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Investigation of the Properties of Dispersed Materials Cellulose-Based as an Object Technological Processing

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Abstract. The properties of dispersed materials based on cellulose as an object of technological processing are considered, the technological characteristics of cellulose diacetate are given.

Key words: properties, like object, material, cellulose.

The development of highly efficient typical dryers is impossible without a comprehensive analysis of the material as an object of drying. To study the properties of materials as objects of technological processing, general theoretical information is not enough, but it is necessary to know the characteristics of wet materials in all groups and methods for their determination.
This paper discusses the main characteristics of wet materials such as:

1. Technological characteristics (permissible heating temperature of the material, fire and explosive properties), often limiting the choice of drying method and the design of the apparatus;
2. Structural and mechanical (adhesive-cohesive properties, particle size and shape) affecting the choice of hydrodynamic drying mode and design of loading and unloading devices;
3. Thermophysical (thermal conductivity, thermal conductivity, heat capacity), - responsible for thermal resistance in the drying process;
4. Hygrothermal (drying thermograms, wetting heat, thermography) – determining the types and energy of moisture binding with materials;
5. Sorption-structural (sorption-desorption isotherms, pore distribution curves by radii), - responsible for internal diffusion resistance during drying.

A huge range of materials and a wide variety of their properties cause significant difficulties in their analysis as an object of drying, classification and selection of rational apparatus and technological design.

The literature [1,2,3,4,7,8] provides data on the properties of many polymer dispersed materials, which are generalized and systematized.

For cellulose-based polymer materials, there are also data on their properties, but they are insufficient to choose the method and type of drying apparatus.

The main characteristics that are necessary to achieve this goal are structural-kinetic, thermophysical, thermographic and technological properties. Hence, it became necessary to study these properties for the most common cellulose–based polymer material - diacetate cellulose, husk and polyanionic cellulose in order to choose an effective method of heat treatment and the type of drying apparatus.

The most appropriate methods for obtaining the main characteristics of diacetate cellulose are considered below.

The analysis of the most important characteristics and complex analysis of materials as an object of technological processing is carried out on the example of a dispersed polymer material based on cellulose – cellulose diacetate, which is very important in various branches of the chemical industry.

Technological and physico-mechanical properties of diacetate cellulose.
Technological characteristics.
Cellulose esters are acetyl derivatives of cellulose obtained by esterification of cellulose with mineral acids or anhydrides of organic acids [6].
None of the cellulose derivatives finds such a wide and versatile application as cellulose acetate, from which threads, sheets, etrols, film-photo films, plastics, varnishes and other coatings, adhesives and binders are produced.

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In industry, cellulose acetates are obtained by heterogeneous and homogeneous methods.

As a result, the final product is obtained in the form of white granules. The degree of polymerization for diacetate cellulose is 400, the degree of substitution is 250, the content of acetic acid is 0.02%. By its chemical properties, diacetate cellulose is soluble in acetone, acetic acid, dioxane, ethylactate, furfural, methyl acetate, nitromethane, methylene chloride and cyclohexane. Resistant to the action of benzene, toluene and gasoline.

The permissible heating temperature is 120 °C, the auto-ignition temperature is 420 °C, the softening temperature is 200 °C, the decomposition temperature is 220-270 °C.

The main quality indicators of diacetate cellulose presented to the finished product according to the technological requirement and the corresponding technical specifications-6-55-11-88 for the production of acetate filaments.

The physico-mechanical properties of polymer materials are granulometric composition, bulk and true densities, porosity of the fixed layer, angle of natural slope and internal friction, shape coefficient and a number of other factors. These properties affect, first of all, the movement of particles in the apparatus. Knowledge of all these characteristics is necessary for the correct selection and justification of the design of drying plants, the development of methods for calculating aerodynamic and thermal processes in drying machines.

To determine the bulk density, a measuring cylinder was used, and the true density was determined in a pictometer, the choice of a liquid wetting, but not dissolving particles, was made on the basis of data on the solubility of substances.

The study of the granulometric composition of diacetate cellulose was carried out with a set of sieves GOST 3584-73.

According to the granulometric composition, the equivalent diameter of the particles of the dried material is determined. The granulometric composition of diacetate cellulose in the form of an amorphous product corresponds to the-6-55-11-88 .

Important quantities characterizing the rheological properties of the material are the angle of natural slope and the angle of internal friction.

The angle of the natural slope characterizes the bulk properties of the material, being related to the opening angle in the dryers of the suspended layer, it determines the possibilities of organizing the downward movement of the peripheral zone in the fluidized bed without the formation of stagnant zones on the walls of the housing, sticking and clumping of the material.

A static method was used [1] to determine the angle of natural slope for our material under study, since the material takes the form of a cone with free precipitation.

The angle of internal friction allows you to calculate the resistance of the bulk material to shear at any value of normal stress. The experimental determination of the angle of natural slope and the angle of internal friction was carried out according to the well-known method [1,5].

The value of the angle of natural slope for dry diacetate cellulose was 27 ° C, for wet - 32 ° C, the angle of internal friction - 46 ° C.

The geometric shape coefficient of the particles of fiber-forming polymers is of great importance. The shape coefficient is the ratio of the particle surface Fh (or volume Vh) to the surface of an equally large ball Fh (or volume Vh) 13.62.

A photographic method was used to determine the particle shape coefficient [2].

References

1. Голубев Л.Г., Сажин Б.С., Валашек Е.Р. Сушка в химико-фармацевтической промышленности. - М.: Медицина, 1978. – 727 с.
2. Сажин Б.С., Лукаячевский Б.П., Мухиддинов Д.Н., Шаисламов А.Ш. Определение геометрического коэффициента формы фотографическим методом. – Изв. АН УзР, серия технических наук, 1982, № 5, С. 22-25.
3. Сажин Б.С., Шадрина Н.Е. Выбор и расчет сушильных установок на основе комплексного анализа материалов как объекта сушки. – М.: МТИ, 1976. – 93 с.

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4. Мухиддинов Д.Н. Теория выбора сушильных аппаратов взвешенного слоя. – Изв. АН УзР, № 3, 1989.
5. Сажин Б.С., Сажин В.Б. Научные основы техники сушки. М.: Наука, 1997. – 447 с.
6. Аким Э.Л., Перепечкин Л.П. Целлюлоза для ацетилирования и ацетаты целлюлозы. – М.: Лесная промышленность, 1971. – 232 с.
7. Атаназевич В.И. Сушка пищевых продуктов /В.И. Атаназевич. - М.: ДеЛи, 2010. - 295 с.
8. Васильев, В. Н. Технология сушки. Основы тепло- и массопереноса / В. Н. Васильев, В. Е. Кулакова, С. В. Фролов. — СПб.: ГИОРД, 2013.
9. Романков П.Г., Фролов В.Ф., Флисюк О.М. Массообменные процессы химической технологии. - Химиздат, 2011.