THEORETICAL BASIS OF THE PROCESS OF DRYING COTTON RAW MATERIALS UNDER THE INFLUENCE OF INFRARED RAYS

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Abstract: *In particular, to produce high-quality fiber, special attention is paid to ensuring optimal heat and moisture conditions for cotton raw materials during the cleaning and ginning processes, drying at high temperatures and reducing the use of traditional sources of hydrocarbons. In world practice, large-scale research work is being carried out to ensure the optimal technological state of the material during the primary processing of cotton raw materials, achieving resource efficiency of equipment and technology of the drying process, and cleaning cotton from small particles. and large impurities, as well as separate its fibers.*

Keywords: *cotton, tape, drying, infrared radiation, layer, efficiency, height, conveyor, movement.*

INTRODUCTION

Under the influence of infrared rays, products dry, or in other words, water molecules evaporate and fly out of its composition. Under the influence of the received thermal energy, internal vibration and rotation movements occur, and the molecules are activated, and the molecules with the kinetic energy of the forward movement, which can overcome the binding forces that bind them to the liquid, fly out.

In nature, mutual heat exchange of bodies occurs in three different ways, in the form of heat conduction, convection and electromagnetic radiation. Heat conduction is the transmission of complex generalized mechanical movements of atoms and molecules that make up bodies, and the amount of heat is an energetic measure of the intensity of these movements. According to the molecular-kinetic theory, there must be an environment for heat transfer, if there is no environment, heat transfer cannot be observed. The second method is convection, in which energy is transferred in the environment due to the displacement of a large gas or liquid mass, and as a result, heat exchange is observed. In the third method, heat is transferred from one body to another in the form of electromagnetic radiation.

Sample preparation

Infrared rays are electromagnetic waves in the infrared range of the spectrum and are also referred to as thermal radiation. Infrared radiation is caused by changes in energy states caused by molecular bonds of atoms in molecules and transitions of weakly bound electrons in the upper electron shells of atoms. When infrared rays are absorbed by molecules, internal vibration, rotation, and forward thermal movements of atoms that make up molecular structures occur [1-7].

When a molecule is irradiated, the complex internal movements of the atoms that make up it lead to a change in the total dipole moment of the molecule, and dipole oscillations produce molecular infrared radiation. Radiation is not observed if the dipole moment of the molecule does not change, which depends on the internal structure and symmetry of the molecule [8-9].

The water molecule is considered a three-atom molecule, and according to the theory of vibrations, vibrational and rotational movements are observed in the molecule. Figure 1 schematically depicts the structure of a water molecule and the uncorrelated mechanical normal vibrations and rotational motions observed in such structures.

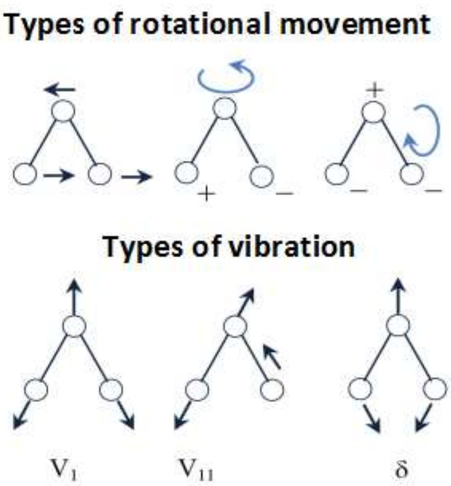

Figure 1. Types of rotational and vibrational motion of the water molecule

The motions can be written in terms of 6 different sets of states based on 3 uncorrelated hormonal oscillator and 3 rotator models. We can express the energy of this set of states most simply by the quantum oscillator and rotator [10-16] energies

$$E_{осц} = \hbar\omega_0 (n + \frac{1}{2}), E_{pom} = \frac{\hbar^2 J(J+1)}{2I}. \quad (1)$$

Here n, J are the quantum numbers, I is the moment of inertia of the molecule, and the $\omega_0 = \sqrt{k/m}$ specific frequency of the oscillator. The total energy of a triatomic molecule consists of the sum of the energies of the electrons in the electronic shells the three different vibrations and spatial rotations of the atoms.

For the absorption spectra of water vapor $\lambda_i(\omega_i)$, the experimentally observed and theoretically calculated values of -wavelengths range from 278 microns to 0.55 microns.

In the drying device proposed for drying cotton raw materials, infrared rays are obtained by heating ceramic materials with the help of electric current coils. For this, a glass tube made of quartz is taken, a nichrome spiral is placed inside it, and a specially prepared ceramic material is applied to the surface of the tube. When the spiral is heated by electric current, the ceramic material emits infrared radiation. The chemical composition of the effective ceramic materials used for radiation generation should be selected in such a way that the emission spectra of infrared rays of such materials should fully correspond to the range of the absorption spectrum of the water molecule [17-25].

For example, a special ceramic material known as mullets emitting radiation with a wavelength of up to 25 μm and a pulse of 10 μs is recommended. Also, ceramic materials made on the basis of quartz compounds emit infrared rays up to 3-5 μm.

Results

Now, we will analyze the performance of the dryer based on the belt conveyor throughput during the changeover period. The results are presented in table 1.

1-table

Effect of belt speed and layer height on productivity

№	$v_л$	h	y
1	0.1 0.2	0.1/0.2/0.3/0.4 0.2/0.4 0.3	0.153/0.306/0.459/0.612 0.200/0.400/0.500/0.700 0.450/0.550
2	0.5 0.6	0.1/0.2/0.3/0.4 0.3/0.4 0.35	0.765/1.53/2.295/3.06 0.800/2.58/3.100/3.56 2.78/3.150
3	1.0 1.5	0.1/0.2/0.3/0.4 0.1/0.2 0.15	1.53/3.06/4.59/6.12 2.03/3.16/4.71/6.78 3.26/4.89
4	1.5 2.0	0.1/0.2/0.3/0.4 0.2/0.3 0.25	2.295/4.59/6.88/9.18 2.312/4.98/7.11/9.68 5.11/7.66

Looking at the results, it can be seen that both factors have a linear effect on dryer performance. In particular, as the belt speed increases, the dryer performance increases. In this case, as the value of the height of the cotton layer increases, the productivity increases with greater intensity.

To determine fiber yield, we took ten samples of 500 grams each of irradiated seed cotton. We took three samples of treated seed cotton, 500 grams each. From them, fiber output and fiber length were determined in the elite farm laboratory Table 2.

2-table

Indicator name	Irradiated cotton	Medicinal seed cotton
Fiber yield (in %)	37.4-37.5	36.36-36.46
Fiber length (mm)	34.0-34.1	33.3-33.5
1000 seed weight	120-130	120-130

As it can be seen from the analysis, the fiber yield of irradiated seed cotton was 37.4%, while the fiber yield of medicated seed cotton was 36.34 %, and the fiber yield of treated seed cotton was 0.6-1.1% less. The absolute weight of the obtained seeds was 120 grams per 1000 seeds according to both options.

Table 3. shows the results of tests conducted in the laboratory of the Institute of Materials Science of the Academy of Sciences of the Republic of Uzbekistan on layer drying of cotton raw materials under the influence of infrared radiation based on functional ceramics.

3-table

Time, min.	Weight, gram		Humidity	
	initially	after	initially	after
1	100	98.0	12	10.3
2	100	96.8	12	8.8
3	100	95.8	12	7.8

Conclusion

When the product is dried under the influence of infrared rays, the infrared rays interact only with water molecules and displace them from the composition of the product. Since the organic hydrocarbon molecules, the main component, are not affected by infrared rays, they retain their original molecular structure, and the natural biological composition of the product remains unchanged. Because the energy of infrared rays, which have a lower frequency and energy compared to optical and ultraviolet rays, is not enough to break down the constituent molecules.

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