ABSTRACT AND REFERENCES

TECHNOLOGY ORGANIC AND INORGANIC SUBSTANCES

SYNTHESIZING T-2 TOXIN CONJUGATES WITH PROTEINS FOR THE USE IN IMMUNOSENSITIVE TEST SYSTEMS (p. 4-9)

Oksana Gojster, Vladimir Kriwenchuk, Grigory Khmelnitsky

We have devised the methods for synthesizing conjugates of mycotoxin T-2 with the proteins of bovine serum albumin, ovalbumin, hemocyanin and gelatin for producing antigens, subsequent immunizing animals, and obtaining specific antibodies. We have proved that T-2 toxin conjugates with bovine serum albumin, ovalbumin and hemocyanin are insoluble in water and are suitable only for the immunization of animals, but cannot be used in immunochemical reactions. Only a T-2 toxin-gelatin conjugate is soluble in water and can be used in immunochemical reactions. Availability of a T-2 toxin-bovine serum albumin conjugate is proved by the method of a thin-layer chromatography.

We have obtained antibodies to T-2 toxin after immunization of rabbits with a T-2 toxin-bovine serum albumin conjugate. A T-2 toxin-gelatin conjugate is used for immobilization on a solid surface of an immunosensor with the effect of a surface plasmon resonance. Antisera with an antibody titer of 1:5000 were selected to calculate the concentration of T-2 toxin by the specified method on the basis of competition. The proven methods for obtaining conjugates, producing immune antisera and identifying antibodies can be the basis for domestic biosensor immunodiagnostic test systems.

Keywords: T-2 toxin conjugates, antibody, bovine serum albumin, ovalbumin, hemocyanin, gelatin, thin-layer chromatography.

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DEVELOPMENT OF METHODS FOR NEUTRALIZING THE FREE FATTY ACIDS OF FATTY CORIANDER OIL (p. 10-15)

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In the present paper, the information on the process of enzymatic conversion of free fatty acids in fatty coriander oil (FCO) was considered. Enzymatic esterification was performed according to the following algorithm: FCO was treated with enzymes, purified by adsorbents with a variation of the basic process parameters, alcohols of a different nature were added. The quality of the samples of the purified FCO was determined by the basic physicochemical index – acid number.

Ethanol (96 %) and glycerin (99.3 %) were used as reagents. Enzyme preparations (manufactured by «Novozymes» Denmark): Novozym 435, Lipozym TL IM were used as catalysts.

Using the FCO fining methods, given in the paper, it was managed to reduce the acid number of oil from 17.0 mg KOH/g to 0.3 mg KOH/g. It was proved that using vacuum is an appropriate technological stage of enzymatic esterification of the FCO.

Using molecular sieves for the FCO fining to reduce the content of water formed in the esterification and, thus, improve the conditions for the conversion reaction of free fatty acids – reduced acid number to less than 2.1 mg KOH/g was investigated. It was found that when adding molecular sieves in the FCO – reagent – enzyme system, water removal is not observed and their use does not decrease the acid number of oil at all.

The fatty acid composition of the sample of the initial FCO was investigated by means of gas-liquid chromatography. It was found that in the initial FCO the percentage of the main fatty acids are the following: palmitic – 2.4 %, petroselinum – 71.3 %, oleic – 7.8 %, linoleic – 15.6 %.

The authors have examined the process of adsorption of free fatty acids from the esterified FCO using the anionite EDE – 10P. It was found that the increase in the ratio of FCO to the adsorbent does not result in complete removal of free fatty acids and, accordingly, sufficient decrease in the acid number of the purified oil.

Keywords: fatty coriander oil, enzymatic esterification, adsorption, free fatty acids, acid number, ethanol, glycerin, anionite.

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OBTAINING A POWDERED SILICONE-ACRYLIC COPOLYMER BY EMULSION COPOLYMERIZATION (p. 16-22)

Olesya Ruban, Yekaterina Kiseliova-Loginova, Yevgeniy Popov

Based on experimental studies, a method for obtaining a powdered silicone-acrylic polymer by emulsion copolymerization of acrylic acid and 3-methacryloxypropyl-trimethoxysilane using a reaction initiator (ammonium persulfate) for implementing the modifications in the polymer cross-link to impart improved physico-chemical properties to the final product was presented in the paper.

The optimum conditions of synthesis were determined. Based on the study of the kinetics of the copolymerization reaction by the graviometric method, it was found that it is advisable to conduct the reaction for 4.5 hours at a temperature of 90 ºC, since the copolymer yield after this time was 45.3 %.

During the synthesis, silicone-acrylic polymer, which is a white powder without strong smell, insoluble in organic solvents was obtained. The copolymer was characterized using IR spectrum analysis and dispersion determination.

The obtained silicone-acrylic copolymer is recommended for use in paints and varnishes as a surface modifier.

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

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STUDY OF THE FRACTIONAL COMPOSITION OF SUGARS OF THE SECONDARY PRODUCTS OF POTATO PROCESSING (p. 23-28)

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The chemical composition of secondary products of potato processing (SPPP) shows that they contain a complex of substances that will allow to level the production process parameters of yeast semi-finished products at the stage of the yeast medium pre-activation or yeast dough maturation.

The object of the research were solutions of SPPP, pre-crushed, frozen and dried.

The aim of the research was to determine the fractional composition of SPPP by a spectropolarimetric method.

In determining the fractional composition, optically active substances were in optically inactive solution. Therefore, the concentration of components in a solution of a mixture of optically active substances can be found if rotation constants and the total number of components in the mixture are known.

The values of rotation constants of optically active potato carbohydrates at different wavelengths λ_i were found from experimental data of measuring the rotation angle of the polarization plane when radiation passes through the standard carbohydrate solutions with different known concentrations.

In this case, the system of five linear equations, linking the rotation angles $\varphi_{\lambda i}$ of the polarization plane of the solution with unknown concentrations Ci and specific optical activities $[\alpha_\lambda]$ of potato carbohydrates at different wavelengths λ_i, took the form of expressions (1) and (2).

To solve systems of linear equations (1) and (2), the Gaussian elimination method with pivoting, which greatly reduces the effect of computational error in the computer calculation was used.

Studies have shown that pre-freezing of SPPP increases the amount of reducing sugars by 3–4 times.

Keywords: secondary products of potato processing, potato dry additive, optically active carbohydrates, rotation angle of polarization plane, standard solutions.

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INFLUENCE OF MICROWAVE RADIATION ON TEMPERATURE CHARACTERISTICS OF DEHYDRATION (p. 29-34)

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In crystal hydrates of inorganic salts, water is in a particular, bound state. The crystal lattice of each crystal hydrate is individual, and by default it should be similar to the structure of the water ice Ih, which is not observed in practice.

It is assumed that the water of crystallization with the crystal hydrate is frozen water in other forms of ice that correspond to specific phases of ice, and salt simulates the application of high pressure. Due to the study of weight loss, the assumption is confirmed. Using microwave radiation also allows to reduce the adsorbent recovery temperature, which is very important for lower energy expenditure. So, many crystal hydrates are melted in the water of crystallization, which makes it necessary to evaporate water from it, and can also fill in the recovery installation.

Microwave radiation is weakly absorbed directly by ice because of the symmetry in it, and weak intermolecular vibration, in depth, and, therefore, it starts from the surface. The appearance of the salt in the water of crystallization can also be presented in the form of ice, and this significantly improves the absorptivity and allows the water of crystallization to volatilize, which provides recovery. Thus, using a microwave oven as an alternative method of recovery is highly relevant.

Keywords: crystal hydrates, radiation, recovery, ice, phase, lattice, pressure, temperature.

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ASSESSING THE EFFICIENCY OF REDOXITES DERIVED FROM A WEAKLY ACIDIC CATIONITE DOWEX MAC-3 BY IRON COMPOUNDS (p. 34-38)

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The best option for reducing corrosion aggressiveness of water is to extract oxygen from it. The dissolved oxygen is commonly removed with the help of redoxites, i.e. ionites modified by reducing agents. However, derivation and use of redoxites envolve problems of modifying ionites, assessing their quality, renewable capacity and reliability as well as the problem of durability.

The study reveals the process of removing oxygen from tap water, distilled water and a mixture of tap and distilled water in the ratio of 1:1 by means of redoxites, on the basis of iron (II) compounds-modified cationite Dowex mac-3. We have disclosed the impact of the ionite shape on the secondary water pollution with iron ions and proved that the effectiveness of deoxygenation depends on the hardness of water and the type of ionite.

Ionites were modified by processing a certain amount of placed in column cationite with application of modifying reagents in a given sequence at the selected optimal conditions of modification. Salt with a chemical element of variable valence –iron sulfate ($FeSO_4 \cdot 7H_2O$) – was used as a modifier.

It is proved that ionite in the form of Fe^{2+} effectively restores oxygen at an early stage. The oxygen exchange capacity amounted to 536 mg-eq/dm^3, and the total exchange capacity reached 1,251 mg-eq/dm^3. The disadvantage is desorption of iron from the surface of the ionite and its replacement by calcium ions.

It is found that in the case of ionite with hydrolyzed iron, iron ions were not desorbed when distilled water was passing through a layer of ionite.

Keywords: oxygen, cationite, redoxite, sorption, iron, capacity, ion exchange, hardness, tap water, distilled water.

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BIOCENOSES IN THE LOADS OF IRON AND MANGANESE REMOVAL FILTERS AND THE METHODS OF SETTLING THEM IN ZEOLITE (p. 39-43)

Oleksandr Kravchenko

We have studied the composition of biocenoses in the loads of iron and manganese removal filters and linked the composition to the potency in the processes of iron and manganese removal. We have proved that efficiency of iron and manganese removal is determined by such microorganisms as Leptothrix and Siderocapsa (their ratios are 11–17 % and 3–8 % respectively) in biocenoses of the loaded filters. We have revealed that effective removal of both elements (up to 92 % of iron and 84 % of manganese) requires, in addition to the aforementioned microorganisms, equal ratios (2–3 %) of Metallogenium, Galionella, Siderocapsa, and Hyphomicrobium in the structure of biocenoses.

The devised technique of settling the filters with biocenoses of iron and manganese oxidation microorganisms, which consists in washing the biocenoses off similar filters and settling the wash-offs onto the loads of the new filters. This technique gives a one-day biocenosis almost as active as a twenty-day biocenosis. This peculiarity can be used in technological schemes of iron and manganese removal when dealing with an artificial settlement of microorganisms.

Keywords: biocenosis of iron and manganese oxidation bacteria, removing iron and manganese from the water, zeolite loading of filters, wash-off.

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NITROUS OXIDES DESORPTION FROM NITRIC ACID (58–60 WT. %) (p. 43-48)

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The process of nitrous oxides desorption from nitric acid solutions (in domestic schemes) was considered. It is shown that in the process of desorption (or stripping), the nitrous oxides are not removed from solutions completely, so, the nitric acid does not satisfy the technical requirements in Ukraine.

The research objective was to bring the quality of nitric acid to technological standards by removing (stripping) nitrous oxides from its solutions.

To achieve the research objective, the balance in the system of nitrous oxides – nitric acid – water was analyzed. Dependences of the partial pressures of N_2O_4 and NO_2 on their concentrations in the liquid phase, the nitric acid concentration and temperature were investigated and determined.

It is shown that the Henry's law is applicable for the nitrous oxides desorption in the purge columns of domestic production schemes of nitric acid.

Based on experimental studies, expressions for the Henry coefficients for NO_2 and N_2O_4 were formalized. Values of solubility of NO_2 and N_2O_4 in the liquid phase under equilibrium conditions (and similar), i. e. 58–60 wt. % HNO_3 at 40–70 ^oC were determined.

Using the obtained dependences, a new purge column, allowing to desorb (strip) nitrous oxides from nitric acid to technological standards was designed.

Keywords: nitrous oxides, nitric acid, desorption, partial pressure, solubility, Henry coefficient.

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THE STUDY OF TECHNOLOGICAL AND KINETIC REGULARITIES OF SIMULTANEOUS METHACRYLATES OBTAINING OVER ZIRCONIUM-CONTAINING CATALYSTS (p. 49-52)

Yuliia Nebesna, Volodymyr Ivasiv, Roman Nebesnyi

The development of active and selective catalysts for the process of methacrylates obtaining by aldol condensation of methyl propionate with formaldehyde is a key issue on the way to industrial implementation of said process. To solve this problem, a catalyst based on boron and phosphorus oxides was promoted by zirconium oxide. The effect of temperature and zirconium oxide content in B_2O_3-P_2O_5-ZrO_2/SiO_2 catalysts on methyl propionate conversion, methyl methacrylate and methacrylic acid selectivity and yield has been investigated. It was found that the promoter content in the catalyst does not significantly affect the conversion of saturated ester, but conversion significantly increases with the temperature increasing. The highest yield and selectivity of methyl methacrylate and methacrylic acid were at the temperature of 623 K in the presence of a catalyst, wherein the molar ratio of ZrO_2/P_2O_5 was 0.3. Over this catalyst at 623 K total yield of methacrylate monomers was 63.2 % while their total selectivity was 65.4 % and conversion of methyl propionate was 96.6 %. The basic kinetic regularities of simultaneous methacrylates obtaining were determined over the best catalyst.

Keywords: methacrylic acid, methyl methacrylate, zirconium oxide, aldol condensation, catalyst, methyl propionate, formaldehyde.

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STUDY OF THE UREA HYDROLYSIS KINETICS IN THE PRECIPITATION CONDITIONS OF HYDROXIDES AND METAL SALTS (p. 53-57)

Elena Korchuganova, Emiliya Tantsyura, Kamila Abuzarova, Pavel Prygorodov

The results of studies of the urea hydrolysis kinetics in the temperature conditions corresponding to the precipitation conditions of hydroxides and metal salts were presented. The research was carried out at temperatures of 80–100 °C.

The process mechanism was determined – the first-order reaction takes place, the kinetic equation of the urea hydrolysis process was obtained, the dependence of the reaction rate on temperature was defined. The activation energy – 88 kJ, indicating the process flow in the kinetic region was calculated. The rates of accumulation of the hydrolysis products – ammonia and carbon dioxide, which are precipitators of hydroxides and metal salts, in the solution were experimentally studied. It was found that in the hydrolysis process, the amount of ammonia and carbon dioxide in the solution decreases. The temperature at which the there is the highest amount of hydrolysis products in the solution is 90 °C.

Keywords: urea, hydrolysis, precipitation, kinetics, reaction rate, dispersbility, hydroxides, carbonates.

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PECULIAR PROPERTIES OF CRYSTAL-CHEMICAL STUCTURE OF SPINELS OF THE SYSTEM $Mg(Fe_xCr_{2-x})O_4$ OBTAINED THROUGH THE HYDROXIDE COPRECIPITATION METHOD AND SOLID STATE TECHNOLOGY (p. 57-63)

Anna Lutsas, Ivan Yaremiy, Mykola Matkivskiy

Using the coprecipitation method of metal hydroxides, magnesium ferrite-chromites of the system $Mg(Fe_xCr_{2-x})O_4$ were synthesized, and a comparative analysis of crystal-chemical parameters of the obtained samples with similar samples, made through the solid state technology was performed. The precipitation method provides high dispersion, lower sintering temperature and more even distribution of components in the sintered ferrite. It was found that in samples, synthesized through the hydroxide coprecipitation method, the value of lattice constant is greater and reversibility degree is lower compared with samples synthesized through the solid state technology. The formation of magnesium ferrite-chromites from coprecipitated hydroxides is completed at temperatures 500–700 °C lower than with the standard solid state technology using oxides.

The dimensions of the crystallites in the samples obtained through the hydroxide coprecipitation method are within 50–130 nm and are smaller than samples, obtained through the solid state technology (200–400 nm). The changes in dispersion and ionicity degree of the chemical bond, depending on the composition and synthesis method were monitored. The obtained results demonstrate the possibility of synthesis through the hydroxide precipitation of ferrites of the system Mg–Fe–Cr and allow to predict their crystal-chemical parameters.

Keywords: ferrite, spinel, crystal lattice, precipitation method, ceramic technology.

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