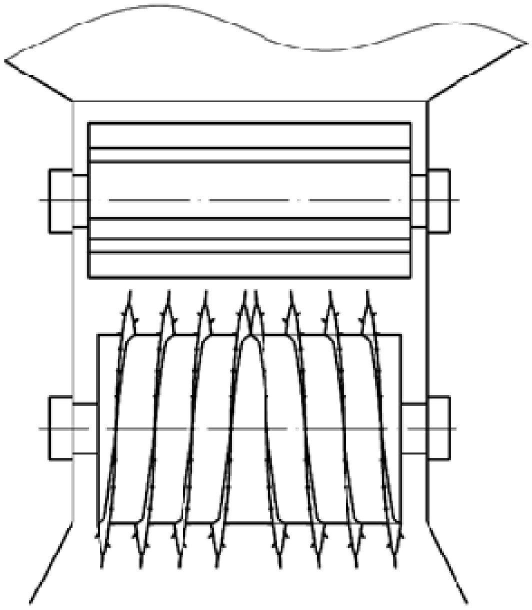

Figure 2. Proposed improved transmission scheme

When the drum rotates, cotton and hot air enter, as well as heat exchange between the drum body, cotton dryer, and the hot air used is expelled through the groove.

The main challenge is to use enough cotton in the drop zone and use the right side of the drum for faster heat and mass transfer. This was necessary in order to optimize the number of drum rotations to ensure that about half of the cotton lying on the paddles on the cutting surface of the drum falls evenly and evenly. The rest of the cotton should be sprayed onto the shovels, before and after the shovel. As a result, the heat exchange surface of the drum in a convective and conventional manner with the inner surface of the drum and shovel increases sharply.

This will provide an accelerated heat and moisture exchange by reducing the amount of cotton currently in the drop zone and using a dry zone for condensation drying.

A condition for stable operation of the drum dryer is a drop of cotton remaining in the blades when the drum rotates 1.5 times [4-5-6].

V. CONCLUSION

In world practice, the creation of new technologies and technologies for drying raw cotton, which have a positive effect on the technological processes of primary processing of cotton, and the quality of products, is becoming increasingly important. In this regard, the creation of a scientific basis for the regularities of changes in the thermophysical parameters of cotton and its components, substantiation of the speed and uniformity of the construction of cotton fiber and seeds in non-stationary processes of heat and mass transfer, new technologies, and One of the important tasks is to conduct targeted scientific research in areas such as technology development. The aforementioned research studies explain the relevance of a new system design to provide this cotton seed dryer.

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