

FEATURES OF FORMATION AND IDENTIFICATION OF SPARINGLY SOLUBLE AND COORDINATION COMPOUNDS OF POLYHEXAMETHYLENEGUANIDINE WITH Pb(II), Cd(II), Cu(II), Zn(II) IN AQUEOUS SOLUTIONS (p. 4-8)

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Existing methods of water treatment are faced with the problem of accompanying secondary contaminants introduced by the process of purification or neutralization of the primary contaminants. Polyhexamethyleneguanidine (PHMG) is effective for heavy metals ions removal and reduces environmental pollution.

The efficiency of polyhexamethyleneguanidine as a complexing agent, biocide and flocculant is directly related to the ability to bind heavy metal ions, and the stronger the metal aggregates with the polyelectrolyte, the better the water purification and the easier the precipitation.

The assumption was confirmed about the complex reaction of polyhexamethyleneguanidine with ions of heavy metals (Pb, Cd, Cu, Zn), the features of which are determined by the electron configuration of these metals: Pb(II) and Cd(II) are characterized by the formation of associates on the basis of sparingly soluble basic salts, and the direct coordination reaction of the metal ion with the PHMG nitrogen is more characteristic of Cu(II) and Zn(II).

The products of the reaction of salts of heavy metals (Pb, Cd, Cu, Zn) with polyhexamethyleneguanidine were investigated by IR spectroscopy. The bonds, confirming the formation of stable compounds were revealed in the samples. The level of bond strength and the method of metal binding with polyelectrolyte were studied by polarography. The stability constants and coordination numbers of coordination compounds were computed, which allows predicting their stability in the process of technological transformations. This makes it possible to recommend PHMG for use in multi-stage processes of water purification from heavy metals.

Keywords: polyhexamethyleneguanidine, heavy metals, waste water treatment, Me-PHMG-associates, polarography, IR spectroscopy, coordination compound, flocculant, polyelectrolyte, disinfection.

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OBTAINING OF POLYMETHACRYLATE ADDITIVES AND STUDYING OF OPERATIONAL PROPERTIES OF AN ALLOYED INDUSTRIAL OIL (p. 9-15)

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The study explored the influence of temperatures and the impact of concentrations of the initiator and the monomer on the kinetics of lauryl methacrylate homopolymerization in benzene. The reaction sequence with respect to the initiator

(1.38 ± 0.07), the monomer (1.69 ± 0.02) and also the activation energy ($E_a = 96.4 \pm 0.506$ kJ/mol) was determined according to the experimental points of the first fixed area in the polymerization process ($S \leq 10\%$). The numerical values of the reaction order for this system were high due to the high structuring of the LMA and a high viscosity of the system. The optimal conditions for obtaining polymethacrylate additives were determined on the basis of kinetic studies and the following parameters: the temperature of 80 ± 1 °C, the concentration of benzoyl peroxide of 0.5 wt. % based on the total monomers' weight, the ratio of lauryl methacrylate:benzene = 1:1, and the reaction time of 3 to 4 hours. The qualitative composition of the additives was confirmed with the infrared spectrometry. According to a thermogravimetric analysis, it has been found that synthesized (co)polymers are thermally stable up to the temperatures of 255–265 °C.

The influence of polymethacrylate additives in the oil I-20A on the rheological, depressor and antiwear properties was also studied. The viscosity curves for the obtained systems were described. The viscosity index of the obtained alloyed oil was determined according to the kinematic viscosity values at the temperatures of 50 °C and 100 °C. The depressor and antiwear properties of the lubricant were investigated at the optimal concentration of the additive in the amount of 2 wt. % in the oil. The operational properties of the industrial oil with an additive in the amount of 1.4 wt. % were also summarized in the study. The antiwear properties of the alloyed oil I-20A were tested in friction on a four ball machine. It has been found that the PMA20 additive with concentration of 2 wt. % in the oil can be used to obtain an alloyed industrial lubricant as a commodity with desirable operational properties ($VI = 140$ at $T_{Fr} = -19$ °C).

The obtained lubricant can be used for friction reduction and wear protection of equipment elements of power plants.

Keywords: lauryl methacrylate, methyl acrylate, kinetics, polymethacrylate additive, alloyed industrial lubricant I-20A, operational properties.

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DESIGN OF ENERGY-SAVING TECHNOLOGY OF SHAPING AND FIXING THE SHAPE OF HEADRESSES PARTS (p. 16-25)

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The problem of increasing the quality of women's headresses by designing an energy-efficient technology of their shaping and fixing the shape in the medium of chemical dressings was studied, which makes it possible to obtain the parts of volumetric shape made of fabrics without breaking up.

As a result of analytical and experimental research, the selection of a liquid-active working medium was substantiated.

ated for the implementation of the process of shaping, which is a designed dressing of the following composition: 50–60 g/l lakriteks, 50–60 g/l of carbamol CES, 1–2 g/l ammonium chloride;

A vibration method was designed, which has three implementation variants and an installation for the vibroshaping and fixing the shape of parts of headdresses in the medium LAW. As a result of the research of the efficiency of the method, we received graphical dependencies of the quality of a part on the input parameters that are described mathematically. The main rational parameters of the process of shaping arise from these dependencies: the frequency of vibration $\nu=4.8$ Hz, the amplitude of vibration $A=2.3$ mm, increase in pressure $\Delta P=0.17$ MPa, the period of the air supply to the chamber of a pneumatic drive $T=3/5$ half-period.

The headdress head, shaped under these parameters, displays high quality of this part ($K_s \leq 0.28$). The designed method allows exploring the process of shaping and fixing the shape in one cycle of treatment that provides increase in labour productivity by 12.7 % and reduction of energy costs by 49 %; the assessment of the process of fixing the shape was performed by the indicator of the number of created crosslinks. Shaped heads and women's headdress were manufactured by the designed method.

Keywords: shaping, headdresses parts, matrix, vibration method, liquid-active working medium, base pressure, frequency, amplitude, time of shaping, dressing.

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DESIGN OF ELECTRICALLY CONDUCTING POLYMER HYBRID COMPOSITES BASED ON POLYVINYL CHLORIDE AND POLYETHYLENE (p. 26-32)

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Interest to electrically conducting polymer composite materials in recent times has grown considerably, which is associated with the design of new branches of science and technology. The existing analogues are different in the complexity of production and high cost. One of the ways of solving the problem may be designing polymer composite materials with a combined filler. The research was carried out on creating electrically conducting hybrid polymer composites, based on emulsion polyvinyl chloride and polyethylene, using fillers of varying nature and dimensions. We studied the dependence of electrical conductivity of mono- and binary-filled polymer composites on the type and content of fillers. It was found that the binary filling allows designing electrically conducting polymer composites, which are more promising economi-

cally compared to mono-filled ones. We defined physical and mechanical characteristics: tensile strength and relative elongation at break of obtained polymer composites. A method to improve them was proposed by introduction of a compatibilizer – graft-polymer of polyethylene with maleic anhydride.

Depending on the value of the electrical conductivity, polymer hybrid composites can be used for: at a value of electrical conductivity 10^{-4} – 10^{-7} Cm/cm as anti-static materials; at 10^1 – 10^4 Cm/cm – as scattering anti-static materials, at 10^1 – 10^4 Cm/cm as current-conducting materials.

Keywords: polyethylene, polyvinyl chloride, graphitized carbon black, carbon fibers, nickel powder, copper fibers.

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A STUDY OF FAT INTERESTERIFICATION PARAMETERS' EFFECT ON THE CATALYTIC REACTION ACTIVITY OF POTASSIUM GLYCERATE (p. 33-38)

Natalia Sytnik, Igor Demidov, Ekaterina Kunitsa, Viktoria Mazaeva, Olga Chumak

The study has disclosed the peculiarities of the interesterification process in the presence of potassium glycerate as the catalyst. The properties of palm olein as a result of interesterification have been found to depend on such parameters as temperature, duration, and catalyst concentration. The study makes use of a central composite design (CCD) of the second order orthogonal plan. The melting temperature of palm olein is accepted as a response function. The initial palm olein and the samples obtained according to the plan of the experiment were researched by differential scanning calorimetry to determine the characteristics of the phase transitions – melting and crystallization. The biggest difference was observed between the melting temperatures in a capillary and the temperature peaks on the curves of DSC thermograms for highly-fusible samples; the peak temperature in the DSC thermogram exceeds in these cases the temperature determined in the capillary.

The study has revealed that the maximum melting temperature of palm olein occurs during the interesterification process at a temperature of 100 °C, with the process duration of 1.5 hours, and with the catalyst concentration of 0.5 %. The temperature difference between the initial melting and the interesterified palm olein was observed as exceeding 12 °C when the catalyst concentration, most often used in interesterification, was 0.1 %, at a temperature of 100 °C, and with the process duration of 1.5 hours.

Keywords: interesterification, catalyst, palm olein, melting point, differential scanning calorimetry, mathematical planning.

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DESIGNING LOW VISCOSITY FURAN-EPOXY POLYMERS OF THE MATERIALS FOR CONSTRUCTION INDUSTRY (p. 38-44)

Alex Rassokha, Anna Cherkashina

The materials are designed and the properties are studied of the low-viscosity furan-epoxy reactive oligomers, structured by amine complex curing agents for the use as injection systems during the repairing and recovery construction work. A wide range of the amine-containing structuring

agents that have industrial potential and ensure a high degree of conversion was analyzed.

This makes it possible to form the rational structure of furan-epoxy polymers, which is due to the application of optimal parameters of structuring (temperature, concentration of ingredients, time and others) during the formation of the polymeric composition systems for construction purposes. The structural-topological parameters were studied (traditional topological criterion of Wiener and others) and certain parameters of reactivity (structural functionality, formal unlimitedness, the index of distribution of electron density on the atoms of molecule, etc.) parent substances (monomers) during obtaining furan-epoxy materials. The knowledge of this set of characteristics makes it possible to purposefully regulate structure and properties of the designed low-viscosity injection furan-epoxy polymeric materials.

The deformation-strength, adhesive, sorption, technological properties of the proposed low-viscosity injection furan epoxy polymers for construction purposes were explored. As a result of the optimal combination of the set of structural-topological parameters and technological factors, the high level of physical-mechanical, adhesive properties, water resistance of the designed composite materials is ensured.

The development of composite polymeric systems was accomplished with the use of the "green chemistry" principles.

Keywords: furan-epoxy reactive oligomer, amine-containing curing agent, strength, sorption properties, adhesive strength, low-viscosity injection system, construction industry.

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ALKYLPHENOL DERIVATIVES OF THE POLYMER OF THIOCYANIC ACID AND 5-AMINO-1,2,4-DITHIAZOLE-3-THIONE AS AN EFFECTIVE ADDITIVES TO FUELS AND LUBRICANTS (p. 45-51)

Oleksandr Vasylykevych, Olena Kofanova, Kostyantyn Tkachuk, Oleksii Kofanov

For ensuring the operation of the mechanisms at high temperatures and pressures, it is necessary to use both stable base oils and effective additives in the composition of the lubricants. In the research, antioxidative and anticorrosive properties were identified in the oils of the condensation products of the alkylphenols with paraformaldehyde and thiocyanic acid polymer. The condensation products of the 5-amino-1,2,4-dithiazole-3-thione (Xanthane Hydride) with the 2,6-di-tert-Butylphenol and paraformaldehyde were investigated. A mixture of the products was obtained in the solution of the glacial acetic acid where the ratio of the 5-amino-1,2,4-dithiazole-3-thione and 2,6-di-tert-Butylphenol fragments is 1:1 and 1:3, respectively.

An assumption about the structure of the substances was set up on the basis of the chemical and spectral data. For the compound with the empirical formula $C_{19}H_{27}N_2O_{(3-5)}S_3$ the structure containing a residue of the 2,6-di-tert-Butylphenol and one heterocyclic fragment was proposed. For the compound with the empirical formula $C_{43}H_{65}N_2O_{(3-5)}S_3$ the structure containing three residues of the 2,6-di-tert-Butylphenol was proposed. It was found that the products with a high content of the 2,6-di-tert-Butylphenol residues dissolve in the oils best of all. It was also found that alkylphenol derivatives of the thiocyanic acid and Xanthane Hydride are promising inhibitors of the corrosion and oxidation of the fuels and lubricants. The technique of the 5-amino-1,2,4-dithiazole-3-thione synthesis was improved. It was determined that it is better to synthesize it by treating an aqueous solution of the ammonium thiocyanate with the concentrated hydrochloric acid (instead of the sulfuric acid) in equimolar proportions at the temperature of 5–15 °C. At the same time, the output of the aim product does not decrease and it can be easier purified.

Keywords: 5-amino-1,2,4-dithiazole-3-thione; 2,6-di-tert-Butylphenol; paraformaldehyde; Mannich bases; ashless oxidation inhibitors; thermal-oxidative stability; corrosion; antioxidant; thiocyanic acid; fuels and lubricants.

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DEVELOPMENT THE TECHNOLOGY OF OBTAINING MICROCRYSTALLINE CELLULOSE FROM THE HEMP FIBERS (p. 51-56)

Valerii Barbash, Mariia Karakutsa, Irina Trembus, Olha Yashchenko

A new, environmentally cleaner, technology of obtaining microcrystalline cellulose of fibers of hemp was proposed. The various stages of obtaining microcrystalline cellulose were studied and the optimum values of technological parameters of alkali extraction of hemp fibers, organosolv pulping, chelation and hydrolysis of cellulose were defined. It was determined that the consistent treatment of fibers of hemp by extraction of 5 % KOH solution during 210 minutes at the temperature of 95 °C, performic cooking in a mixture of 85 % formic acid and 30 % of hydrogen peroxide in the ratio of 60:40 of volume % at 100 °C during 210 min, chelation by the solution of trilon B of the concentration of 10 g/l during 30 min at 50 °C and hydrolysis by a mixture of 98 % acetic acid and 30 % of hydrogen peroxide solution in the ratio of 70:30 of volume %, allows obtaining microcrystalline cellulose in the form of white powder with a degree of polymerization 80

and the content of sulfate ash of 0.10 %. Using the methods of scanning electronic microscopy, thermogravimetric analysis and X-ray diffraction confirmed that the consistent multistage chemical treatment increases the content of crystalline part of cellulose by the removal of extractive and mineral substances, hemicellulose and amorphous fraction of cellulose of the fibers of hemp. Application of the proposed technology of obtaining microcrystalline cellulose from the fibers of hemp is environmentally more friendly and enables to reduce significantly the cost of finished products by using national, annually renewable plant raw materials compared to imported cotton or pine cellulose.

Keywords: microcrystalline cellulose, hemp fiber, extraction, hydrolysis, X-ray diffraction, thermogravimetric analysis.

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