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THE EFFECT OF DRUM DRYING TEMPERATURE ON THE MOISTUREOF COTTON COMPONENTS

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Abstract. The article is devoted to the process of drying cotton in the drum, and shows that the unevenness of the initial moisture distribution in cotton, fiber, is the main factor influencing the uneven construction of the seed. The effect of drying temperature on cotton, fiber and seed moisture was determined and their regression equations were obtained. It was found that the initial moisture differences of the cotton components were significantly greater and that the possibility of minimizing them at the expense of changing the drying temperature was very low. The amount of moisture separation from cotton, seeds and fibers at different drying temperatures was determined and analyzed.The average construction rates and moisture release rates of the cotton components were determined, and the nature of the exposure to the drying temperature and the average construction rates of the cotton and seeds were found to be almost the same.It has been shown that the rate offiber construction is lower than the rate of cotton and seeds when the drying temperature is up to 160 ^{0}C, and the reasons for this are shown. The formula for determining the moisture content of the seeds was given. It was recommended to take fiber and fiber moisture as indicators of the moisture content of cotton in technological processes.

Keywords. Construction roughness, moisture absorption, air absorption capacity, cotton components, humidity, construction speed, drying temperature, drying drum.

INTRODUCTION

The main factors influencing the effective implementation of decontamination of cotton are the efficiency of cleaning equipment, material moisture and initial contamination [1, 2, 3].

During the initial processing of cotton, depending on its initial moisture and contamination, the efficiency of drying of technological equipment, drying regimes are determined according to the recommendation "Coordinated technology of primary processing of cotton (PCP 75-2017)" [4, pp. 25-37].

In the process of cleaning and ginning cotton, the humidity should be 8-9%, depending on the navigation. Bringing the moisture content of cotton to the level of technological requirements is achieved through the correct choice of drying mode, mainly the drying temperature.

It is known that during the drying process, the fiber receives heat from the hot air, and the amount of heat obtaineddepends on the difference between the air and fiber temperatures. The heat transferred to the fiber first heats it, separates the moisture, and then transfers some of the heat to the seed due to heat transfer. The amount of heat used to separate the moisture and heat the seed depends on the moisture content of the fiber and the seed, and if it is in balance with the amount of heat received by the cotton, the fiber will not overheat and dry out. Excess heat, ie high hot air temperature, leads to a sharp rise in fiber temperature and uneven drying of seeds and fibers.

Humidity of cotton produced in ginneries from 7% to 22% and above leads to a number of complications. These include lowering the humidity of high-moisture cotton to 8-9%, ensuring a uniform drying of fiber and seed moisture,not reducing the quality of fiber.

A number of studies [5, 6, 7, 8] have shown that the main factor influencing the efficiency of cotton is its inability to fully characterize the moisture state as an object of cleaning and ginning, mainly due to the interaction of technological equipment with the working elements of fiber. . It should be noted that the research was conducted mainly in the laboratory, and its results do not always correspond to the results obtained under production conditions. The reason is the difficulty of modeling the state of cotton in the laboratory under production conditions, the temperature of the cotton fiber varies depending on the temperature regime of the drying drum. Although the fiber humidity is the same, the temperature difference also affects the cleaning efficiency of the cleaners [9, 10, 11].

Although rational moisture content in cotton fiber cleaning processes has been recommended, the problem of bringing it to that moisture content has not been resolved.

The article explores the possibilities of minimizing the uneven drying of cotton components by choosing the drying temperature.

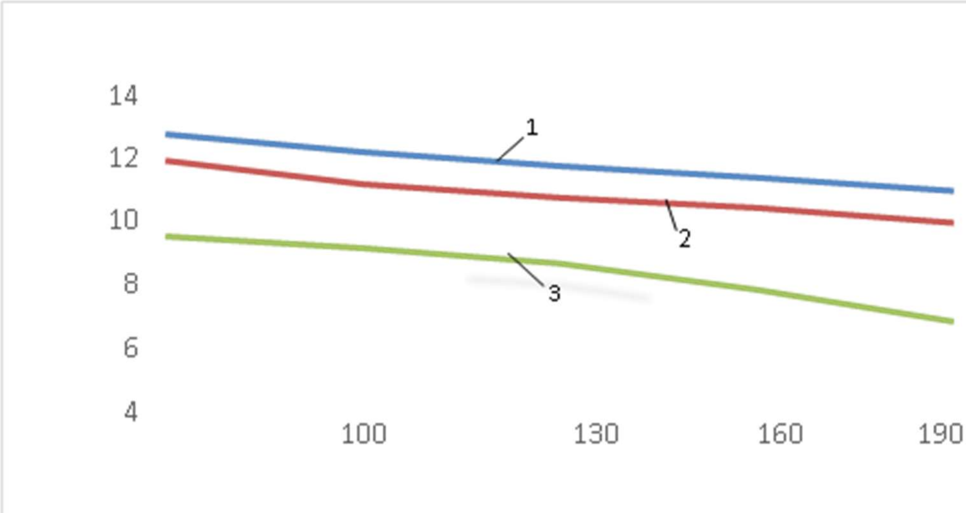
METHODS OF CONDUCTING EXPERIMENTS

The object of the study was cotton of S65-24 1/3 selection variety with initial moisture Wp = 11.14%, fiber moisture Wt = 7.8%, seed moisture Wch = 12.5%, impurity 4.3%. The experiments were conducted at the Chinabad factory. The cotton was dried on a drying drum at a working capacity of 7 t / h at a drying temperature of T = 100- 130-160-190 ^{0}C, cleaned in a UXK unit and ginned in 5DP-130 gin and cleaned in a 1VP gin. Samples were taken to determine the moisture content of cotton, fiber, seeds, fiber contamination, and defective compounds.

The obtained experimental results were mathematically and statistically processed [12].

In the regression equations, the empirical correlation ratio η_{yx} of the bond density between the variables is evaluated by the correlation coefficient r and the correlation index l. The constant coefficients in the equation are determined using the method of having the smallest value of the square deviation. The adequacy of the regression equations was determined using the Fisher-Snedekor criterion.

Figure 1 shows the change in humidity of cotton components at different drying temperatures.



Drying agent temperature ^0C
1-seed, 2-cotton, 3-fiber

FIGURE 1. The effect of drying agent temperature on changes in moisture content of cotton components

As can be seen from the following figure, the difference in initial moisture content of cotton components is significant, the deviation of seed and fiber moisture relative to cotton moisture is 14.4% and 30%, respectively, the fiber moisture deviation relative to seed moisture is 37.6%. these differences in values remain virtually unchanged.

The moisture content of the fiber decreases sharply and the difference with the moisture content of cotton increases.

This condition will definitely negatively affect the cotton cleaning and ginning processes.

The results showed that in technological processes it is not enough to rely only on the moisture content of cotton, it can not fully characterize the moisture content of cotton, and the moisture content of the fiber must be taken into account.

The regression equations of the results obtained were as follows. Cotton moisture

$$y1 = -0{,}000009x^2 - 0{,}0115x + 11{,}14 \quad (1)$$

Seed moisture

Fiber moisture

$$y2 = -0{,}0000469x^2 - 0{,}0062x + 12{,}5 \quad (2)$$

$$y3 = -0{,}000163x^2 + 0{,}0111x + 7{,}8 \quad (3)$$

One of the main technological parameters of drying drums is moisture absorption ΔW, which is determined as follows.

$$\Delta W = W_1 - W_2 \quad (4)$$

Where W_1 and W_2 are the moisture before and after drying the cotton. Using this formula, the effect of drying temperature on the amount of moisture released from the cotton components was determined. In addition, the average rate of construction of cotton components in the drum is determined by the following formula.

$$\Delta W = W1 - W2\ \%/m \qquad (5)$$

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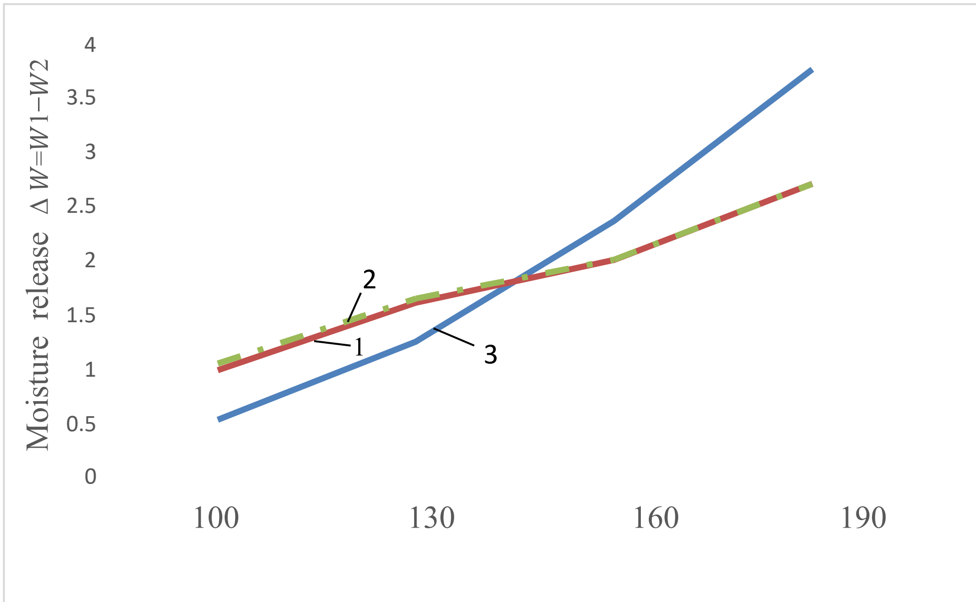
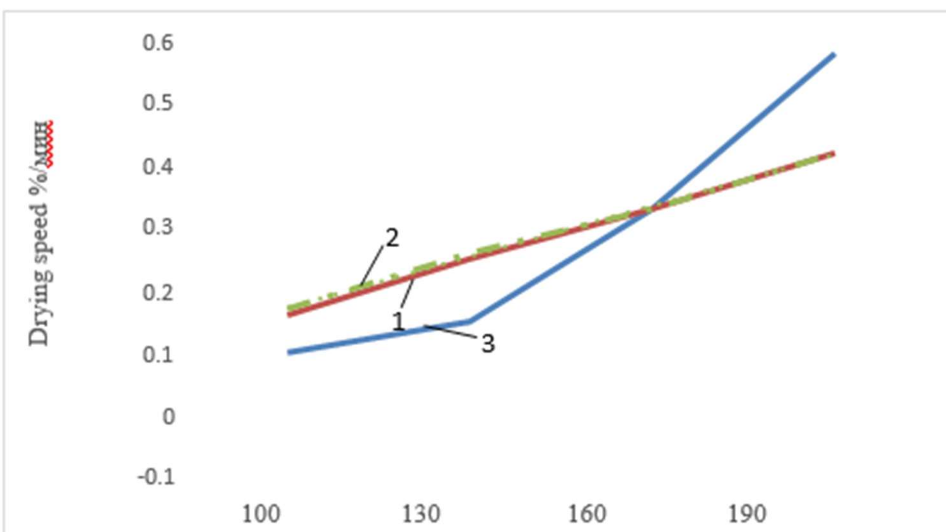
in this r − time to a cotton in the drying drum, $r = 6{,}5\ min$

The results are shown in Figure 2.



Drying temperature, ^{0}C 1-cotton, 2-seed, 3-fiber



Drying temperature, ^{0}C 1-cotton, 2-seed, 3-fiber

FIGURE 2. Moisture release and construction rate in cotton components

Moisture separation from seeds and cotton is ΔW and the average construction rate is almost the same and increases significantly when the construction temperature is above 130 ^{0}C. Moisture removal from the fiber and the average build-up rate increase sharply as the building temperature is low to 160 ^{0}C and then to a high temperature.

It is known that the hot air supplied to the drying drum also absorbs the moisture from the cotton and carries it out. In this case, the ability of the air to absorb moisture must be at the level of complete self-absorption of the released moisture. Otherwise, the air may become saturated with moisture and wet the fiber at the expense of condensation atthe end of the drum.

When the temperature exceeds 160 ^{0}C, the heating process of cotton is accelerated, the ability of the air to absorbmoisture is high, the condensation of moisture from the air to the fiber is eliminated.

The fact that the amount of moisture released from the seed and cotton and the average build speeds are close toeach other is explained by the fact that the moisture content of the cotton corresponds to at least 70% of the seed.

Let us determine the moisture content of the cotton components accordingly with the following moisture contentcoefficients

$$K_{s/c} = \frac{W_s}{W_c} \quad (6)$$

$$K_{s/f} = \frac{W_s}{W_f} \quad (7)$$

$$K_{c/f} = \frac{W_C}{W_f} \quad (8)$$

and if we determine their values before and after drying, the possibility of explaining the nature of the differencein the humidity difference of the components and the effect of the drying temperature on them expands.

Table 1 shows the values of the moisture ratio coefficients

TABLE 1. The ratio of moisture of cotton components before drying

S/N	Drying temperature, ^{0}C	Seed and cotton moisture ratio, $W_{Ч}/W_{П}$		Seed and fiber moisture ratio, $W_{Ч}/W_{Т}$		Moisture content of fiber and cotton, $W_{Т}/W_{П}$	
		Humidity ratio	Humidity ratio coefficient	Humidity ratio	Humidity ratio coefficient	Humidity ratio	Humidity ratio coefficient
1	Initial humidity ratio	12,5 / 11,14	1,12	12,5 / 7,8	1,6	11,14 / 7,8	1,43
2	100	11,52 / 10,5	1,1	11,52 / 7,28	1,6	10,5 / 7,28	1,44
3	130	10,9 / 9,5	1,15	10,9 / 6,6	1,65	9,5 / 6,6	1,44
4	160	10,4 / 9,07	1,15	10,4 / 5,44	1,91	9,07 / 5,44	1,67
5	190	9,8 / 8,4	1,17	9,8 / 4,04	2,43	8,4 / 4,04	2,1

The following conclusions can be drawn from the analysis of Table 1:

- the coefficient of moisture content of seeds and cotton showed that the change in drying temperature $K_{S/c} = \frac{W_S}{W_c}$ from 1,1 to 1,17 at values of 100 ^{0}C to 190 ^{0}C is not significant
- the coefficient of moisture content of seeds and fibers $K_{S/f} = \frac{W_S}{W_f}$ and the coefficient of moisture content of cotton and fiber $K_{C/f} = \frac{W_C}{W_f}$ remain unchanged at 1,6 and 1,41, respectively, when drying varies from 100 ^{0}C to 190 ^{0}C. When drying is 160 ^{0}C and 190 ^{0}C, the coefficients of sharp increase are $K_{s/f} = \frac{W_S}{W_f}$ and $K_{s/c} = \frac{W_S}{W_c}$ 1,91, 2,23 and 1,67, 2,08, respectively.

This situation shows that it is advisable to dry cotton with a moisture content of 11,14% at a temperature of 130 ^{0}C. The moisture content of dried cotton is 9,5% and fiber moisture is 6,6%.

The following conclusions can be drawn from the results:

1. The main reason for the drying unevenness is the uneven distribution of moisture in the cotton components, and the possibility of reducing the moisture unevenness due to the drying temperature is limited.
2. It was observed that the fiber does not over-dry at a drying temperature up to 130 ^{0}C, and a sharp decrease in the moisture content of the fiber is exceeded. It was recommended that fiber and cotton moisture can be obtained as indicators of the moisture content of cotton in technological processes.

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