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Study Of The Influence Of Heat Flow Temperature On The Heat Capacity Of Raw Cotton And Its Components

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Abstract: The article studies heat capacity of raw cotton and its components.

Key words: parameters, drying, raw cotton, thermal conductivity, heat capacity, thermal conductivity, fibers, hygroscopic parameters, temperatures, humidity, measurements.

In order to select the right technological parameters for drying and processing raw cotton, thermal characteristics such as thermal conductivity, heat capacity, temperature conductivity, thermal conductivity, as well as possible types and forms of moisture bonding of raw cotton, its fibers and seeds should be known.

The known scientific and applied works [2] do not allow to receive satisfactory enough thermal and hygroscopic parameters of raw cotton. Therefore, there is an

urgent need to develop methods to objectively assess the thermal and moisture parameters of cotton.

In the given experience heat capacity of raw cotton and its components depending on temperature and humidity was investigated.

Measurement of heat capacity was carried out in vacuum-diabatic calorimeter with discrete input. The copper hermetic calorimeter with the volume of 10 cm-3 is used. The error of determining the heat capacity in the temperature range of 30-1500C is not more than 0.5 %.

This method is widely known in the scientific literature [3].

The method of adiabatic calorimeter with discrete heat input is used to measure the heat capacity of raw cotton. However, it is not the true heat capacity that is measured, but the average heat capacity at the temperature range ΔT

$$C = \Delta Q / \Delta T \text{ J/KG , where}$$

ΔQ is the final amount of heat supplied to the sample;

ΔT is the final temperature increment of the sample caused by this;

ΔT = T2 - T1 where T1 and T2 sample temperature before and after heating;

This value of heat capacity is referred to the average temperature

$$T_{cp} = (T_1 + T_2) / 2$$

At width of a calorimetric step T = 3 - 5 K in the field of smooth change of heat capacity of a material with temperature (far from phase transitions) average heat capacity practically coincides with true at this temperature.

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At researches of heat capacity of materials the physical interest represents specific heat capacity.

$$C = C_{sample}/ m \text{ J/Kg*K , where}$$

m is the weight of the sample, kg.

The specific heat capacity of the sample is determined by the measurements:

$$C = Sn - S0 / m \text{ where}$$

C_f - heat capacity of the filled calorimeter, J/K;

C_e - heat capacity of an empty calorimeter, J/K.

The method of carrying out the experiment is as follows:

-The calorimeter is filled with a known by its mass object (raw cotton, chloropool, seeds, etc.) and weighed on an analytical scale;

-The calorimeter is placed under a vacuum hood and pumped out within 10-20 minutes. After pumping the calorimeter is weighed again on the analytical scales, if the change in the total weight within the accuracy of the analytical scales - the calorimeter is considered sealed. Then the heat capacity is measured according to the standard method.

Picture 1 shows experimental data on the specific heat capacity of raw cotton depending on the temperature at different humidity. As it is visible from the presented figure this dependence can be represented as linear. Here it is necessary to note that unlike known literary sources the change of specific heat capacity of raw

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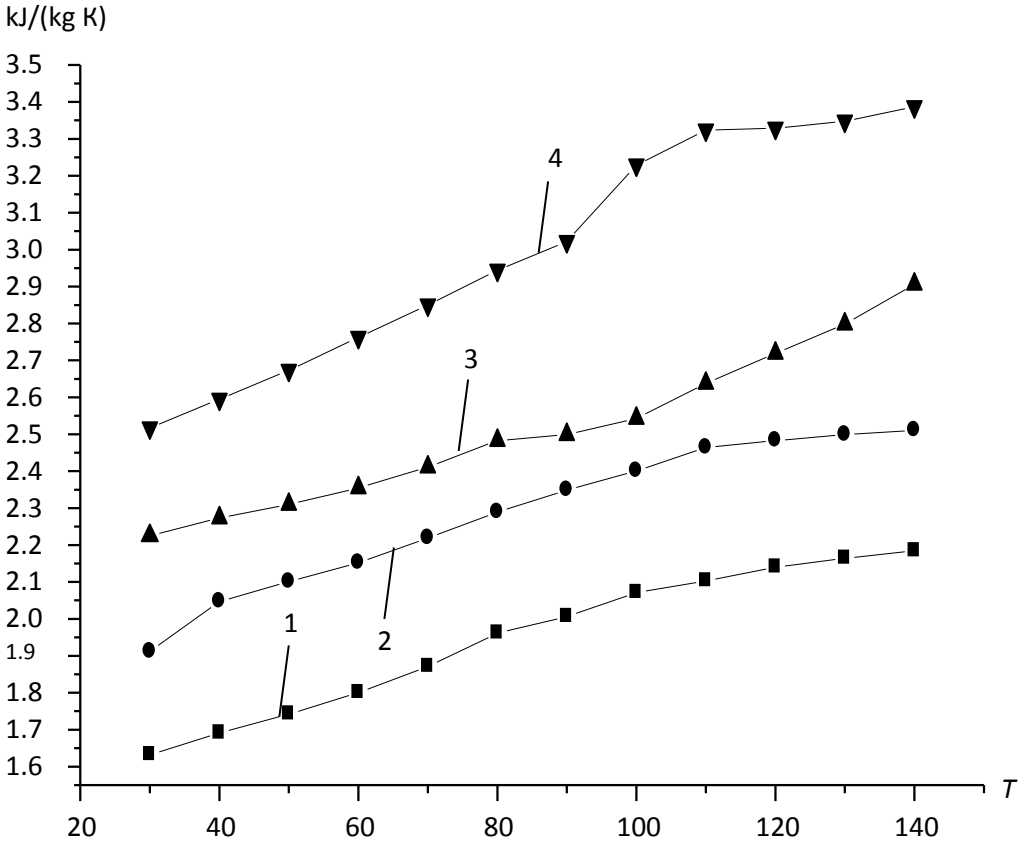
cotton in the temperature range of 20-90 C is about 15%, and 20-150 C more than 45%.

Picture 2 shows experimental data on specific heat capacity of cotton fiber depending on temperature at different humidity. As can be seen from the figure at different humidity and different temperatures up to 90-100 0C heat capacity increases linearly, and over 100ºC increases dramatically, which is associated with changes in the structural properties of cotton fiber at high temperatures.



Picture 1: The dependence of the heat capacity of raw cotton on the temperature at different humidity (humidity (%): 1-8, 2-24, 3-36, 4-45).

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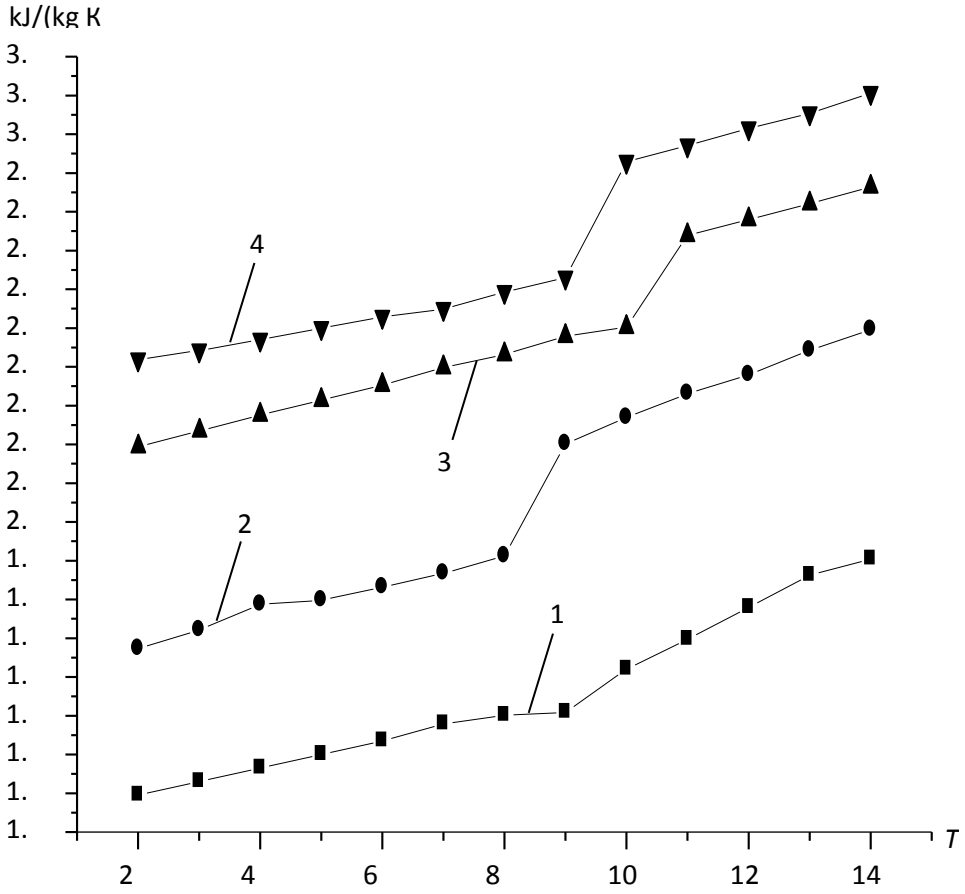

Picture 2: Dependence of heat capacity of cotton fiber on temperature at different humidity. (humidity (%): 1-7, 2-17, 3-38,9, 4-56).

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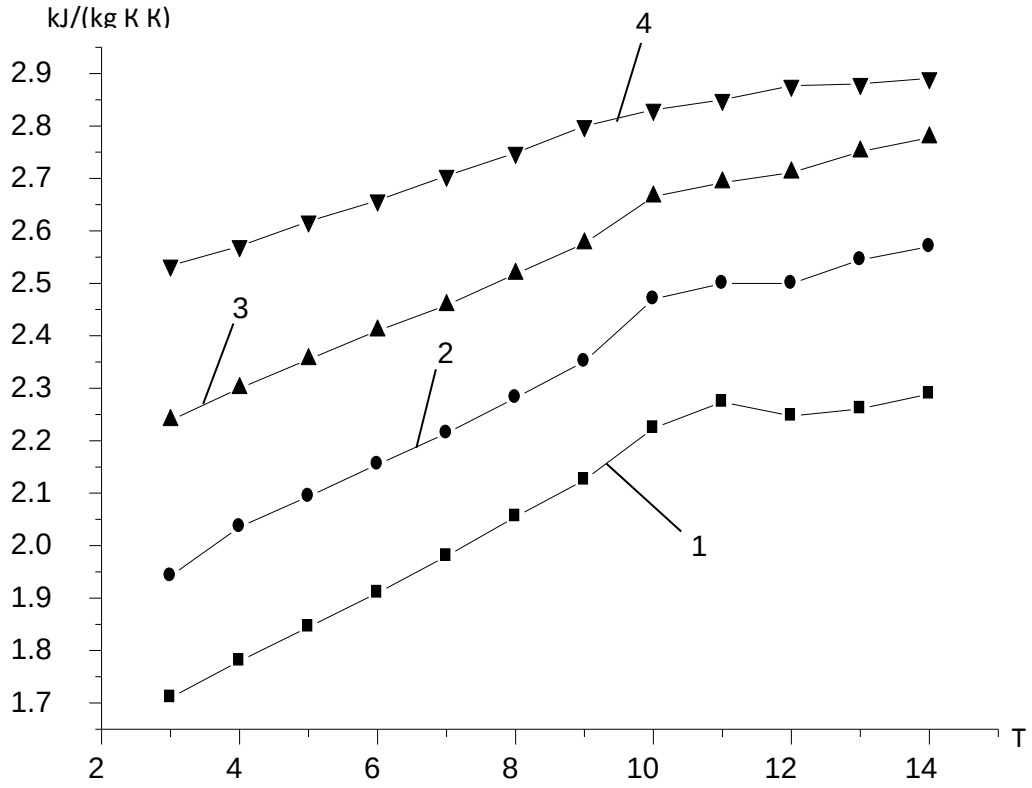

Picture 3: Dependence of the heat capacity of seeds on the temperature at different humidity conditions. (humidity (%): 1-0, 2-10, 3-20, 4-30).

Pic. 3 shows experimental data on specific heat capacity of seeds depending on temperature at different humidity. As can be seen from the figure the increase in humidity and temperature of the heat flow increases the heat capacity of seeds.

Conclusions

1. Based on the results of experimental data, the curves of heat capacity dependence on temperature and humidity were obtained, which allow to determine the regularities of heat capacity change and to make quantitative estimates of the influence of temperature and humidity on the heat capacity of raw cotton, cotton fiber and seeds.

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2. It is proved that seeds, then raw cotton and fibers have the highest heat capacity among raw cotton components. The relations allowing to make qualitative and quantitative comparisons of heat capacity of raw cotton, fibers and seeds are established.

3. It is established that with the growth of humidity the heat capacity of raw cotton and its components increase by linear, and with the growth of temperature by more complex in comparison with linear laws.

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