ABSTRACT AND REFERENCES

TECHNOLOGY ORGANIC AND INORGANIC SUBSTANCES

INFLUENCE OF SURFACE ACTIVE SUBSTANCES ON THE INTENSIFICATION OF EXTRACTION WHEN CHANGING HYDRODYNAMIC INDICES OF THE TECHNOLOGY OF ORGANOPREPARATIONS (p. 4-13)

Maria Paska, Uliana Drachuk, Bohdan Halukh, Iryna Basarab

An influence of surface-active substances (SAS) on the change of physical characteristics of extractants of the group of organic preparations (chonsorid, heparin, and ronidase) was studied. Authors established rational concentrations of SAS in extractants, at which the minimum of coefficient of surface tension and the decrease in coefficient of dynamic viscosity are reached. For the solution of extractant of chonsurid – SAS butanol in the concentration of 0,05–0,06 % by weight, of heparin – butanol in the concentration of 0,5–0,6 % by weight, of ronidase – butanol in the concentration of 0,45–0,6 % by weight.

Mean values of a near–surface laminar layer were established with the help of theoretical calculations, namely: for heparin – 1 mm, for chonsurid – 3 mm, for ronidase – 1 mm. Kinetics of extracting demonstrated an increase in the amount of the mass of extract when using extractants with SAS: for chonsurid – by 1,4 times, for heparin – by 1,7 times, for ronidase – by 1,9 times. Mathematical calculations proved a change in the similarity numbers under the influence of the surfactants, the Archimedean, Euler and Reynolds numbers were calculated and their values were compared. The Archimedean number changes its value for the extractants of chonsurid from 1028 to 10028, for those of heparin – from 3463 to 5910, for those of ronidase – from 990 to 6236. The value of the Reynolds number changes with the use of industrial extractants and the proposed extractants with the addition of SAS for chonsurid – from 18,6 to 91,6, for heparin – from 34,8 to 265, for ronidase – from 17,5 to 65,1. The Euler number with the use of industrial extractants for chonsurid is 170, for heparin – 92,2, for ronidase – 69,9, and when using the proposed extractants with the addition of SAS, it is: 37,5; 11,3; 12, respectively.

Authors assessed hydrodynamic situation on the border of the contact "solid body – liquid" using the ratio of forces of surface tension to inertial forces on the basis of dimensionless set – surface number. Surface number changes its value when using industrial extractants and the proposed extractants with the addition of SAS for chonsurid from 2295 to 2164, for heparin from 530 to 346, for ronidase from 4641 to 197.

The expediency of applying surface number was proved.

Keywords: extractant, coefficient of surface tension, mean thickness of surface laminar layer, surface number.

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DESIGNING AND EXAMINING POLYTETRAFLUOROETHYLENE COMPOSITES FOR TRIBOTECHNICAL PURPOSES WITH ACTIVATED INGREDIENTS (p. 14-21)

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The influence of mechanochemical activation of matrix, fillers of various nature and composition on the structure and operating properties of polytetrafluoroethylene composites was explored. The effect of technological parameters of the process of mechanical activation on the structure, physical, mechanical and tribotechnical properties of polytetrafluoroethylene-based composites was examined.

We established the modes of mechanic activation equipment for the preparation of matrix and fillers that provide for the maximum wear resistance of the composite while maintaining sufficient level of strength and we designed antifriction composites based on polytetrafluoroethylene of a new generation.

Special features of developed technology for the production of composite based on polytetrafluoroethylene with the required operational properties include a preliminary separate preparation of the matrix and the fillers before their mixing by means of mechanical activation under different modes of equipment, as a result of which an increase in the indices of strength at break and wear resistance occurs.

A synergistic effect of using mechanical activation of both matrix polytetrafluoroethylene and the fillers before their mixing was displayed by an increase in the indices of performance characteristics of the obtained composites: with a fibrous filler, strength at break increased by 18,6 %, relative elongation – by 28 %, wear resistance – by 6,9 times; with a dispersed filler, strength at break increased by 19,3 %, relative elongation – 27,6 %, wear resistance – by 1,7 times in comparison to the use of non-activated ingredients.

The technology we developed for obtaining antifriction polytetrafluoroethylene composite of a new generation made it possible to increase wear resistance of materials by 3,7–6,0 times, strength at break – by 1,4 times compared to materials of the old generation.

The rings of the compressor 4GM 2,5 U-3,4/2,8-251, made of the designed composite, allowed us to increase working resource of equipment of compressor engineering by 1,8–2,3 times.

Keywords: polytetrafluoroethylene, fillers of various nature, mechanical activation, supermolecular structure, composite, durability.

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HYDRODYNAMIC AND KINETIC PROCESSES OF THE MINERAL FERTILIZER GRANULES ENCAPSULATING IN THE MULTISTAGE DEVICE WITH SUSPENDED LAYER (p. 22-28)

Mykola Yukhymenko, Ruslan Ostroha, Artem Artyukhov

One explained the possibility of reducing economic and environmental indicators in the production of mineral fertilizers by covering their surface with the protective coating (capsule), which creates additional resistance to mass transfer in the process of fertilizer dissolving. It is proved that the use of organic suspensions as a material for the capsule shell is very promising.

Using a many-stage countercurrent contact of a fluidizing agent and dispersed phase in the fluidized bed during the heat exchange process is a perspective way of reducing economic and energy costs. Therefore, in order to reduce the cost of processing wet materials and increase the uniformity of particle size distribution of the final product one offered to carry out the process of granules coating with organic substance in a many-stage shelf apparatus with the suspended layer.

One defined structural features of the shelf device classification section and experimentally established influence of the shelf length and degree of its perforation on the process of the fine fraction entrainment. Fine fraction entrainment is reducing with the increase of the shelf length. Also, pneumatic classification process of the material for the shelves with open area up to 5 % is more intense than for the shelves with open area of more than 15 %.

The kinetics of mineral granules enlargement during their encapsulation with organic suspension is experimentally and theoretically studied. It was found out that in the process of encapsulation the curve of particle size distribution has one typical maximum. It confirms the theory of uniform enlargement of granule surface, when organic substance is fixed on the particle surface in the form of a solid layer and no shearing of the granule coating takes place. It enables to obtain the complete organic shell (capsule) on the mineral granules surface.

One studied the transfer of material flows in the individual stages of the apparatus granulation section. A mathematical model of the granulation kinetics in the many-stage shelf apparatus, which takes into account changes of granules distribution density as to their sizes in each contact stage is developed. The resulting model is characterized by a cell structure in which the material flow is seen as divided into a number of series-connected zones, wherein different granulation modes are implemented.

Keywords: granulation, many-stage apparatus with the suspended layer, perforated shelf, organic suspension, entrainment.

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IMPROVING THE PROCESS OF DYEING A LEATHER SEMI-FINISHED PRODUCT BY TITANIUM COMPOUNDS (p. 29-35)

Anatoliy Danylkovych, Victor Lishchuk, Alexander Zhygotsky

We developed technology of dyeing a leather semi-finished product of chrome tanning based on research into the processes of interaction in the system of dermis collagen-azo dye-titanium compounds. Physical and chemical properties of the working solutions of azo dyes, modified by titanium compounds of different chemical composition, were explored. A more energetic interaction was established between the brown azo dye 345, the molecules of which contain phenolic group, and titanium compounds with possible formation of chelate compounds.

A study of kinetics of the sorption of azo dyes by collagen fibers, structured by the compounds of chromium, revealed a significant dependence of sorption of the dye, the molecules of which contain less auxochrome $-SO_3Na$-groups, on temperature in the presence of titanyl oxalic acid. In this case, absolute values of the sorption of a dye at temperature of 20 °C are two times lower compared to the brown dye 345. With increasing concentration of the dye with a lower molecular weight, acidic blue-black, modified by ammonium sulfate titanylate, its diffusion capacity into the gel of gelatin is reduced by two times with an increase in the concentration to 80 g/dm^3. An increase in the concentration of a dye in the system is symbatic to an increase in the activity of its interaction with collagen, accompanied by reduced diffusion capacity into the gel of gelatin. It was found that filling a semi-finished product of chrome tanning with acrylic polymers contributes to the increase in chemisorption of azo dye when using ammonium sulfate titanylate by 1.5 times.

The effect of the composition of dyeing solution on the coloristic properties of a filled semi-finished product was demonstrated when fixating the dye on its surface by ammonium sulfate titanylate. We determined optimal ratio of ammonium sulfate titanylate and a dye, which ensures the formation of leather material with a higher saturation of coloration of the surface of a semi-finished product by 2.1–2.9 %, maximum resistance to wear and light fastness in comparison with the control technology. The designed technology of comprehensive filling-dyeing-greasing makes it possible to reduce the consumption of azo dye, exclude at the final stage of dyeing additional consumption of a dye and environmentally harmful compounds of chromium by the use of ammonium sulfate tytanilate as a fixative of dye with a 5-fold saving of reagent.

Keywords: dyeing a leather semi-finished product, azo dye, titanium compound, coloristic indicators, mechanical properties.

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INFLUENCE OF ORGANIC PLASTICIZERS ON SENSORY, PHYSICAL-MECHANICAL PROPERTIES AND CHEMICAL CHANGES OF BIODEGRADABLE FILMS (p. 36-42)

Oksana Shulga, Anastasia Chorna, Larisa Arsenieva

The research to establish the influence of different organic plasticizers on the properties of biodegradable films was done. The most widespread, relatively inexpensive plasticizers were chosen that were added to the film based on corn starch or modified starch and gelatin. The complex organoleptic indicator of quality is calculated that is the highest in such plasticizers as glycerin and sorbitol; films with glucose, sucrose and fructose as plasticizers have a lower index; films with urea have the lowest index. The changes in tensile strength and elongation depending on the plasticizer are calculated. The obtained results can be explained by properties of organic compounds used as plasticizers. IR Spectroscopy was used to determine that carbohydrates (fructose, glucose, sucrose) and polyhydric alcohols (glycerin, sorbitol) did not enter into chemical reaction with film forming agents (starch and gelatin). Only acid amides (urea) react with gelatin strengthening biodegradable films. The obtained results allow to predict the properties of the films, and in future will help to expand the range of raw materials used to make biodegradable films.

Keywords: biodegradable films, plasticizers, starch, urea, glucose, fructose, sorbitol, sucrose, glycerol.

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ANALYSIS OF RAW MIXTURE COMPOSITION AS A FACTOR OF INCREASE OF PORTLAND CEMENT CLINKER WHITENESS (p. 43-49)

Nataliia Dorogan, Lev Cherniak

The newly developed compositions of raw mixtures for clinker production contain minimized amounts of coloring oxides and are controlled by a specially designed computer program CLINKER. The study used various types of enriched carbonate, aluminum- and silica-containing raw materials from different parts of Ukraine to reveal the peculiarities of coagulated structures and phase transformations of dispersions. It has proved that control of the parameters of coagulated structures of slurry dispersions (such as viscosity, fluidity, and kinetic stability) is essential for optimizing raw mixture compositions for wet and combined production of white Portland cement. We have assessed the effect of mineralizing additives necessary to intensify clinker sintering on the characteristics of the slurry coagulated structure and identified the peculiarities of clinker minerals C_3S, C_2S, C_3A, C_4AF, and $C_{12}A_7$ that are formed in burning the novel raw mixtures. In addition, we have proved that optical and physical properties of crystalline phases are related to clinker whiteness and traced how burning raw mixtures based on the oxide system $CaO–Al_2O_3–SiO_2$ results in crystalline phases with a relatively lower refractive index of the optically isotropic and transparent mayenyte $C_{12}A_7$ (Ng=2.85–2.90) as a factor of increasing clinker whiteness. The supplied example shows how to obtain clinker with increased whiteness (80–83 %) by intensifying the synthesis of $C_{12}A_7$, C_2AS, and C_3A.

Keywords: white Portland cement, combined method, clinker, raw mixture, kaolin, chemical composition, dispersion/dispersed system, coagulated structure, crystalline phase, cement whiteness.

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RESEARCH OF NANOMODIFIED PORTLAND CEMENT COMPOSITIONS WITH HIGH EARLY AGE STRENGTH (p. 50-57)

Uliana Marushchak, Myroslav Sanytsky, Taras Mazurak, Yuriy Olevych

An innovative method for the creation of rapid hardening building composites with multifunctional purposes and specified properties under different operating conditions is their nanomodification. This technique is based on the principles of directional control and control over the processes of structure formation of material, as well as over kinetics and mechanism for chemical interactions at the early stages of the hardening process of cement matrix.

Comprehensive assessment of particle size distribution of ultrafine mineral additives by the indicator of differential coefficient of surface activity was carried out. Physical and mechanical properties of the nanomodified Portland cement composition, which contain ultrafine mineral additives, polycarboxylate superplasticizer, alkaline containing accelerator of hardening, as well as nanoscale particles of calcium hydrosilicate, were investigated. Peculiarities of the phase composition and microstructure of nanomodified Portland cement composition were established by physical and chemical analysis methods. It was established that the examined Portland cement compositions are characterized by intensive development of early strength, and by the indicator of standard strength they are related to high strength binder. It is demonstrated that acceleration of the hardening processes of nanomodified Portland cement compositions is due to the optimization of particles packing of the system, the presence of energy-active particles in the composition of mineral additive, increasing of liquid phase alkalinity, stimulating of nucleation processes in the intergrain space due to heterogeneous or homogeneous nucleation, accelerating of reactions associated with pozzolanic activity of ultrafine additives.

A widespread using of rapid hardening concretes based on the nanomodified Portland cement compositions with high strength at an early age will provide for an increase in efficiency of erecting monolithic structures, road infrastructure objects, of manufacturing precast reinforced concrete products, of carrying out repair and restoration works, including those under different temperature conditions.

Keywords: nanomodification, Portland cement composition, ultrafine mineral additives, early strength, hydration, alkaline activation.

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THE STUDY OF SUPERCRITICAL EXTRACTION OF COMPLEXES OF MOLYBDENUM WITH CARBON DIOXIDE (p. 57-63)

Boris Borts, Stella Skoromnaya, Anna Palamarchuk, Viktor Tkachenko

Characteristics of short-living isotope ^{99m}Tc, the main instrument of nuclear medicine derived as a result of radioactive isotope ^{99}Mo decay was given. 85 % of all diagnostics scans in the world for treatment of cancer diseases are conducted using the ^{99m}Tc isotope. In order to solve the problem of ^{99}Mo isotopes extraction probe preparation and extraction method for Mo included in nitrate-containing complexes with tributyl phosphate (TBP) from molybdenum containing matrixes by the method of supercritical extraction with carbon dioxide (SCE-CO_2) were offered. Quasi-periodic dependence of residual content of Mo in nitric acid solution on dilution time was shown, for the description of which the three-trophic model was offered. Theory of description of Mo dissolution in the diluted nitric acid by means of channels and jokers method was offered which gives good correspondence with experimental data.

The content of Mo as a SCE-CO_2 extraction under different variations of modifiers and ways of extraction was studied. It was shown that the largest efficiency of Mo extraction reaches 90 % and is observed under the following ratio of modifiers: 0.2 ml TBP+Mo, 0.1 ml of acetyl-acetone and 0.05 ml of water.

Keywords: supercritical carbon dioxide, supercritical extraction, molybdenum isotopes.

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INVESTIGATION OF PHASE FORMATION IN THE SYSTEM $Fe^{2+}/Co^{2+}/O_2/H_2O$ (p. 64-68)

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The dispersed iron oxide compounds are widely used as magnet carriers, pigments, catalysts, sorbents. Therefore, the study of phase formation in the system $Fe^{2+}/Co^{2+}/O_2/H_2O$, as well as the study of the influence of the basic oxidative environment parameters on the phase composition of iron (III) oxides over a wide pH range, and obtaining precipitates with a given chemical composition appear to be urgent.

As a result of the studies involved, it was found that in the system $Fe^{2+}/Co^{2+}/O_2/H_2O$ with constant cobalt content, the alkali consumption rate and the rate of product formation increase with increasing effective air flow rate. At constant rate of oxidation the oxidation time is reduced with the increase of cobalt content in the system.

The phase composition of the resulting compounds is determined by the mode of OHCP (dynamic or static). Formation of $Co_xFe_{3-x}O_4$ spinel structure occurs at pH 11–12 and air flow rate 4 min^{-1}.

In the presence of cobalt ions 3+, the rate of iron 2+compounds oxidation by atmospheric oxygen increases, because of their catalytic action.

Keywords: ferrous sulfate, ferrous hydroxide, oxyhydroxide, magnetite, catalytic phase formation, cobalt (II), oxygen.

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