THE SIGNIFICANCE OF THE MODIFIED COULOMB ENERGY MODEL IN THE BINDING ENERGY EQUATION

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ABSTRACT

Recent research has shown that the proton-proton repulsion in the nucleus of an atom results in the Coulomb force that is screened by the neutrons residing in the surface region of the nucleus. The exact nature of nuclear interaction and other types of interactions between the protons and the neutrons inside the nucleus is not known exactly. However, the protons inside the nucleus are enclosed in an extremely small volume, and hence the otherwise long-range Coulomb interaction must be confined to a very small volume, with a range of the order of the radius of the nucleus. Thus, the Coulomb potential must be modified to make it more effective inside the nucleus. Investigations on the significance of the modified Coulomb potential among the isobars are carried out to describe in-depth the stability of finite nuclei, particularly the super heavy and the hyper heavy nuclei that have been very elusive to synthesize. It is found that the modified Coulomb potential model yields results that are in agreement with values of the most stable nuclides in the light and intermediate-mass nuclei that are obtained from the nuclear mass parabolas, whereas in the heavy nuclei, different values of stable atomic numbers for the stability of isobars are obtained.

FRACTAL DIMENSIONS OF MICROPOROUS STRUCTURE IN A CELL WALL OF GROWING COTTON FIBERS

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ABSTRACT

In this research, a fractal approach was used to study microporous structure in the cell wall of growing cotton fibers. It was found that dependences of a specific volume of micropores (P) and an apparent density (ρ) on the scale factor, F = H/h, can be expressed by power-law equations: $P = P_o F^{(D_v - E)}$ and $\rho = \rho_o F^{(E-D\rho)}$, where his minimum thickness of the microfibrillar network in the primary cell wall, H is the total thickness of cell wall in growing cotton, and D_v = 2.556 and D_ρ =2.988 are fractal dimensions. From the obtained results it follows, that the microfibrillar network of the primary cell wall in immature fibers is loose and disordered, and therefore it has an increased volume of micropores (P_o= 0.037 cm^3/g) and low density (ρ_o =1.474 g/cm^3). With enhancing days post-anthesis of growing cotton fibers, the wall thickness, and density increase, while the volume of micropores decreases, until the dense structure of completely mature fibers is formed with maximum density (1.537 g/cm^3) and minimum volume of micropores (0.006 cm^3/g). The fractal dimension for a specific volume of micropores, D_v = 2.556, evidences the mixed surface-volume sorption mechanism of sorbate vapor in the pores. On the other hand, the fractal dimension for apparent density, D_ρ = 2.988, is very close to the Euclidean volume dimension, E=3, for the three-dimensional space.

FRACTAL DIMENSIONS OF THE FIBRILLAR STRUCTURE OF A CELLULOSE IN COTTON FIBERS

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ABSTRACT

In this research, a fractal approach was used to the multilevel fibrillar structure of cellulose in cotton fibers. It was found that with an increase in diameter of nanofibrillar bundles of cellulose, their specific volume (V) increases, and the density (ρ) decreases, up to the formation of the fibrillar structure of primary cell wall in cotton fibers. With the beginning of secondary cell wall formation, an inverse relationship is observed: with an increase in the thickness of the cell wall of cotton fibers, the specific volume of the cell wall (V) decreases, while its density (ρ) increases. The power-law dependences of V and ρ on relative scale factor (R) were derived: $V = V_p R^{\pm (E-Dv)}$ and $\rho = \rho_p R^{\pm (E - D_\rho)}$, from which constants and fractal dimensions were found: V_p = 0.68 (cm^3/g), ρ_p = 1.47 (g/cm^3). If $R \leq 1$ then $D_v = D_\rho = 2.980$. On the other hand if $R \geq 1$ then $D_v = D_\rho = 2.987$. Designations: V_p and ρ_p - specific volume and density of primary cell wall, respectively; D_v and D_ρ – fractal dimensions for a specific volume and density, respectively. The obtained values of fractal dimensions, D_v and D_ρ are very close to the Euclidean volume dimension, E = 3, for the three-dimensional space.

NEW BIODEGRADABLE SURFACTANTS: PROPERTIES AND PROSPECTS OF USE

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ABSTRACT

The work is devoted to the study of the physicochemical and functional properties of new surfactants obtained from biologically environmentally friendly raw materials to expand their field of application. External environmental factors quickly destroy the developed materials. A review of the scientific literature on the properties characterizing synthesized surfactants and methods for their study is given. The experimental part of the work includes a description of the methods and objects of research. The results of studying the properties of two surfactants, as well as recommendations for their use, are presented. Surfactant-1 is an aqueous solution of protein hydrolysis products. Surfactant-2 – is a mixture of sodium salts of organic sulfonic acids. Studies of the behavior of new substances at the water-air interface have shown that they belong to the class of active anionic micelle-forming surfactants that reduce the surface tension of water by more than three times. The critical micelle concentration (CMC) was determined for both surfactants. Surfactant-1 is soluble in water; with organic solvents, it forms a stratified mixture. The indicated property can play a decisive role when it is used as a component of detergents (creation of emulsion compositions, disposal of waste detergent solutions). The ability of Surfactant-2 to form stable gels can be used in the development of currently popular gel-like detergents. It was established that both surfactants have some corrosive activity, and, when

used on metal surfaces, it is necessary to provide for the introduction of corrosion inhibitors. Determination of the washing ability of surfactants showed the possibility of their use as components of industrial detergents. Surfactant-1 possesses the best washing ability concerning technological pollution (machine oil, conservation greasing) than Surfactant-2. The strength of Surfactant-1 to the formation of stable foams has been successfully used at present in the production of foam concrete. Surfactant-2 based foams are even more stable; therefore, it can also be recommended as a foaming agent. Increased foaming can adversely affect the use of surfactants in detergents for mechanized cleaning methods. In this case, it is necessary to provide for the introduction of defoamers. Comparative environmental safety of surfactants allows us to recommend them for use in household and cosmetic products, but this requires the elimination of some harmful properties, for example, the specific smell of Surfactants-1.

NEW COMPOSITE FLOCCULANTS-COAGULANTS USING FOR THE PURIFICATION OF NATURAL SURFACE WATER

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ABSTRACT.

Coagulation is an essential process in the treatment of water and industrial wastewater. In the field of drinking water treatment since ancient times, water purification using coagulants using various substances has been practiced. Coagulation is the most common method of purification of natural and wastewaters from the bulk of colloidal, finely dispersed, and partially dissolved contaminants. The characteristics of the new composite flocculants-coagulants ASFC and ISFC developed by the authors are presented in comparison with conventional aluminum and iron salts. The titration method was used to study the behavior of coagulant flocculants at different pH. The titration method was used to study the behavior of coagulant flocculants at different pH. The ζ-potentials and isoelectric points for aluminum hydroxide obtained by hydrolysis of a coagulant are determined. The nature of the interaction of active silicic acid and the products of hydrolysis of aluminum salts as components of composite flocculants-coagulants is shown. The characteristics of natural waters are given, on which the efficiency of using the obtained flocculants-coagulants is investigated. A comparison of the coagulating ability of coagulants in water purification with high color from the Orsha River and with medium color from the Volga and Tvertsa rivers is presented.

STRUCTURE-FORMING PROCESSES OCCUR DUE TO WELDING LAYERED COMPOSITE STEEL-COPPER-BRASS

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ABSTRACT

The object examined is the composite material 20-steel M1-copper L80-brass obtained by explosion welding. It is shown that as a result of mechanochemical interaction during explosion welding in a layered composite material in contact zones, reaction products are formed in the

form of nonequilibrium and equilibrium phases, including the nonequilibrium electronic phase of Cu_5Zn_8 in brass-L80 and the non-equilibrium γ-iron phase. It is shown that the structural transformations in the contact zone of the layers of the composite material are the result of an abnormally rapid mass transfer of copper to iron and zinc from brass to copper, as well as the fact that mechanochemical processes occur in the wave mode. The microhardness of the layers of the obtained composite material was studied.

RHEOLOGICAL PROPERTIES OF EXTRUDABLE FLUOROPOLYMERS

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In memory of Dr.Sergei Peshkovsky, talented physicist and dear friend.

ABSTRACT

Fluoropolymers (FP) are among the most important high-performance polymer materials widely used in various modern industries such as electrical and electronic, automotive, food packaging, medical, pharmaceutical, architectural, and many other industries and applications. Processing of FP, however, is difficult and costly due to complicated rheological, physical and chemical properties, high melting points, and high apparent ("effective") melt viscosity. Results of studies of the rheology of fluoropolymers are very valuable for the development of novel and optimized processing of FP by extrusion, injection molding, lamination, and other modern processing technologies. We attempted to cover these issues as well as novel FP and trends of their development and applications in series of large reviews. Some fluoro-containing polymer like for example PTFE (widely known under DuPont's trademark "Teflon") have such a high melt viscosity that people (even polymer specialists) are mistakenly considering this material as "*non-meltable*". Such materials are commercial "non-melt-extrudable" and being processed via sintering and skiving and paste- and ram-extrusion into a film, sheets, rods/tubes, plates, and machined into various items. This paper briefly describes the main industrial melt-extrudable FP, being melt formable, their viscous and viscous-elastic and specific properties based on measurements and experimental results as well as reviews of the most important results published by researches during the recent time.