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The Choice of Drying Devices is Based on a Comprehensive Analysis of the Properties of Wet Materials Studied as Drying Objects

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ABSTRACT:To create the drying technology and its hardware, it is necessary to develop methods for controlling the processes occurring in the material itself - the drying object, in order to obtain a high-quality product with regulated physic-chemical, structural-mechanical and organoleptic indicators. To create the drying technology and its hardware, it is necessary to develop methods for controlling the processes occurring in the material itself - the drying object, in order to obtain a high-quality product with regulated physic-chemical, structural-mechanical and organoleptic indicators.

KEYWORDS:dryings; seeds; cellulosic.

I. INTRODUCTION

Therefore, the solution of urgent problems in the field of drying should be based on the scientific principles of drying technology: from studying the properties of the material (product) as a drying object - to choosing methods and justifying the process regimes and only on this basis - to the creation of rational designs for drying plants.

Wet materials as drying objects have different specific features, which are due to their nature and structure (capillary-porous, colloidal, capillary-porous-colloidal), chemical composition, pre-treatment methods and preparation for drying [1]. In wet materials, there are various forms and types of moisture bond, and in the conditions of "deep" drying it is necessary to remove moisture, which is very tightly bound to the solid skeleton of the product [2].

Technological properties of materials are described by the thermodynamic characteristics: the potential of moisture transfer, the specific mass, the thermo gradient coefficient, the binding energy, etc., ie, the drying technology is directly related to the thermodynamics of mass transfer.

The transfer of moisture and heat in dispersed bodies also depends to a large extent on the forms and types of moisture binding to the solid phase. There are various methods for determining the forms of the connection of moisture with the material. The most common methods for determining the hydrothermal characteristics of materials are the methods of thermograms, energygrams and isotherms of sorption and desorption of water vapour.

II. SIGNIFICANCE OF THE SYSTEM

The method of thermograms is a powerful tool in the study of the properties of wet materials. The thermal analysis was recorded on a derivatograph of the Paulik-Paulik-Erdei system [3] at a rate of 10 deg / min and in weights of 140-180 mg with the sensitivity of the galvanometers T-900, DTA, DTG-1/10, TG-200. The recording was carried out under atmospheric conditions. The holder was a corundum crucible with a diameter of 10 mm without a cover. Al_2O_3 was used as a standart.

The derivatograph is a multifunctional system for thermal analysis, which allows one to obtain TG, DTG, DTA and T- curves of the sample TG- thermal gravimeter, DTG- differential thermal gravimeter, DTA- differential thermal analysis, T- temperature) on one tape. The device includes: an analytical balance, an oven, a device for regulating the temperature of the oven for a given program, crucibles for a sample and a standard, a voltage regulator and a galvanometer recorder that operates on the principle of "light beam - photographic paper". Analytical scales with air damping have an accuracy of ±0.2 mg at the maximum deviation, a working interval of measuring the mass from 10 mg to 10 g.

The energy heterogeneity of bound water is estimated from the temperature drop of dewatering (dehydration) of a thin (1-2 mm) wet sample -ΔT fixed by a thermogram of drying under thermodynamic conditions for the

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successive evaporation of moisture of different forms of bonding (quasi-equilibrium state of the material under soft drying conditions). The drying thermogram automatically recorded on the potentiometer chart has a series of singular points that characterize certain forms and the state of the absorbed moisture. The presence of a standard thermogram of a capillary-porous body, on which all forms and states of absorbed moisture are presented, allows us to decipher the thermogram of the investigated wet material. A complex analysis of two non-similar wet materials as a drying object was investigated and carried out: sunflower seeds and cellulose materials [4,5].

The heating curve of a crushed sunflower kernel for five minutes on an agate mortar is characterized by a single endothermic effect at 108 ° C. On the DTA curve of the kernel of the sunflower seed with scissors in half, one endothermic effect was observed at 112 °C. The heating curve of the upper part of the seed without a sunflower kernel cut off with scissors revealed one endothermic effect at 104 °C. Four exothermic effects were identified at temperatures above 142°C. The obtained derivatograms of heating sunflower seeds allowed to substantiate the permissible heating temperature of the material.

To calculate the forms of moisture binding, isotherms of sorption and desorption of gases and vapors obtained experimentally are used. Isotherms of sorption and desorption of gases and vapors are usually experimentally obtained on special vacuum sorption plants with McBen weights. On the basis of the experimental isotherms of sorption and desorption, the most important structural characteristics of sorbents are calculated, namely the specific surface area and the integral differential porosity of the sorbents characterizing the porosity of the sorbents in the sorption filling region.

III. LITERATURE SURVEY

The structure of a porous space is usually understood as a form of organization of pore space as a system of individual elements of this space in their interrelation with each other. The most important characteristics of a porous structure are:

1. The total porosity. 2. Equivalent pore radius. 3. The magnitude of the specific surface area. 4. Integral porosity.

Based on the experimental isotherms of sorption-desorption of sunflower seeds, the material is classified according to colloidal-physical properties, differential and integral functions of pore distribution along radius are calculated. Based on the sorption data, a nomogram for determining the binding energy of the moisture of sunflower seeds, the specific volume of micropores, the specific surface area and the net heat of desorption of the monolayer were calculated. In terms of the maximum hygroscopic moisture content of sunflower seeds, the limiting sorption volume "over water" is estimated.

IV. METHODOLOGY

Based on the results of sorption of water vapor, the parameters of the capillary-porous structure of the samples, sunflower seeds, sesame and rape were determined. Based on the results of the study of the isotherms of sorption and desorption of sunflower, X_m- is the monolayer capacity, S_{sp} - is the specific surface area, W_t- is the total pore volume and r_k- is the critical pore radius. These data make it possible to determine the drying time and form of the moisture bond with the materials studied.

The capillary-porous structure of samples of sunflower seeds, according to sorption of water vapor, is given in Table 1.

Table1 Capillary-porous structure with sunflower seed according to water sorption data.

Sample	Sunflower seeds
Monolayer capacity, X_m, g/g	0,0028
Specific surface area, S_{sp}, m^2/g	9.858
Total pore volume, W_t, cm^3/g	0.136
Critical radius of pores r_k, A	275.9

On the basis of a complex analysis of the properties of sunflower seeds as an object of heat-technological treatment, according to the value of the maximum hygroscopic moisture content, according to the classification table of Professor Mukhiddinov D.N. [6], a drying device of the fluidized bed was chosen.

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A comprehensive analysis of the properties of cellulosic materials as drying objects was carried out. The mechanism of the physico-mechanical connection of moisture retention is considered.

The data on physicomechanical, thermophysical and sorption-structural properties and characteristics of cellulose materials as drying objects have been studied, systematized and generalized in order to choose the most rational method of drying. The physicomechanical characteristics of cellulosic materials are determined.

V. EXPERIMENTAL RESULTS

Based on the analysis of thermograms (Table 2.) the drying regime was determined, i.e. there were permissible or necessary material temperatures in the drying chamber. It is shown that in order to intensify the drying process with a high initial moisture content of the material in the first drying period, it is possible to increase the temperature of the coolant without fear of local overheating of the material. However, such a regime is inadmissible in the second drying period. As this leads to overheating and melting of CDA (cellulose diacetate) particles, as a result of which critical internal stresses in the material can occur, leading to an increase in the adhesiveness of the surface of the filters.

Results of thermographic analysis of cellulosic (TAC) materials Table 2.

Communication form	Types of bonding	Materials			
		Fibrous cellulose	Powder-like cellulose	TAC	CDA
Physicochemical bonding	Moisture of monomolecular adsorption,%	3.14	3	2	3.4
	Moisture of polymolecular adsorption,%	3.14-10	3-9	2.1-4.0	3.4-7
Physico-mechanical bonding	Capillary moisture of micropores,%	10-18	9-32	4-10	7.65-12
	Butt moisture of micropores,%	18-25	32-78	10-20	12.8-26.3
	Moisture of capillary state in pores and osmotic moisture,%	25-50	78-120	20-40	26.3-37

Sorption studies of cellulose materials at a hygroscopic level were carried out on a vacuum installation with mercury closures and quartz weights of McBen. Measurements of the phenomenon and processes of sorption and desorption of water vapor were carried out at 293K and residual air pressure 10^{-3} -10^{-4} Pa. The sorption-structural characteristics of cellulose materials calculated on this basis are presented in Table 3.

Sorption-structural characteristics of cellulosic materials Table 3

	Cotton pulp	CDA	TAC
Maximum hygroscopic moisture content,%	21.8	15.2	16.2
Moisture content of monomolecular BET adsorption,%	3.41	3.35	3.3
The limiting sorption volume for water, $m^3/g\ 10^6$	0.213	0,152	0.1
Specific surface area according to BET, $m^2/g\ 10^4$	121	119	116
Average radius of pores, nm	3.6	2.56	2.9

** BET- S. Brunauer, P. Emmet, E.Teller the theory of polymolecular adsorption*

VI.CONCLUSION AND FUTURE WORK

Based on the obtained experimental data on the main properties of cellulose materials as objects of heat treatment and using sorption and other properties of materials, revealed by known generally accepted techniques, calculated generalized drying curves for cellulose materials were constructed. On the basis of a complex analysis of the properties of cellulosic materials as an object of heat treatment according to the value of the maximum hygroscopic moisture content, according to the classification table of Professor Mukhiddinov DN [6], a combined aerophonic type dryer was chosen.

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