MODELS OF WATER VAPOR SORPTION BY HYDROPHILIC POLYMERS

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ABSTRACT

Various models and equations of water vapor sorption (WV) for hydrophilic polymers were considered. However, these models often do not correspond to the sorption mechanism. The new model proposed in this paper is based on the thermodynamics of binary systems and its combination with the Van Krevelen method of polar group contributions in the sorption of WV. It was shown that the mechanism of WV sorption by various hydrophilic polymers is the absorption of water molecules in the volume of amorphous domains of these polymers. Based on the developed model, a universal physicochemical equation was derived, which makes it possible to adequately describe the sorption isotherms of WV by amorphous hydrophilic polymers knowing only the chemical formulas of repeating units of these polymers. To calculate the sorption isotherms for semicrystalline samples, it is necessary to use an additional parameter, namely the degree of amorphicity (Y). The adequacy of the proposed equation was verified for samples of cellulose and other natural polysaccharides, as well as for samples of synthetic hydrophilic polymers such as polyvinyl alcohol, polyamide-6, and polycaprolactone having various Y-values. The verification showed that the experimental isotherms are almost identical to the isotherms calculated by the universal equation.

FEATURES OF WATER VAPOR SORPTION BY CELLULOSE MATERIALS

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ABSTRACT

In this research, the sorption of water vapor (WV) by various cellulose samples (microcrystalline cellulose, cotton cellulose, Kraft pulp, mercerized cellulose, and rayon fibers) has been studied. The sorption isotherms of WV for various samples have a sigmoid shape. To describe such isotherms, various models have been proposed, including mono- and multimolecular adsorption, formation of hydrates and solid solutions, and mixed models combining various sorption mechanisms. After a critical analysis of known models, the new absorption model was proposed to explain the interaction of VW with cellulose samples. It was confirmed that crystallites are inaccessible for water, and therefore water molecules can be trapped only by polar groups of non-crystalline (amorphous) domains of cellulose materials. The developed model permitted obtaining the general absorption isotherm of water molecules in amorphous domains of cellulose. Moreover, the equation was derived, which describes both the general isotherm and isotherm of any semicrystalline cellulose sample, when its crystallinity or amorphicity degree was pre-determined. Based on the developed absorption model, various characteristics can be found, e.g., degrees of amorphicity and crystallinity, the maximum amount of absorbed water, the specific surface area of wet cellulose sample, water, and the amount of capillary condensed water, etc.

INFLUENCE OF THE EFFECT OF "SMALL CONCENTRATION AND EXCITATION" IN THE PROCESS OF OIL REFINING

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ABSTRACT

Nanotechnology was developed as a series of innovative technologies based on the "small concentration and excitation" effect in crude oil water-salt mixture to prevent corrosion in processing plants and chemically purified water lines of Heydar Aliyev Oil Refinery. This technology is dedicated to efficiency improvement of oil desalting (electric dehydrators) during the initial refinery process in chemically purified water lines (economizer, water vapor boiler, water vapor heating systems, strings, technological heater, heat exchanger, refrigerators, and pipelines). Studies were conducted based on the scientifically justified theory of the "small concentration and excitation" effect

A NEW APPROACH TO GRAIN PROCESSING AND STORAGE

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ABSTRACT

The need to maintain the thermal stability of grain at the stage of its elevator, often for many hours, drying, and subsequent storage limits the possibilities of intensification of these processes. Shaft, column, drum, and other dryers, modern granaries are bulky and energy-consuming, poorly or not at all connected with the subsequent stages of grain processing, which, in turn, are lengthy and multistage, which often leads to a decrease in the quality of the final product. To radically solve this problem, it is proposed already at the stage of post-harvest drying of field grain to purposefully violate its thermal stability by applying the method of *"thermovstruding* " high-speed heating, drying, and explosion (swelling) of grain during high-temperature processing in impinging streams for 3-5 seconds. The product of thermovstruding is "*vstrudat-grain"*, in which raw starch is converted into dextrin and sugars, while its disinfection from harmful inhibitors is carried out, maintaining the microelements and vitamin composition. Thus, the process of elevator drying and expensive grain storage is replaced by thermovstruding with simplified (without additional drying and ventilation) floor storage of the vstrudat and obtaining a finished product of an improved quality or semi-finished product used in flour-grinding and cereals, alcohol (ethanol), oil-brewing, brewing, etc. technologies. The implementation of a new approach to grain processing and storage is possible based on the developed technology of thermovstruding. Pilot industrial and industrial thermovstruders of two types have been created - autonomous and satellite ones converted based on the reconstruction of standard grain dryers. Long-term use of thermovsrtuders operating on flue gases, hot air, and superheated water vapor before unattainable temperatures up to 600 ° C (even without the special task of grain drying) has shown high economic efficiency, which

increases when field grain is with high humidity. The universality of thermovstruders allows the use of thermolabile modes of high-intensity drying for seed grain.

MATHEMATICAL MODEL OF A CASCADE SEPARATOR WITH TWO OR SEVERAL INITIAL MATERIAL INPUTS TO THE APPARATUS

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ABSTRACT

A mathematical model of a cascade separator with two or several initial material inputs into the apparatus is developed. We can significantly affect the compositions of final products by feeding material to various stages of the cascade. It is very important for processes whose objective is to obtain powders with specified compositions. By way of example, we can mention copper powders for aircraft and motor-cars industries. The requirements for such powders include limitations on the contents of three different fractions within the total range of powder sizes. Since the sizes of these fractions are much below 100 microns, it is practically impossible to separate them using sieves for further preparation of required compositions on an industrial scale. However, this problem is solved by separation methods by dividing the initial material between two inputs into the apparatus. It is practically impossible to solve this problem empirically. We have managed to do it using the mathematical model described in the present paper.

NEW TECHNOLOGIES FOR PARTICLE ACCELERATORS

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ABSTRACT

The article proposes to consider two fundamentally new ways of accelerating charged particles: linear acceleration (LA) of protons on a backward wave (Professor Bogomolov's Accelerator) and wake acceleration of electrons using a proton driver in the Large Hadron Collider (AWAKE project).