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Drying of Cotton Seeds by using the Construction of a New Transmission Line Based on the Energy Saving of the Drum: A Review

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Abstract

This article is based on the theoretical justification for the development of energy saving projects and the main operating parameters for the implementation of the process of preparing high-density cotton seeds for storage. One of the issues of the program of economic development of the Republic of Uzbekistan is to increase the productivity of high-quality fiber and its implementation on the world market. The production of high-quality raw cotton fiber depends on the fact that the production process is organized on the basis of technical requirements. In particular, in the process of drying cotton in processing plants, it is important to reduce its moisture content and storage.

Keywords: Physical-colloidal • Biomechanical • Cleaning • Cotton

Introduction

Cotton raw material-a material consisting of three different components that are not identical in structure. These components include fibers, cotton seeds and a core. Khlopkova fiber and polishes represent the capillary holes. The fiber is located on the entire surface of the seeds and consists of 97% cellulose. Depending on the type and grade of fiber length is an average of 25 mm-50 mm, a fiber diameter of 15 mkm-25 mkm, and the thickness of the seed 0,25 mm-0,4 mm. According to its chemical composition, the pulp contains 40%-45% cellulose, 20%-25% lignin, 28%-30% lecton, 3% protein and 2%-3% powder (ash). The kernel consists mainly of fats and proteins [1]. It contains carbohydrates, crystals and colloidal sugars, as well as pectin-containing substances in the colloidal-dispersed state. Seeds are naturally colloidal materials and consist of materials with capillary holes. Cotton raw materials are colloidal capillary-hole materials as drying plants.

Due to the different morphological structure of the components of cotton raw materials, the moisture content in them is also different. In the wet state of raw cotton, each component is moistened according to its physical properties [2]. It is known that during storage and processing of cotton humidity should not exceed 10%-12%, at humidity 8%-9%. Drying cotton seeds is one of the most energy-intensive processes that require in-depth scientific analysis. Existing cotton drying plants operate at a temperature of 150°C-2800°C.

Energy consumption of 8400 kJ is used to absorb 1 kg of moisture from cotton [3]. Analyses show that the improvement of fiber quality depends on the efficiency of the drying plant. Existing drying shops do not use the available opportunities, which affects the quality of fibers and seeds [4]. At the same time, the drying mode of cotton raw materials should be taken as a basis: All other indicators, such as breaking load, color, and fiber length, mechanical damage to the fiber and seeds, and others.

Literature Review

Reducing the humidity level is carried out by means of high temperatures in the production and differs from the complexity of its control. On the basis of experimental studies on the implementation of drying of raw cotton by combined hot air and short waves, the temperature control was theoretically developed and proposed for use in the production of the technological map [5].

According to the studies the temperature of technical seeds should not exceed 750S, since the temperature increase leads to a change in the protein content in the seeds. Heating of cotton fiber should not exceed 1050S, excessive temperature will violate its content and reduce the textile and technological properties of the fiber [6]. Many scientists are engaged in drying processes and designing cotton dryers. Numerous scientific studies have been aimed at improving drum dryers and their internal devices in particular other scientists.

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From the point of view of the drying process, raw cotton is a complex material, since seeds with a moisture content of more than 65% have low heat exchange properties. The surface area of the seeds is a low-temperature heat-sensitive fibrous mass, which is the criterion of the drying process. Effect of temperature on drying speed 20°C, 35°C, 50°C, 75°C, 100°C, 120°C and 1300°C was observed after a few hours. In addition, during the drying process, there is a faster change of fiber moisture, as the fiber directly in contact with the hot air, the change in the bark is a little slower, so the bark will be protected by a fiber layer, slower in the wort core, so there will be no direct collision with the drying agent [7]. Fiber with low humidity and larger evaporation surface dries faster than weed. Therefore, in the design of existing cotton drying drums moisture from the fibers and seeds is not lost evenly. During the drying process, the fibers dry and the seeds do not dry properly. As a result, during the subsequent processing of cotton raw materials excessively dried fibers are broken, not dried seeds are broken into pieces [8]. This is reflected in the final production of cotton factories. Thus, even the loss of moisture from the components of cotton raw materials is an important condition for the operation of modern dryers. Currently, the cotton mills are equipped with 2SB-10, SBO and SBT cotton drying drums. These drying drums are fully equipped with heat generation, transportation and transfer systems to ensure continuous operation. The drying scheme of raw cotton with a heat generator TG-1.5 (Figure 1).

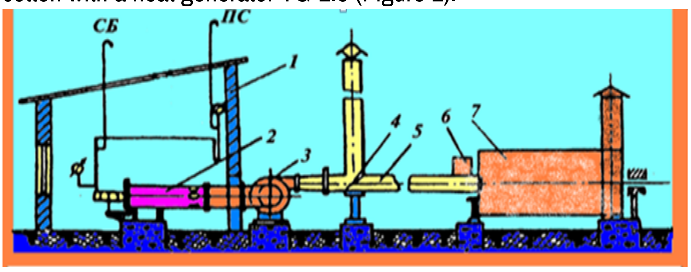

Figure 1. Cheme of drying raw cotton heat generator TG-1.5. **Note:** 1: Terrace; 2: Heat generator TG-1,5; 3: Fan; 4: Smoke suction Cup; 5: Heat pipe; 6: Cotton feeder; 7: Drying drum.

Modern drying drums of type 2SB-10, SBO, SBT, intended for drying of wet cotton raw materials are installed in drying departments of the cotton-cleaning enterprise. According to the results of theoretical and experimental studies of the legislation on the movement of raw cotton, it is necessary to create a new design of transfer devices of cotton drying equipment (Figure 2).

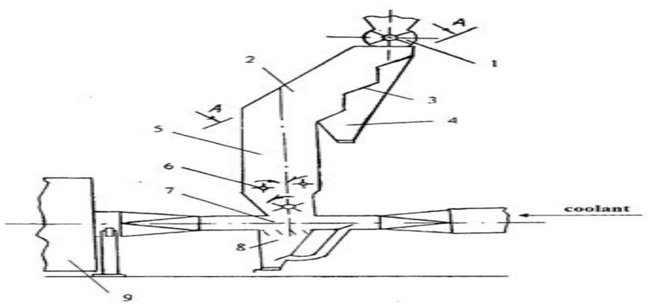

Figure 2. Schematic diagram of the flow dryer for cotton. **Note:** 1: Enters the initial surface; 2: The scheme of supply of a vibrating body in a cotton dryer; 3: The angle of inclination of the natural downward flow moves the cotton seeds from one step to another; 4: Distances between the ridges; 5: Transferred to the aspiration channel; 6: Initial vibrating state by means of the supplying drum; 7: Separation from the heavy compounds; 8: Enter the hopper.

Course, in this direction the proposed design, which has been conducted a lot of research for rice.

The scheme of supply of a vibrating body in a cotton dryer with drying of cotton is presented. Loading of raw cotton through the inclined hopper enters the initial surface. According to the law of inertia, the angle of inclination of the natural downward flow moves the cotton seeds from one step to another. When you transition from one paw to the other cotton sewn with the tip of her paws and starts to vibrate.

When shifting through the ends of the cotton cotton legs, such vibrational trajectories contribute to the weakening of the binding strength of the cotton fabric with decomposing small impurities of the passive form. As a result, separation from dirty impurities occurs in small groups under the influence of inertial and gravitational forces that enter the chamber through the distances between the ridges.

The process of separating from the mixture will continue until the entire surface of the cotton grooves rises and falls. Then the cotton shaft is sewn to the side and transferred to the aspiration channel 6 in the initial vibrating state by means of the supplying drum, where the separation from the heavy compounds that enter the hopper 8 takes place. Purified cotton wool is suspended by the flow of coolant, drying is directed to the drum, and here the drying process takes place.

In the cotton centrifugal and gravitational forces to fill the gaps between the correspondence directed towards the drum and the shovel. After that, the drying agent moves along the line, repeatedly crossing the trajectory of cotton seeds from the dryers and pushing them into the drum. This prevents the drum from passing through the free parts of the drum without touching the cotton. According to statistics, in recent years, the production of cotton fiber that meets regulatory requirements has decreased significantly.

In recent years, conventional convective drum dryers SXL M-1.5 M, 2SBS (for drying agent and material movement opposite) for drying raw cotton in cotton industry and SXL M-1.5 M in the same direction. Used 2SB-10, SBO (where raw materials and drying agent move in one direction). Currently, cotton mills and drying plants are equipped with 2SB-10, SBO and SBT drum dryers.

When the wet cotton dries in the dryer, the temperature of the drying agent drops from 2800S to 1500S during the first four meters of the drum, where the raw material is heated and the surface has a high temperature (250 m^2/kg).

In the next drum, the temperature of the drying agent drops to 70. 800S, and the seed evaporation surface is much smaller (1.0 m^2/kg), and the moisture content in the raw cotton slows down. At such high temperatures, the quality of the cotton fiber deteriorates, the color becomes yellow, and its strength decreases during drying.

To avoid such situations, it is necessary to improve the equipment for drying cotton. It is known that the cotton drum receives heat from the following components:

- Directly from the drying agent when removed from the blades
- The outer surface of the cotton when falling on the laying area and shovels
- From parts and housings of the heated drum

The use of the drum lowering zone is very low-from 39% to 49% depending on the characteristics of the cotton. As you know, the average time of cotton on the drum is 5-6 minutes. At the same time, the total stay in the cotton zone is 1.0 minutes-1.2 minutes. The remaining 4.0 minutes-4.8 minutes are spent on the cotton pad and combs, and this time is not used to effectively heat the cotton [9]. Due to the fact that the proposed device has many technical problems, it is limited by working conditions. It is important to note that the proposed design does not effectively use the flow of hot air in the channel, but it does not have the ability to vibrate the falling cotton and accelerate the drying process at the beginning of the drum. To address these shortcomings, a study was conducted to create a new transmission network that can successfully address many technical solutions.

Discussion

Based on the theoretical and experimental research analysis, the improvement of the drum dryer was carried out as a result of heating the drum shell, increasing the titration of cotton in the drop zone and intensive conductive heat exchange of the inner surface of the drum with cotton. The system of transfer of a drying drum offered by us works as follows. The proposed scheme of the dryer (Figure 3).

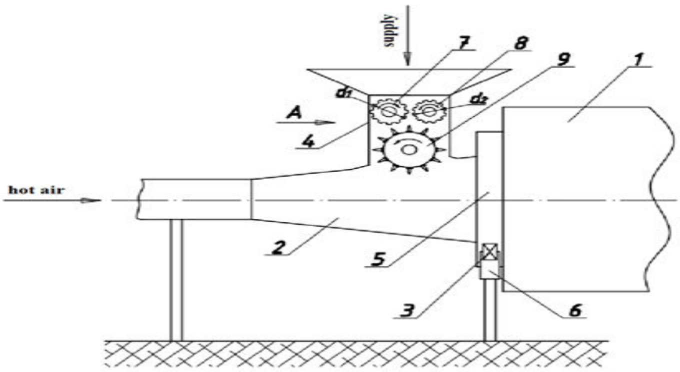

Figure 3. The proposed scheme of the dryer. **Note:** 1: Front of the drum; 2: A loading device; 3: Rotating rollers hinged on 6 racks; 4: Cotton feed zone; 5: With a pin; 6: Hinged on racks; 7: Diameter of the left corrugated roller; 8: Diameter of the right corrugated roller.

The raw cotton dryer contains a rotating drum 1 with a pin 5 mounted on 3 rotating rollers hinged on 6 racks. In front of the drum 1, a loading device 2 is installed, in the upper part of which there is a 4 cotton feeding zone. In the 4 cotton feed zone, two corrugated rollers 7 and 8 are installed. The diameter of the left corrugated roller 7 is 10%-12% larger relative to the diameter of the right corrugated roller 8. Under corrugated rollers 7 and 8 installed the peg line drum. The main task is to use a sufficient amount of cotton in the drop zone and use the right side of the drum for accelerated heat and mass transfer. This was necessary to optimize the number of drum rotations to ensure that about half of the cotton lying on the blades on the cutting surface of the drum would fall evenly and evenly. The rest of the cotton should be sprayed on the shovels, front and bottom. As a result, the heat exchange surface of the drum in the convective and condensate form of cotton with the inner surface of the drum and shovel increases sharply. This will provide accelerated heat and moisture exchange by reducing the amount of cotton currently in the fall zone and using the dry zone for condensation drying. The condition of stable operation of the drum dryer is a drop of cotton remaining in the blades when the drum rotates 1.5 times. Due to the inner parts of the drum and the temperature of the shell from 350S to 700S, the humidity of cotton increased by 64.2% (relative). This indicates that cotton drying should accelerate heat and mass transfer through condensation and that the drying drum should be set to the maximum permissible heating temperature.

Conclusion

Changes in the thermal conductivity and heat capacity of cotton and seeds depend on humidity, bulk density and temperature, which allows for optimal drying mode of the proposed dryer, taking into account differences in the thermal properties of cotton components, providing acceleration and uniformity of the process. To optimize the air flow, cotton was dried along the cross section of the drum, I will be provided. Consequently, with the creation of a new automated cotton swab drum transmission design, it is possible to ensure that the cotton seeds from the top of the drum are not stacked together and that the heat exchange from the hot air is effectively used and it is important to put it into production.

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