SYNERGETIC BASIS TOOLS AND METHODS OF PROCESS CONTROL IN CAPILLARY-POROUS MATERIALS

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ABSTRACT

For solving a number of practical problems which are associated with the technology of impregnation a capillary - porous material, it is proposed to use superheated steam at atmospheric pressure as the working fluid to create condensation effect and control the quality and speed of impregnation. In this work are proposed hardware-technological design based on synergistic combination ages of heating, impregnation and drying, which significantly reduces capital investment and allows the use of engineering solutions for the impregnation of other capillary-porous materials (porous sintered materials, catalysts, construction materials, fur and leather products, textile materials and others.). There are shown the results of studies the influence of condensation process on the kinetics of filling with liquid the capillaries and pores, kinetic characteristics of the process, the depth of impregnation, the degree filling of capillaries, the ratio of the volume impregnated capillaries to the their total volume and etc., which take into account the changes in the driving force of the process and its mechanism.

NANOSTRUCTURING OF CONCRETE MATERIALS

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ABSTRACT

The article presents nanostructuring of cement systems due to introduction of ultra- and nano-dispersed mineral additives. In this process, additional grinding of mineral additives is made in cavitaion installations during preparation of concrete mixtures. Nanostructuring provides compaction of concrete structures and increase of strength parameters 1,5 – 2 times.

ISOPHASE AND PHASE TRANSITIONS OF CELLULOSE
SHORT REVIEW

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ABSTRACT

Cellulose has complicated supramolecular structure consisting of nanofibrils, which are built of ordered crystallites (CR) and low ordered non-crystalline domains (NCD) in various CR/NCD ratios, from 4 for nanocrystalline cellulose to zero for amorphized cellulose. Moreover, crystallites have four main allomorphs, CI, CII, CII and CIV. In this critical review isophase temperature transitions in NCD and phase transition of cellulose crystallites, as well as amorphous cellulose, were described and discussed. It has been shown that due to structural

heterogeneity the non-crystalline domains have three isophase temperature transitions, where the α_1 and α_2 transitions are caused by the occurrence of segmental mobility in dense mesomorphous and medium packed amorphous clusters, respectively; whereas the β transition is related to the mobility of small segments in loose packed amorphous clusters, which probably are located on the outer surface of nanofibrils. Under the action of water and other plasticizers all three isophase transitions are shifted to lower temperatures. Various crystalline allomorphs and amorphous cellulose can be converted into each other as a result of phase transitions, such as recrystallization, decrystallization, transitions between various crystalline allomorphs, etc. Important phase transition is a sol-gel process, when cellulose is dissolved and then regenerated from the solution. In this review mechanism of the phase transitions and their relation to isophase transitions of cellulose was disclosed.

PHYSICOCHEMICAL METHODS FOR DETERMINATION OF CELLULOSE CRYSTALLINITY

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ABSTRACT

Two physicochemical methods for determination of crystallinity degree of cellulose have been developed. The first method was to study the sorption of water vapor (A), and second was to measure the enthalpy of wetting (ΔH). These methods are based on mechanism of interaction between cellulose and molecules of water, which is carried out in the amorphous domains of the polymer. Thus, increase in content of amorphous domains and decrease in degree of crystallinity leads to rise of water sorption and enthalpy of wetting. As a result, an equation for calculation of the crystallinity degree (X) of cellulose was proposed: $X = 1 - (Z/Zo)$, where Z is a physicochemical parameter (A or ΔH) of the sample, and Zo is a theoretical parameter calculated for amorphous cellulose. Both physicochemical methods give similar values of crystallinity degree. For example, crystallinity degree of MCC samples was 0.72 to 0.75. It was shown that the independent physicochemical methods for determination of cellulose crystallinity are free of shortcomings inherent to physical methods such as XRD and NMR; therefore the proposed method can be used to determine the actual degree of crystallinity of cellulose samples.

NANOTECHNOLOGY IN PRODUCTION OF BIOACTIVE PAINTS, COATINGS AND FOOD STORAGE MATERIALS

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ABSTRACT

Present paper is devoted to creation of a new bioactive composite on a basis of silver nanoparticles. The biocidal effect of nanoparicles-modified paints and coatings is investigated. The structure and technology of biologically active nano-composites preparation is offered.

ENVIRONMENTAL FRIENDLY METHOD OF PRODUCTION OF NANOCOMPOSITES AND NANOMEMBRANES

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ABSTRACT

New "green" technology is based on using an unusual physical phenomenon –superdeep penetration (SDP). Synthesis of a skeleton and formation of nanostructure is realized in metals, polymers and ceramics. Physical anomalies at the impact, which appearing in conditions when relative depth of a crater exceeds 10 determining sizes of striker are considered . The influence of the pulse mode on metals and alloys provides reorganization of a material on sub-, micro- and macrolevels. Fibers of ultradisperse structure are formed. Interaction of chemical elements in the field of high pressure produces the metastable connections in large quantities and change of physical and chemical characteristics of the initial materials. Massive composite material from technical aluminum reinforced by fiber zones with reconstructed structure and anisotropy of electro conduction in mutually perpendicular directions in 2 times was obtained. Superdeep penetration is used for manufacturing of special composite metal materials with an unusual complex of properties. Products of interaction for example, carbon and silicon are saved in volume of preform and don't organize harmful waste at manufacture. The new SDP method of polymer tracking membranes production was developed.. The method for manufacturing track membranes by piercing a matrix of a thin-film material with a flow of hard particles generated by an electric field is proposed as well.

ANTI-SALINE DEPOSIT NANOSYSTEM IN OIL PRODUCTION

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ABSTRACT

The paper deals with the development of multifunctional inhibitor preventing hardness deposition forming in oil-water flow in the process of production and conduction of field tests. Effect of nanosystems against hardness deposition on alkane and sulphanole agents and their compositions, as well as, that of this surface active agent (SAA) together with copper-nanoparticles were studied in this paper. These nanosystems prevent the agglomeration of saline crystals forming in produced water and prolong their induction period, as well as, generate protective cover on equipment. According to field test results of the developed inhibitor in production well N2946 of "Bibiheybatneft" OGPU, it was affirmed that multifunctional agents of nanosystem possess highly preventive effect against saline deposits and modify physical-chemical properties of oil for better. As such, after the application of composition of nanosystem, time between overhauls is prolonged from 27 days to 147 and recovery ratio increases by 12,5%.

ENERGY EFFICIENCY OF BLADED WIND TURBINE.
OPTIMIZATION MODEL

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ABSTRACT

**It is believed that the vertical-axis wind turbines are less energy efficient than the widely used high-velocity propeller power plants, but have significant design and operational advantages and can achieve more power. For in-depth analysis of such plants formed an universal optimization model interaction adjustable blades of the wind turbine with the air flow, applicable to a wide range of design and operational parameters. The model reflects the mechanism for converting the kinetic energy of the air flow into the rotary motion of the turbine, assuming a superposition of action of the applied forces, and determines the corresponding volumes withdrawn from the flow of energy (power). The model allows to determine the kinematics of the blades ensures maximum extraction of energy flow. Formed on the basis of the model calculation method allows to determine the optimum orientation (configuration) of the turbine blades, calculate the absolute and unit indicators of picking energy and capacity of the air flow. Implemented features both exact analytical approach and multivariate numerical experiment. Optimal orientation's indicators of the blades essentially depend on the profile of the blades and the turbine velocity mode. Revealed significant effects of
inversion of the blade at its optimization, characterized by abrupt changes orientation parameters (configuration). Efficiency of the turbine with flat blades as a whole is substantially limited due to longitudinal air resistance. Application of the impeller blades allows to use the superposition of the front and lift forces and bring the turbine on high-velocity energy-efficient modes. The proposed technical solution allows to provide the turbine's efficiency by optimal control of impeller blades.**

THE ANALYTICAL SOLUTION OF THE PROBLEM OF WARMING UP
OF THE SANDWICH CONSTRUCTIONS AT FIRES

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ABSTRACT

Here is presented the analytical solution of a problem of a warming-up of a triplex plate essentially various heat-physical performances of extreme stratums, at boundary conditions of the second sort. It is shown, how to gain from extended the settlement formula the similar solutions for double-layered and one-layered plates. There are given the solutions for given functions of a thermal stream.

PROSPECTS AND IMPLICATIONS OF STRUCTURAL INSULATED PANELS IN LOW-RISE CONSTRUCTION

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ABSTRACT

The research of pilot house at the site of the Voronezh State Architecture and Construction University confirmed the high insulating properties of structural insulated panels (SIP). The results allow recommending these constructions for use in the northern regions. The possible consequences of long-term operation of buildings, erected by the SIP technology, were considered. Presented data includes measurements of harmful substances released into indoor air spaces. Obtained dependencies allow predicting the aging of polystyrene, which is filled in the frame and panel construction.

ACTIVATED CARBONS OF DIFFERENT NATURE FOR GOLD EXTRACTION PROCESSES

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ABSTRACT

The morphology and structure of activated carbons derived from vegetable and mineral raw materials have been studied, their physical and chemical characteristics have been determined. The highest specific surface was 1100 m^2/g, this index was calculated for the activated carbons based on coconut shells, for the activated carbons based on birch this index made up 950 m^2/g, for the activated carbons based on furfural copolymers the specific surface was 653 m^2/g, the specific surface of the carbons based on shungite was 246 m^2/g. The activated carbon based on furfural copolymer had low percentage of ash (0.3%) and high mechanical strength (98%). We also carried out the studies on sorption of gold from various industrial solutions with different pH levels. We determined that in 48 hours gold ions were extracted from industrial solutions with the help of furfural activated sorbent up to the value of 99.8%, with the use of birch activated carbon the index was 99.4% and when using activated carbons based coconut shell the index was 98.9% and the recovery with activated carbons based shungite was 49%. The static capacity of birch activated carbon for gold was 7.2 mg/g, the activated carbon based on coconut shell has the index of 7.0 mg/g, the activated sorbent furfural showed 4.7 mg/g, the activated carbon based on shungite had 2.0 mg/g. The results for desorption of the gold from activated carbons with a solution of NaOH are presented in the work.