

**ADSORPTION IMMOBILIZATION OF SULFIDE-OXIDIZING BACTERIA IN THE MASS OF THE SUPPORT MEDIUM MADE OF PHOSPHOGYPSUM**

page 4–7

The basic patterns and mechanisms of adsorption immobilization of sulfide-oxidizing bacteria in the mass of mineral support medium made of phosphogypsum were determined for gas purification system. The advantage of the adsorption method on the granulated support medium of phosphogypsum is that it allows to bind the bacteria in the granules with the bioactive layer formation. Granules based on phosphogypsum are characterized by permeability to *Thiobacillus sp.* and contain useful minerals for bacteria growth such as calcium, magnesium, phosphorus, etc. Bacterial matrix is closely associated with the support medium matrix. Therefore, its use helps minimize the removal of the sulfide-oxidizing bacteria active mass from biofilter during the process of washing and bio-sulfur removing from the surface granules of phosphogypsum.

Keywords: immobilization, sulfide-oxidizing bacteria, phosphogypsum, mineral support medium, sulfur.

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PRESENT CONCEPTS OF NON-TRADITIONAL METHODS OF GROWING OF METAL WHISKER CRYSTALS. PULLING OF WHISKERS FROM SOLUTION

page 8–12

The material of articles were reviewed and analyzed the results of previous studies of whisker crystals on non-traditional growing methods, namely, one of them – the «pull» of metal whiskers from solutions. Analysis of published data shows that the problem in modern conditions given enough attention to that, no doubt, talking about the relevance of the research topic and, therefore, these issues need to be addressed. The results of this analysis show that if prepared solution at a certain temperature is rapidly cooled to a lower temperature, there appear corresponding metal whiskers. The whiskers begin to appear again after the completion of the main stage of crystallization and if it begins to lower the temperature, the amount of the crystal needles will gradually increase. Reaching a certain «threshold overflow» volume growth of whisker crystals becomes an avalanche, and then almost stopped, at the final stage it is appeared whisker curled in a spiral around the axis of growth. The growth of whiskers of metal salts by rapid cooling of saturated solutions occurs at dislocations occurring on the particles of impurities. It is only stopped after the complete drying following solutions. The spectrum of use of whisker crystals in modern industry is expanded, so keeping and use of research will improve the implementation of environmental requirements for the protection of human health and environment.

Keywords: whisker crystals, growing methods, metal «whiskers», growing from solutions, passivating impurities.

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NON-FLUORIC BRIGHTLY COLORED GLASS COVER WITH REDUCED TEMPERATURE OF BURNING

page 12–17

The work featured research of influence of MnO₂ on properties of frits and covers. It is established that even small quantity of output enamel MnO₂ (0,1–0,4 mole %) introduced in composition instead of Fe₂O₃ facilitates improvement of fusibility and colorlessness of frit and improvement of optical and color characteristics of bright glass covers of red color.

Optimal concentration of researched oxide MnO₂ (0,2 mole %) in composition of enamel coatings is established. The brightly colored glass covers of red color with preset color characteristics are obtained: brightness (18–23 %), color pureness (45–55 %) and color tone (640–660 nm). Optical and color parameters of enamel coatings burnt under production conditions are somewhat lower. Thus, for example, color tone is mixed into purple area of visible spectrum that is not desirable. This can be explained by the durable burning of coatings and too high temperature of burning for this type of enamels reaching up to 850–860 °C in some areas of furnace. That is, developed coatings require decrease of temperature and time of burning.

Principal possibility of obtainment of non-fluoric brightly colored enamel coatings of red color by introduction of alloying additives Fe₂O₃ and MnO₂ in determined concentrations in composition of researched enamel (per 0,2 mole %) is established as a result of research. The developed enamel glass covers with specified color parameters are more fusible and meet the requirements to external enamel coatings and can be recommended for testing under production conditions with low-temperature short-term mode of burning.

Keywords: silicate enamel, brightly colored coatings, ferric oxide, manganese oxide.

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PREPARATION OF COPOLYMERS OF ACRYLIC ACID AND 3-METHACRYLOXYPROPYL-TRIMETHOXYSILANE BY THE METHOD OF EMULSION COPOLYMERIZATION

page 17–23

The method for preparing silicone acryl polymer by emulsion copolymerization of acrylic acid and 3-methacryloxypropyl-trimethoxysilane with a reaction initiator (ammonium persulfate) is presented in the article on the basis of experimental studies. The optimum conditions of synthesis are determined. Based on the study of the kinetics of the reaction by gravimetric copolymerization method, it was found that it is desirable to conduct the reaction for 4,5 hours at 90 °C, since after this time yield of copolymer was 53,3 %.

During synthesis it is obtained silicone acryl polymer that is a viscous transparent liquid without sharp odor, soluble in organic solvents. The properties of the silicone acryl polymer are investigated and characterized: molecular mass is calculated, determined the composition of the copolymer is determined and IR spectral analysis is conducted. This polymer is suitable for use in paints and varnishes as a surface modifier.

Keywords: silicone acryl polymer, 3-methacryloxypropyl-trimethoxysilane, acrylic acid, emulsion copolymerization.

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SIMULATION OF ADIABATIC MONONITRATION OF AROMATIC HYDROCARBONS BY WEAK NITRIC ACID

page 24–28

It is developed an advanced model of the adiabatic nitration in the form of system of ordinary differential equations that investigated the use of nitric acid for the adiabatic nitration of benzene and toluene. It is shown that the holding phase distillation under a residual pressure of 13,33 kPa leads to the distillation of 50–90 % hydrocarbons from a mass due to the heat of nitration. At the same time the number of nitro compounds and water that removed in the distillate is relatively small. These results indicate that nitration mixtures that prepared using nitric acid may in principle be used for the adiabatic nitration of benzene and toluene with heat released in the process distillate after separating from the water can be returned to the nitration step instead of pure hydrocarbon. The still liquor — a mixture of the nitro compound and spent acid — should be allocated for the separation and subsequent stage of drying and strengthening of spent acid for recycle.

Keywords: adiabatic nitration, benzene, toluene, mathematical model, weak acid, pressure, distillate, distillation.

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COMPARATIVE ANALYSIS OF WASTEWATER TREATMENT BIOTECHNOLOGIES FOR SMALL TOWNS

page 28–32

A proper wastewater management is essential for sustainable development of any society. However, nowadays, Ukraine faced a huge problem with sewage treatment in small towns, which is inherited from the communist regime. The biotechnology methods of wastewater treatment are reviewed in this article in order to find an optimal solution for this problem. Two types of wastewater treatment biotechnologies can be applied to the scale of small town (capacity from 100 to 10 000 m³ of wastewater per day): high-tech and nature-like systems. The next treatment systems were analyzed: aeration tanks, sequencing batch reactors (SBR), membrane bioreactors (MBR), oxidation ditches, trickling filters (TF), rotating biological contactors (RBC), waste stabilization ponds, aerated ponds (lagoons), and constructed wetlands. The principal schemes of selected systems were provided and feasibility analysis was performed. In conclusion, constructed wetlands were identified as the most sustainable option for treatment of wastewater of small towns with a population from 500 to 50 000 inhabitants, considering climate and economic conditions of Ukraine.

Keywords: wastewater treatment, biotechnology, resource saving, small towns, constructed wetlands.

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INFLUENCE OF WATER-REPELLENT ADMIXTURES ON THE PROPERTIES OF CEMENTS

page 32–37

Influence of organic fatty acid and composition on its basis on the physical and mechanical properties of the cement is investigated. Fatty acids are used in the building industry as water-repellent admixtures. The effectiveness has those admixtures that form on the surface of the cement not solid, but «mesh» protective layer that easily destroyed using traditional method of cement production of concrete and mortar mixes, providing access of water to hydrophilic surface of cement grains.

The effect of oleic acid on the physical and mechanical properties is investigated for a trade cement, clinker and Portland cement on its basis, slag and Portland slag cement on its basis. It is found that oleic acid gives hydrophobic properties for trade cement and Portland cement while slowing down the process of its thickening and gives small hydrophobic properties for blast furnace slag slowing down the thickening of Portland slag cement.

It is researched an influence of hydrophobic compositions based on oleic acid and investigated admixture with food processing waste vegetable oil on physical and mechanical properties of Portland cement and Portland slag cement. It is found that hydrophobic composition effectively hydrophobize the clinker and slag surfaces under certain optimal concentrations without reducing strength of cements.

Hydrophobic composition may be used as a water-repellent admixture for cement and active mineral admixtures to increase the longevity of materials and prevent clumping.

Keywords: trade cement, clinker, blast furnace slag, water-repellent admixture, strength, water absorption.

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DETERMINATION OF KINETIC PARAMETERS OF THE REACTION OF FORMATION OF THE SOLID-PHASE ADSORBENTS

page 38–41

Reaction order of crystalline hydrate formation is calculated in the article. This reaction often takes place during contact with water of a number of inorganic salts, at least — acids and alkalis. Sometimes — and organic substances, such as known hydrocarbon and methane hydrates. These processes are often unwanted, so hydrate inhibitors are used in the main pipelines.

But the formation of crystalline hydrates is useful process too. Thus, their use allows to form crystals, and more importantly, to remove unwanted water. This ability is applied for gas drying as well as organic and inorganic liquids, even — removal of these unwanted water. New compound forms after removal of anhydrous salt water from. The theoretical experience show that the quality of some dehydration salts is very high.

Certain inorganic salts may bind more water by weight than weigh yourself. They also have the ability to some extent to give the bound water and again become anhydrous salts. This ability makes it possible to use them several times with almost no losses.

So, we have a problem how exactly the process of interaction of inorganic salt with water to form crystalline takes place. It is used the fact that lowering the temperature of the reaction is faster, and that on this basis we can calculate the activation energy.

Establishment of the reaction order and activation energy calculation contributes to the proper conducting this reaction in an industrial environment.

Keywords: reaction, rate, order, kinetics, crystalline hydrates, orthophosphates, ethyl alcohol, equation.

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FORMATION OF CONSUMER PROPERTIES OF JEWELLER ALLOYS ON THE BASIS OF 585 FINENESS GOLD WITH MODIFYING COMPONENTS

page 42–48

The research results of physical and mechanical and physical and chemical properties of gold alloys are given. An influence of the chemical composition and structure on the main indicators of quality of finished jewelry is defined.

The main aim of the research was to study the patterns of properties of complex action of ligatures for the metal modifiers (silicon, cobalt, zirconium, manganese, boron).

The influence of the main alloying components and modifying additives in the «gold-silver-copper» system on the formation of physical and mechanical properties of jewelry, reliance of alloy structure formation process from heat treatment regime is proved. The efficiency of improvement of key indicators of jewelry consumer properties by optimizing the main alloying components and modifying additives of B, Co, Zr, Mn, Si in jewelry alloys from 585 fineness gold is shown.

The results related to metallurgy of precious metals and can be used in the jewelry industry.

Keywords: gold, silver, copper, jeweler alloys, gold alloy modifiers, consumer properties.

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THE ACCOUNTING OF THE FEATURES OF GAS DISCHARGE PLASMA AT THE DEVELOPMENT OF THE PLASMA-CHEMICAL REACTOR WITH A LIQUID CATHODE

page 52–56

Data obtained by both the authors with the assistance of laboratory equipment as well as data obtained from the literature are used in the article. The studies identified the factors considered in the design of the reactor, which uses a contact non-equilibrium low-temperature plasma of reduced pressure in the discharge gap between the metal anode and electrolytic cathode. At the same time the metal electrode buried in the liquid and liquid covering it are considered as a whole. An analysis of the characteristics and conditions of such processes is the basis for the creation of new equipment and technologies. Different relationships that allow accounting the size of the gas discharge of the reactor and use them in engineering calculation are obtained during research. The accounting of features of the process reduce energy consumption and reagents for carrying out plasma-chemical fluid processing.

Keywords: contact nonequilibrium plasma, electrolytic cathode, active particles and radicals, dimensional characteristics of the reactor.

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METHODS FOR DETERMINING THE PRESENCE, CHARACTER AND VALUE OF WALL EFFECTS IN FLOW OF POLYMER MATERIAL

page 48–52

One of the features of shear flow of polymer material, which is usually neglected in simplified analysis, is the presence of wall effects of various kinds, which significantly affect the accuracy of the simulation. The most significant errors arise in the calculation of the flow in the channels at the current small sections of some polymers. Wall effects can greatly affect the distribution of the main parameters of the melt across section channels and, consequently, the quality characteristics, dimensional accuracy and necessity of tuning equipment.

The method of determining the presence of wall effects in the polymeric material and the nature of these effects, which allows, depending on the nature of wall effects, select the desired method for determining the magnitude of these effects.

The developed methods for determining the value of wall effects allow obtaining the velocity on the wall, depending on the shear stress under different characters of wall effects – slip along the wall and the formation of low-molecular wall layer. These data can be used to set the boundary conditions of slip on the wall in the numerical simulation of non-Newtonian properties of the material.

Keywords: polymer, wall effects, wall slip, velocity on the wall.

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STUDY OF DESTRUCTIVE PROCESSING OF HYDROCARBONS IN INORGANIC MELTS. INFLUENCE OF CONTROL PARAMETERS

page 57–63

This article is devoted to the study of the destructive processing of hydrocarbons of different composition in inorganic melts. With the help of established methods of laboratory studies it is obtained reliable experimental data on the basis of which the influence of the main control parameters of the process is defined. It is determined an influence of the chemical composition of the melt temperature (in the range 400–600 °C) and contact times (in the range of 0,09–0,27 sec) on the composition and yield of the products in the processing of crude oil, black mineral oil, fuel oil, straight-run gasoline and *n*-hexane. Researches were conducted using melts of binary eutectic mixtures of metal chlorides (LiCl-KCl, NaCl-CuCl, CuCl-ZnCl₂, NaCl-ZnCl₂, KCl-ZnCl₂, NaCl-MgCl₂, CuCl-CaCl₂, KCl-FeCl₃), and also Pb-Sn. The optimal process conditions are virtually identical to the raw material of any composition when the maximum liquid yield temperature of about 500 °C, contact time — from 0,15–0,20 sec, melts — a mixture of metal chlorides with ZnCl₂ or FeCl₃.

Processing of hydrocarbons in optimal conditions can increase the yield of light oil products for crude oil — by 22,1–23,9 %, for black mineral oil — by 23,7–25,9 %; to increase the octane number of straight-run gasoline by 26 points, mainly due to increase in the yield of isoparaffins; obtain a high yield of isomers in the processing of individual hydrocarbons (to 28,9 % from *n*-hexane).

Keywords: hydrocarbons, destruction, melt, eutectic mixtures, control parameters.

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RESEARCH OF AGING OF MINERAL HYDRAULIC OILS. I. FRACTION COMPOSITION

page 64–68

Ukraine, as a member of the International Civil Aviation Organization, claimed responsibility for ensuring high requirements for flight safety, which constitute a set of measures, including the organization of reliable and trouble-free operation of the hydraulic system of the aircraft and its units. The working body of the hydraulic system of the aircraft is hydraulic oil, its properties depend on the efficiency and reliability of the aircraft exploitation.

The ability of the oil to keep the chemical composition and performance of the limits that ensure the reliability of the hydraulic system of the aircraft determines its guaranteed resource life. In this context, the problem of research of aging process of hydraulic oil during the operation of the aircraft is relevant.

During researches it is established peculiarities of degradation reactions in molecules of bicyclic and tricyclic naphthenes of first fractions of model samples of oil «Hydrauncoil FH-51», the result of which is the formation of mono- and bicyclic naphthenes. During the last dehydrogenation it is formed unstable cyclomono- and cyclodiolefine and aromatic hydrocarbons, which results in a compression during operation of the oil to decrease as the content of the first fraction of all types of naphthenic

compounds and reducing output of the first and second fractions to increase the yield, respectively.

Keywords: oil aging, mass spectral analysis, destruction of hydrocarbon molecules, guaranteed resource life.

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EFFECT OF MANGANESE COMPOUNDS ON SYNTHESIS OF FERRATES(VI)

page 69–73

The features of preparation processes of potassium and barium ferrates(VI) in the presence of a manganese compound contained in the feedstock are studied. It is established that manganese impurities during ferrate synthesis transferred in alkaline solution and in crystalline ferrates in the form of oxoanions MnO_4^{2-} .

The influence of Mn impurities on the effectiveness of synthesis process of ferrate solutions in various ways is defined. It was revealed that product yield decreases and manganates accumulate in solution during anodic dissolution with increasing manganese content in the anode material.

It is shown that the degree of decomposition of crystalline barium ferrates during in the presence of Mn compounds more than for potassium ferrate derived from the same mother liquor. The degree of decomposition increases with increasing manganese content in solid ferrates.

It is proposed efficiently select the feedstock and include additional purification in inorganic and organic solvents in production cycle to reduce the transition of manganese compounds in the desired product.

Keywords: synthesis of ferrates(VI), manganese compounds, manganate pollution, determination of Mn(VI), barium ferrate.

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