

HIGH POWER DISK LASERS: ADVANTAGES AND PROSPECTS

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ABSTRACT

A number of advantages of high-frequency pulse-periodic lasers emitting short pulses, as applied to a wide range of industrial technologies, is the basis of many modern concepts of disk lasers. High-intensity light with an insignificant thermal lens effect in the central high-loaded zone of the active medium have led to the lifting of restrictions on the brightness of the pump diode. This has reduced the cost of laser sources, and thus has significantly improved the efficiency of electro-optical conversion, especially in the regime of high average power. Creation of megawatt high-frequency pulse-periodic lasers with a large cross section of the active medium opens up great prospects for their use in solving the problems of launching of small satellites with lasers, formation of super-long conducting channels in space and atmosphere, cleaning of the near-Earth space from the space debris

COLLOID-CHEMICAL PROPERTIES OF POLYACRYLNITRILE DERIVATIVES COMPOSITES WITH SURFACTANTS

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ABSTRACT

The paper contains a data on systematic investigations of the colloidal-chemical properties of the polyelectrolytes of the polyacrylnitrile derivatives of various hydrolysis degree and polymers hydrophobic part structure in compositions with surfactant. It is established that the addition of the surfactants into polymers solutions leads to a creation of the non-stoichiometric complexes between hydrolyzed polyacrylnitrile (HPAN) and sodium oleate (OLNa), OLNa and polyacrylamide (PAA) due to the electrostatic interaction between polyelectrolytes (PE) and surfactant micelles. It is shown, that properties of the compositions depend on the components mixing procedure, components ratio, which influence the conformation conditions, charge sign of the polycomplex, viscosity properties, and surface activity of the formed composition materials. Based on the obtained results it was shown, that at relative concentration of HPAN $[\beta]$ is of $1 \div 2.5$ a charge of the complex is defined by OINa micelles charge sign. While at $[\beta] > 2.5$, it was observed an inversion of ξ - potential of the OINa micelles, where a charge sign of the complex is defined by sign of HPAN charge. At alkaline media, all surfactants ions are involved into micelles formation *via* electrostatic connections. Furthermore, at $\beta > 4.5$ an increase of a positive charge of the HPAN-OINa complex on protonization (due to excess of polybasic functional groups) leads to a slight increase of the reduced viscosity. It is established that formation of the composites leads to an increase of the surface activity and a reduction of the polymer's adsorption standard free energy, which are important parameters for the composites usage in various technological processes at interface surfaces.

EFFECT OF LOW-ALUMINA BLAST FURNACE SLAGS AND PHOSPHORGYPSUM DIHYDRATE ON PROPERTIES OF SUPERSULFATED CEMENTS

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ABSTRACT

The paper discusses the possibility of obtaining of supersulfated cement made almost totally of waste raw materials such as, low alumina blast furnace slag and waste phosphogypsum dihydrate. The research studied the influence of alternative components on the phase composition, strength properties and microstructure of supersulfated cement. The technological peculiarities of preliminary treatment of phosphogypsum and manufacturing of supersulfated cement are explained. The rate of structure formation in this type of cement was investigated by setting time determination and the microstructural characteristics were studied by means of X-ray analysis, and scanning electron microscopy. It has been demonstrated that the strength properties of this innovative supersulfated cement are comparable to those of blast furnace slag cement.

WOLLASTONITE IS THE EFFECTIVE FILLER FOR RUBBER AND POLYVINYLCHLORIDE

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ABSTRACT

Wollastonite, a natural mineral, is of great interest as a filler of polymer materials. It is characterised with needle structure of crystals, at splitting of which granules of anisodiametric shape are being formed. Wollastonite of needle-fibrous structure is an absolutely safe mineral filler. It is non-toxic, non-radioactive, non-explosive and non-hygroscopic. This is a calcium-aluminosilicate functioning in many materials as a reinforcing filler. In the plastics industry wollastonite is used in production of vulcanized and thermoplastic rubbers, concrete and vinyl floor tiles, vinyl, polyester and epoxy resins, vinyl plastisoles. Wollastonite provides the reduction in cost of rubbers and plastics in combination with high heat resistance, low dielectrical features, moisture absorption and stability of mechanical properties. Introduction of wollastonite in the content of PVC and SIR compositions appears efficient from technical points and also considering economic and ecological factors.

PHYSICS OF GAS AND WATER FLOWS IN PLANTS: SUPERFLUIDITY OF GROUND WATER IN XYLEM CAPILLARIES

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ABSTRACT

To complete the process of photosynthesis of organic compounds in plants, ground water, carbon dioxide and hydrogen should be used. Mechanisms of ground water supply of the plants and receipt of hydrogen out of it, that is necessary for photosynthesis of organic matter, as well as the problem of extracting the carbon dioxide from the air, has long attracted the attention of scientists. However, to solve these problems based on the known laws of physics was not possible. The application of the solutions "superfluidity" phenomenon, that was observed by us, in the electrically charged capillaries and associated effects to plant life processes can solve these problems. The mandatory conditions of the appearance of "superfluidity" are observed in plants: inner surface of the xylem capillaries is electrically charged (as in electret tubes); the groundwater is a solution of humus acids and salts.

SUPERFLUIDITY OF AQUEOUS SOLUTIONS IN CAPILLARIES

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ABSTRACT

Abnormal superfluidity of aqueous solutions in capillaries of porous bodies (in membranes made of ground powders) has been found. The phenomenon has been caused by electrically charged and chemically active surfaces of capillaries which pierce through layer membranes made of mechanically active powders. The solution value of viscosity calculated by the measured speed of filtration and geometrical parameters of capillaries in layers of membranes appeared to be 2-5 times less than the value of viscosity of water.

NANO, MICRO TRANSFORMATIONS OF TERMO DEGRADED PRODUCTS OF WOOD AND THEIR INFLUENCE ON THE SAFETY OF FOOD

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ABSTRACT

The problem of use of products of thermal decomposition of wood for reception of food is considered. It is shown, that contents of polycyclic aromatic hydrocarbons (PAH) in food depends from the nano and micro sizes of smoke particles. The paper examines the dependence on the nature of the wood used for smoking on the formation of fifteen PAHs. Eight PAHs (benzo[*a*]pyrene, benzo[*a*]anthracene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, benzo[*ghi*]perylene, chrysene, dibenzo[*a,h*]anthracene, indene[1,2,3-*cd*]pyrene) are the indicators of presence of dangerous substances in food, selected as markers of PAHs.

GREEN NANO-PROTECTIVE COATING

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ABSTRACT

A green zero-discharge technology for preparation of nano-compositions aimed for protective coating of hydrophilic biodegradable packaging materials was described in this paper. The technology comprises the following steps: (1) hydrolyzing of cellulose raw-material with acidic catalyst in the presence of process additive at a low catalyst/cellulose ratio; (2) introducing special precipitators into the obtained acidic slurry of nano-cellulose in a manner that pH-value of the slurry achieves 6-7 and inorganic nano-particles are precipitated into nano-cellulose containing slurry; (3) admixing the slurry containing agglomerates of the nano-particles with a solution containing hydrophobic biodegradable polymers and some other additives soluble in organic solvents; and (4) mechanical disintegration of the prepared mixture in high-pressure homogenizer to break out the agglomerates of nano-particles and obtain a uniform nano-composition having an average particle size of 100-300 nm. The proposed coating nano-composition imparts to natural packaging materials an increased strength and effective barrier against water and grease without change in biodegradability properties of the coated materials.

WATER AND FUEL COMBUSTION IN INTERNAL COMBUSTION ENGINES

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ABSTRACT

Expressing and discussing some of the known data on the impact of introducing water into the fuel or air of internal combustion engines to reduce their fuel consumption, as well as the results of the use of a steam generator on the diesel engine of the tractor MTZ-82.

NANOTECHNOLOGY IN AGRICULTURE

*Dedicated to the blessed memory of
Prof. Igor Ruban*

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Part 1

PLANT IMMUNIZATION AS AN ENVIRONMENTALLY SAFE LINK TO THE ORGANIC AGRICULTURE CONCEPT

ABSTRACT

Nutrition micro- and mesoelements, as also intense activity plant growth regulators and other physiologically active substances, depending on the crop variety, cultivation conditions and possible risks, can be added to such pre-sowing treatment (nano) technologies. Using physiologically active, complex, polyfunctional, multicomponent (nano) systems – (nano) chips in the pre-sowing seed treatment (nano) technology allows precise seeding; enhancing field seed germination; reducing plant morbidity rate considerably or even deleting disease incidents; increasing plant adaptability to unfavorable environmental conditions; expanding crop yield; improving products quality by not using toxic chemical means of plant protection; intensifying competitive ability of agricultural products as well as assuring environmental safety in crop cultivation regions.

Part 2
ENVIRONMENTALLY SAFE NANOCHIPS FOR AGRICULTURAL SECTOR

ABSTRACT

Physiologically active, complex, polyfunctional, multicomponent (nano) systems – (nano) chips in the pre-sowing seed treatment (nano) technology allows precise seeding; enhancing field seed germination; reducing plant morbidity rate considerably or even deleting disease incidents; increasing plant adaptability to unfavorable environmental conditions; expanding crop yield; improving products quality by not using toxic chemical means of plant protection; intensifying competitive ability of agricultural products as well as assuring environmental safety in crop cultivation regions.

**THE HARDENING OF EPOXY-ANHYDRIDE COMPOSITIONS
IN THE PRESENCE OF IMIDAZOLES**

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ABSTRACT

Reaction of interaction between 1,2,3,6-tetrahydro-3,3-methylphthalic anhydride (TMPA) and phenylglycidyl ether (PGE) and diglycidyl ether of diphenylolpropane (ED-20 resin) in the presence of imidazoles has been investigated by method of differential scanning calorimetry (DSC). Optimal concentration dependence of activity of catalysts (1-vinylimidazole and 2-ethyl-4-methylimidazole) has been found; this dependence proved to be not linear. Kinetics of the hardening of ED-20 resin in the presence of imidazole derivatives has been investigated by the DSC method; kinetic parameters and calorific effect of the reaction have been determined. It has been shown that imidazole/zinc chloride complex has a latent reaction capacity, and the reaction starts only at 105°C. Physic-mechanical properties of hardened epoxy polymers, glass transition temperature and Vicat softening point have been determined by thermomechanical method. The rise in glass transition temperature (by 25-30%) and in the softening point (by 10-20%) observed in the presence of imidazole catalysts have been ascertained. Such a phenomenon is not observed when a noted catalyst – 2,4,6-tris(dimethylaminomethyl)phenol – is applied for the hardening of epoxy-anhydride compositions.