## DEVELOPMENT OF NOVEL CATALYTIC SYSTEMS BASED ON $B_2O_3$ AND $P_2O_5$ OXIDES FOR PRODUCTION OF METHYL METHACRYLATE AND METHACRYLIC ACID

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The article deals with issues related to preparation of acrylate monomers through aldol condensation. Earlier considered aldol condensation process of methyl propionate with formaldehyde in the gas phase on solid catalysts has high conversion, but its disadvantage is significant methyl propionate hydrolysis to propionic acid and methanol. To address this disadvantage it is proposed to obtain methyl methacrylate and methacrylic acid by the combined aldol condensation of methyl propionate and proponic acid with formaldehyde.

As a result of researches high selective catalytic systems based on oxides $B_2O_3$ and $P_2O_5$ is developed. In particular, on the $B_2O_3$–$P_2O_5$–$Bi_2O_3$–SrO/$SiO_2$ catalyst 100 % selectivity was achieved at 563 K. The effect of temperature changes on the aldol condensation process of methyl propionate and propionic acid with formaldehyde is determined and the optimal conditions of the procedure are established. An optimal release of methyl methacrylate and methacrylic acid catalyst is $B_2O_3$–$P_2O_5$–$Bi_2O_3$–$WO_3$/$SiO_2$, where the total release for one run is 55,2 %, while the total selectivity of their formation is 97,5 % and the conversion of methyl propionate and propionic acid is 56,6 %

The proposed method allows receiving two valuable products at one stage and eliminating methyl propionate hydrolysis, increasing the competitiveness of products receiving by such method. The developed catalysts ensure efficient use of raw materials due to the high selectivity of formation of desired products.

**Keywords:** methacrylic acid, methyl methacrylate, propionic acid, aldol condensation, catalyst, methyl propionate, formaldehyde.

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## WATER RESISTANCE IMPROVEMENT OF LEAD-FREE JEWELRY ENAMEL

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Glass research in the system $SiO_2$–$Na_2O$–$B_2O_3$–+BaO+$K_2O$–$Al_2O_3$–$TiO_2$–ZnO to produce lead-free glass coatings on copper samples is conducted. The influence of oxides $Al_2O_3$, $TiO_2$, ZnO on the properties of glass and enamels based on it is studied.

The glass of second hydrolytic class was obtained at the ratio of $Al_2O_3$:$TiO_2$:ZnO is 1:6:6.

$TiO_2$ increases the refractive index and water resistance, but reduces the coefficient of linear expansion.

$Al_2O_3$ improves water resistance and refractive index of the investigated glass. However, increasing the $Al_2O_3$ content up to 10 mol. % reduces the coefficient of linear expansion and gloss of coating, which is undesirable in the development of jewelry enamel.

Increase of ZnO content of the base glass increases the water resistance and refractive index. Addition of zinc oxide does not change the coefficient of linear expansion and original glass-fusion point. Therefore, addition of ZnO to jewelry enamel compositions has a positive impact on technological and decorative properties and is a promising addition.

Area of rational enamel compositions for coating of gold, silver and copper has the following limitations of oxide content, mol. %: $Al_2O_3$ — 1,0–3,0; $TiO_2$ — 1,0–5,0 and ZnO — 5,0–10,0.

Clear, defect-free, smooth, uniform enamel layer having rational firing temperature of 800 °C and the firing duration of 3 minutes is obtained on copper samples 1 mm thick (copper marks M1).

**Keywords:** jewelry enamel, lead-free enamel, water resistance, refractive index of the glass, gold, silver, copper.

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## INVESTIGATION OF ADHESIVE PROPERTIES OF BARRIER-TYPE GEOCEMENT-BASED COATINGS

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The results of the adhesive test of the research object — barrier-type geocement-based coating applied to metal polymer film, formed as a result of redox reaction of «Contrrust» rust converter and metal corrosion products are shown in the article. Despite the diametrically opposite pH of the two substrates, traces of rejection coating on the film, detachment and blistering, peeling and other defects aren't observed. The adhesive characteristics of the compositions included in the developed system of protective coating ««Contrrust» rust converter + barrier-type geocement-based coating» are determined: adhesive characteristics of the compositions included in the developed system of protective coatings: ««Contrrust» rust converter + barrier-type geocement-based coating»: adhesion for incision method of metal polymer film 117 microns thick to metal substrate is 1 point, and geocement coating to metal polymer film 550 and 168 microns thick is 3–4 and 1 point; adhesion for normal force separation method of metal polymer film 117 microns thick to the metal substrate is 1,8-6,1 MPa and barrier-type geocement-based coating applied to metal polymer film 550 microns thick is 1,7 MPa, which respectively in 3–10,2 and 2,83 times higher than regulations.

Adhesive bond of geocement coatings to the metal polymer film consisting of water-resistance chelate complexes is so large that facilitates the joint separation of the two protective compositions from the surface of the metal substrate. The combined use of the above mentioned compositions contributes to a significant reduction in costs both in preparation and in terms of the painting works for metal structures.

**Keywords:** adhesion, atmospheric corrosion, geocement coating, metal substrate, rust converter, protective coating system.

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## EFFECT OF PRESSURE ON THE STABILITY AND ABILITY TO DRYING OF WATER-SATURATED GASES

page 18–22

The inorganic salts-based solid phase adsorbents are often used as driers of gases or weakly polar liquids (for example — ethanol) as the cations of metal elements have the ability to readily form aquacomplex compounds, which easily solidify and form crystalline hydrates. However, since there is often a need to conduct drying gas from other pressure than atmospheric pressure, there is a need to carry out the dependence of properties of inorganic salts, which form crystalline hydrates, from the pressure.

Results based on the use of four different inorganic adsorbents have shown that the pressure increase accelerates dehydration and generally deepens its extent. It is caused both by van der Waals bonds and a more effective mechanism for the formation of bonds of the donor-acceptor mechanism. Effect of pressure increase on various adsorbents is uneven and is linked to the strength of relationships, which are formed by a cationic mechanism, and is also associated with coordination number of the central atom, its radius, the distance to its electron shells and the position in the periodic table.

The results make it possible to develop an adsorbent for effective drying gas to replace traditional gas drier, such as phosphorus (V) oxide, and sulfate (sulfuric) acid.

**Keywords:** pressure, crystalline hydrates, metals, spectroscopy, ligands, bond, electronegativity, hydration.

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## THE PREPARATION OF BIOCOMPATIBLE POLYMERIC FIBERS BY ELECTROSPINNING METHOD

page 22–26

Object of research — biocompatible nanofiber nonwovens with antiseptic and fungicidal properties obtained by electrospinning method. Biocompatible polymers with additives of bactericidal and fungicidal agents are not before processed by electrospinning method in fiber because of high energy and cost.

A method for producing nonwoven functional polymeric materials by electrospinning method using capillary laboratory unit is proposed. An optimal voltage electric field is 30 kV and the distance between electrodes is 13–15 cm for fibers with a biocompatible polyvinyl alcohol and the decasan addition.

As a research results of morphological features of fibers obtained by optical polarization microscopy it is demonstrated that fibers with diameters ranging from 0,9 to 6,6 mm are obtained under certain electrospinning parameters. As a result of determining the statistical distribution of polymer fibers in

the nonwoven material by diameter it is found that 56 % of the fibers have a diameter of 2,6–3,8 mm. Some fibers obtained using laboratory unit of capillary electrospinning meet the nanoscale region, opening prospects to obtain biocompatible nanofibers with antiseptic and fungicidal properties.

**Keywords:** electrospun fibers, polymeric biocompatible fibers, nonwoven materials, nanofiber materials, diameter of fibers.

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## INVESTIGATION OF CAVITATIONAL TRANSFORMATION OF MOTOR FUELS

page 26–32

The object of research is a process of hydrocarbons isomerization and synthesis of oxygen-content organic compounds in the cavitation field. The disadvantage of this method is that the increase in the octane number by 2–5 units does not solve the problem of improving the quality of such straight-run gasoline. To increase the efficiency of cavitation in the article it is proposed to inject hydrogen peroxide in the flow of gasoline. It is known that hydrogen peroxide at dynamic cavitation decomposes into two hydroxyl radicals, which can interact with molecules of alkanes with formation of methanol. Methanol is one of the most common additives that are injected in the composition of low-grade gasoline to improve its quality indicators.

A characteristic feature of the proposed process is that it is only in the cavitation field. Dynamic cavitation is proposed to create cavitation fields.

During the passage of fuel through the reactor cavitation field there is partial destruction of linear hydrocarbons with formation of alkyl radicals and subsequent recombination of radicals. Due to this, there is isomerization of linear hydrocarbons. As a result, the octane number of gasoline after cavitation processing increases by 2–5 units.

The study proved that the gasoline processed by cavitation method with hydrogen peroxide can be used for production internal combustion engines. It is shown that the experiment was able to increase the octane number of gasoline using research method by 14,8 points (from 74,9 to 88,7) and 12,7 using motor method by 12,7 points (from 72,2 to 84,9). Maximum octane number is achieved at a pressure of 19–20 MPa.

**Keywords:** cavitation gasoline processing, octane number, methanol, toluene, hydrogen peroxide.

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## INVESTIGATION OF THE EFFECT OF THE RELATIVE SURFACE POWER ON THE MEAT FRYING PROCESS

page 33–36

Analysis of theoretical studies showed value correlation of surface power for heating surfaces in devices for conductive frying process duration, output of finished products made of meat and relative electricity consumption. Its impact on the above parameters for bilateral meat frying has not been investigated. Average integral temperature difference between frying and product surfaces; fried items temperature from the value of relative surface power of frying surfaces as one of the factors for the formation of heterocyclic amines must be investigated.

Object of research is conductive frying process, characterized by high energy costs because of process duration, low product yield and overrated relative surface power of devices, as well as heterocyclic amines formation probability in a finished product.

Aim of research is to determine the effect of relative surface power on the efficiency indicators for bilateral meat frying under pressure and average integral temperature difference $\Delta\overline{T}_c$ between frying and product surfaces.

It was proved that the value increasing for relative surface power of frying surface of the device from 50 to 350 kW/m$^2$ causes the increasing of average integral temperature difference between frying surface and meat surface from 7 to 14 K and final temperature increasing in meat surface from 385 to 409 K.

Value increasing for relative surface power of the device from 50 to 350 kW/m$^2$ causes the increasing of bilateral meat frying process from 68 to 78 sec, product yield decreasing from 90,4 to 88,8 % and relative electricity costs increasing from 0,171 to 0,343 kW70 · hr/kg.

**Keywords:** relative surface power, average integral temperature difference, bilateral frying, surface layers.

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## INTEGRATED QUALITY RESEARCH OF DOMESTIC SPECIAL VODKA

page 37–42

This article is devoted to complex research of quality and safety performance for special vodka TM «Pervak home Rye». In the course of the analytical study analyzed the regulations governing the quality of special vodka in Ukraine.

Evaluation of packaging and labeling of special vodka TM «Pervak home Rye» found that bottle, which poured special vodka protects the product from the negative impact of environmental factors on the quantitative and qualitative losses, and information labeling that printed on packaging contain full information about the product and meet the requirements of ISO 4256:2003.

Making special organoleptic evaluation of vodka TM «Pervak home Rye» conducted by tasting the sample, as a result of which found that the sample meets ISO 4256:2003 organoleptic characteristics.

The results of evaluation of physical and chemical indicators of quality for special vodka TM «Pervak home Rye», made with alcohol «Lux», showed that strength, alkalinity, aldehydes mass concentration, fusel oil mass concentration, esters mass concentration, volume fraction of methanol match the requirements of ISO 4256:2003.

Particular attention is paid to research safety parameters such as heavy metals (cadmium, lead, copper and zinc) using voltammetry. Analysis of sample voltammograms of special vodka TM «Pervak home Rye» showed that the content of heavy metals for special vodka TM «Pervak home Rye» meets the requirements of ISO 4256:2003.

As a result of a comprehensive study of special vodka TM «Pervak home Rye» production of «UDC» we can say that it is a high quality and safe for consumption.

**Keywords:** vodka, manufacturer, packaging, labeling, quality, safety, ester, alcohol.

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## INVESTIGATION OF THE INFLUENCE OF PROCESSING METHODS BY ANTIOXIDANT COMPOSITIONS ON THE KEEPING QUALITY OF THE FRUIT

page 43–47

Research is devoted to scientific assessment of the impact of antioxidant compositions treatment methods for preservation of fruit production. As an object model is used the fruits of apple varieties Aidared, Golden Delicions, fruits of pear varieties Iziumynka Krymu and Konferentsiia, fruits of plum varieties Voloshka and Stenlei. Fruits were treated by three antioxidant compositions. Fruits treated by water and without treatment were taken as a control. Application of antioxidant composition on the surface of fruits served in four ways: immersion in working solutions, irrigation by working solutions on the line of preparing fruit for storage, irrigation on the parent plants and by aerosol method in the storage. After processing, the fruits were stored at a temperature of 0±1 °C and relative humidity of 90–95 %. As a result it was found that the value of the average daily fruit loss during storage has the most significant impact type of antioxidant composition. Application of antioxidant composition on the fruit surface can be performed by any of the three studied methods: immersion in working solutions, irrigation by working solutions on the line of preparing fruit for storage, irrigation on the parent plants. The aerosol method of processing the fruit is not acceptable when using such antioxidant compositions that are not capable of forming a gas dispersed environment.

**Keywords:** fruits, antioxidants, processing method, stress, daily loss, immersion, irrigation, aeration.

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## INVESTIGATION OF FUNCTIONAL AND TECHNOLOGICAL INDICATORS OF MINCED FISH SYSTEM WITH THE USE OF PROTEIN ADDITIVES

page 48–51

This paper substantiates the prospects and feasibility of using protein additives on the basis of salmon skin as part of minced fish systems. The main aim was to study and evaluate the effect of developed protein additives on functional and technological indicators of minced fish systems, in particular, water binding capacity and molecular mobility of the water in the system. These data show that the best functional and technological parameters are characterized for samples of minced model with 15 % replacement of fish raw materials for developed additives. It was also found that the most promising protein additives is an additive based on the skins of smoked salmon, due to the partial denaturation of collagen fibers during smoking and maturing fish. We propose to use developed protein additives in minced systems based on low-value, low fat fish raw materials, functional and technological properties of which are significantly reduced due to prolonged or multiple freeze.

**Keywords:** minced fish system, protein additives, water binding capacity, molecular mobility of the water.

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## RESEARCH OF RHEOLOGICAL PROPERTIES OF HYDROCOLLOID COMPLEXES AS FILM — FORMING COATINGS

page 51–56

The research results of functional-technological and rheological properties of hydrocolloids of different origin and their complexes are given.

Investigating the film-forming solution on the basis of polysaccharides (CMC, guar gum), at a concentration of 2 %, and polysaccharides (alginate, xanthan gum, carrageenan) with a concentration of 3 % served as a Newtonian fluid, given that the viscosity remained constant as the shear rate . Comparing with other concentrations of these polysaccharides, all other showed non-Newtonian behavior as pseudoplasticity by decreasing viscosity with increasing shear rate. Based on these results, we can conclude that the hydrocolloids concentration of 2,3 % is better to create a film-forming coating because their viscosity does not change as it passes through the sprayer of the nozzle.

Research of complexes showed that the addition of any hydrocolloid to sodium alginate increases the viscosity of the

solution compared with monocomponent solution. Adding glycerol solutions also increases viscosity compared to the same composition, but without glycerol. Analyzing the results the authors article concluded that appropriate for further study are the solutions № 2, 4, 6, 8.

**Keywords:** hydrocolloids, polysaccharides, film-forming coating, sodium alginate, viscosity, gels, meat.

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## STUDY OF BK-BIRD FUNCTIONAL ADDITIVE INFLUENCE ON THE PHYSICAL AND CHEMICAL PROPERTIES OF BROILER CHICKENS' MUSCLE TISSUE

page 56–60

This article discusses the impact of new BK-Bird functional additive containing probiotic flora species *Bifidobacterium pullorum, Lactobacillus plantarum, L. paracasei ssp. paracasei, L. rhamnosus* on the physical and chemical parameters of cross «Cobb-500» broiler chickens' muscle tissue.

This functional additive was applied in fattening in dose of 1 g per 1 kg of basic feed. At 38 days of age controlling slaughter of broiler chickens was carried out. Morphological analysis of meat quality of broilers was conducted. Composition, physical and chemical parameters were investigated. Muscle energy and biological value were calculated.

The results of influence of this additive on the composition of muscle tissue, its biological and energy value is shown. In particular, the introduction of a functional additive in the composition of the basic diet of chickens proved an effective means of improving the composition of the raw meat, namely to reduce the moisture, to increase the protein content of muscle tissue and the energy value and thus to increase the quality and safety of raw materials and as a consequence its industrial capacity for production of food products.

BK-Bird functional additive is recommended for industrial bird farms as an alternative to veterinary drugs. BK-Bird additive is an environmentally safe and effective for therapeutic and preventive measures and to obtain products with high biological value.

**Keywords:** chicken broilers, functional additive, probiotic, physical and chemical parameters, biological and energy value.

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## EFFECT OF ABIOTIC FACTORS ON THE FORMATION OF BIOACTIVE COMPOUNDS OF PARSLEY

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The volatile nature of abiotic factors in the growing season corrects the specific of metabolic processes and accumulation intensity of bioactive substances. But no clear idea about the degree of influence of each factor of the weather to predict the realization of the productive potential of parsley and adjust it using special farming practices.

It was established that the degree of influence of weather conditions is 15,0 ... 41,4 %; season — 20,5 ... 55,5 %; cultivar — 0,0 ... 13,5 %. It was revealed that autumn parsley accumulates 5,7 ... 23,4 % more phenolic compounds, is more 1,3 times the content of chlorophyll, β-carotene than spring leaves. However, spring parslry contains 14 % more ascorbic acid. High quality or seasonal specifics in the level of accumulation of carotenoids in parsley weren't found.

**Keywords:** parsley, abiotic factors, ascorbic acid, polyphenols, chlorophyll, carotenoids, β-carotene.

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