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RESEARCH ON THE MECHANISM OF WOOD PROTECTION WITH ECO-FRIENDLY PAINT AND VARNISH COATINGS

pages 6–11

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The problem of using wood products is to ensure their protection with a paint and varnish coating in order to increase their durability. Therefore, the object of research was the resistance of the paint and varnish coating when finishing wood to the destruction of adhesion and the action of chemical reagents during operation. It has been proven that for a wood sample finished with nitro-urethane varnish SU-29, when determining adhesion, slight delamination in the form of small scales is observed in the places where the grid lines intersect. However, there are no signs of delamination on a wood sample finished with melamine varnish Plastofix 96 RF. Comparing the samples finished using different technologies, they can be evaluated by points: samples finished with nitro-urethane varnish SU-29 received an adhesion rating of 2 points, namely, slight delamination in the form of small scales in the places where the grid lines intersect. The damage is observed on no more than 5% of the surface of the grid, and the samples finished with Plastofix 96 RF melamine varnish are rated at 1 point – the edges of the cuts are completely smooth, there are no signs of delamination in any square of the grid, i. e. they have better adhesion to wood. The wood surface treated with varnish was assessed for staining, and it was found that the wood surface belongs to 1 point, i. e. there are no visible changes. The results of determining the resistance to water of a wood sample treated with SU-29 nitro-urethane varnish showed a visible trace left by water with a diameter of about 20 mm. In contrast, there are no traces of water on the sample of wood treated with melamine varnish. The practical significance is that the results obtained justify the use of eco-friendly varnish for wood finishing. Thus, there is reason to argue about the possibility of directed regulation of the wood protection process through the use of coatings capable of forming a protective layer on the surface.

Keywords: protective agents, paint and varnish coating, adhesion, surface treatment, protection efficiency.

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DEVELOPMENT OF A COMPOSITION FOR FOOTWEAR USING SECONDARY RECYCLED MATERIALS

pages 12–16

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The object of this study is the process of forming a coating on a chromium-tanned split leather semi-finished product. The study is aimed at developing an optimal formulation of a finishing composition for the production of footwear upper leather.

A technology has been developed for forming a decorative coating on chromium-tanned split hides from pigs and heavy cattle. The composition of the finishing formulation was determined through computer modeling and multiparameter optimization using Harrington's desirability function. Based on the analysis of the physico-mechanical properties of the resulting monolithic films, the qualitative composition of the film-forming finishing composition was established.

Computer-aided modeling of the "composition – property" system for a three-component formulation, using the Scheffé mathematical model, enabled the derivation of analytical relationships between the physico-mechanical properties of the finishing composition and its constituents. The optimal composition was determined at the maximum values of the desirability function and physico-mechanical parameters through multiparameter optimization.

The leather produced using the optimal composition was tested under industrial conditions and complies with DSTU 2726-94 and DSTU 3115-95, for upper footwear leather and leather for garment production, respectively. The use of a highly porous chromium-tanned split leather semi-product derived from pig hides ensures the production of high-quality, elastic upper leather.

The developed finishing technology for split hides of pigs and heavy cattle demonstrates significant potential for use in the manufacture of everyday footwear.

Keywords: chromium-tanned split leather, polymer films, multiparameter optimization, physico-mechanical properties of leather.

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DEVELOPMENT OF A METHOD FOR PROCESSING CONCENTRATES FROM WATER DESALINATION PROCESSES TO OBTAIN ALUMINUM COAGULANTS

pages 17–24

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The process of processing concentrates and eluates formed during desalination of natural surface, artesian, and mine waters with increased mineralization by reverse osmosis and ion exchange methods has been studied. Specifically, this study examined the processes of processing sodium chloride solutions and mixtures of sodium chloride and sodium sulfate via electrodialysis, and obtaining alkaline and aluminum salt solutions, were examined.

Aluminum salts were produced using AD-31 aluminum anodes. A stainless-steel plate of grade 12H18N10T was used as the cathode. The process was conducted at current densities ranging from 1.67 to 8.33 A/dm² in two- and three-chamber electrolyzers using MK-40 cation-exchange membranes and MA-41 anion-exchange membranes. In all experiments, alkaline solutions were obtained in the cathode region and aluminum salt solutions in the anode region. When using a three-chamber electrolyzer, the salt solution was placed in the working chamber, separated by a cation-exchange membrane from the catholyte and an anion-exchange membrane from the anode zone. During electrolysis, alkali concentration occurred in the catholyte and aluminum salts in the anolyte. In the three-chamber electrolyzer, desalination occurred in the working chamber due to the diffusion of sodium ions through the cation-exchange membrane

into the catholyte and the diffusion of anions (chlorides and sulfates) through the anion-exchange membrane into the anode area. Aluminum oxidation in the anode area resulted in the formation of Al^{3+} cations, and in the presence of chlorides, aluminum chloride was formed. Hydrolysis of aluminum chloride partially produced aluminum hydroxychlorides, predominantly forming 1/3 aluminum hydroxychloride. Before electrolysis, the anode chamber pH was adjusted to 2.5 with hydrochloric acid. During electrolysis, the pH was maintained at 2.5–3 due to electrode reactions. The salt content in the working chamber decreased to 2–20 mg-eq/dm^3. In a two-chamber electrolyzer, electrolysis produced alkali in the catholyte and aluminum chloride in the anolyte. Conversion of sodium chloride in the anolyte was limited due to poisoning of the cation-exchange membrane by aluminum ions.

Keywords: demineralization, concentrate, reverse osmosis, ion exchange, electrolysis, electrodialysis, coagulant, aluminum chloride, membrane.

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THE IMPACT OF FOREST FIRES IN THE CONTEXT OF CLIMATE CHANGE: AN INTERDISCIPLINARY ANALYSIS

pages 25–37

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The object of the study is forest fires as a complex natural and social phenomenon that encompasses ecological, climatic, technological and management aspects of their occurrence, spread and consequences for ecosystems and society. Forest ecosystems are a complex natural system that plays a key role in economic activity, biodiversity conservation, climate regulation and the carbon cycle. One of the most problematic areas is the increasing frequency and scale of forest

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fires caused by both natural and anthropogenic factors, as well as the lack of an integrated approach to analyzing, forecasting and managing this phenomenon. The study used the method of an interdisciplinary literature review with a focus on key concepts: "forest fires", "fire spread", "anthropogenic impact", "modelling", "carbon cycle", "environmental consequences". The analysis of publications and clustering of topics in a term-oriented environment to identify structural links between scientific areas made it possible to obtain a qualitative typology of approaches to the study of forest fires, which includes: analysis of natural and social determinants, modelling of fire spread, assessment of environmental damage, impact on climate processes and development of prevention systems. This is due to the fact that the proposed approach covers a wide range of risk factors, allows for ecosystem specificity and emphasizes the need for interdisciplinary management. This makes it possible to develop effective strategies for climate change adaptation, increase ecosystem resilience and improve fire prevention systems. The proposed structure of the review provides a holistic view of the problem and identifies priorities for further research in the field of environmental safety and natural resource management.

Keywords: forest fires, ecosystem, climate change, modelling, management, anthropogenic factors.

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DEVELOPMENT OF IRON-CONTAINING ADSORBENTS FOR FLUORIDE ION REMOVAL

pages 38–47

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Ingestion of too much fluoride ions through drinking water can seriously harm human health. Adsorption is one of the most effective approaches that have been proposed for removing fluoride ions from the aquatic environment. Analysis of modern publications shows that the search for new effective sorbents obtained by resource-saving technologies is an urgent scientific and practical problem. It is proposed to use sediments from groundwater deironing stations as sorbents. These sludges are formed in significant quantities and create significant environmental problems. Therefore, the object of the study is samples of agglomerated iron-containing adsorbents.

Two samples of sorbents with different iron contents were studied. The influence of various parameters on the efficiency of fluoride ion adsorption was analyzed: contact time, initial fluoride concentration and adsorbent dose, pH value of the initial solution, and the presence of competing ions.

The experimental data fit well with the pseudo-second-order kinetic model (coefficient of determination $R^2 = 0.8581$ for sample A03 and $R^2 = 0.9947$ for A06). The best correlation of the experimental data with the Langmuir model is the coefficient of determination $R^2 = 0.965$ for A03 and for A06 $R^2 = 0.970$. It was found that the maximum efficiency was achieved at pH 4. With an increase in the initial fluoride concentration, the sorption capacity increases, and the removal efficiency first increases and then decreases.

For the sorbent A03, the optimal dose is 5 g/dm^3, and for A06 – 6 g/dm^3. The study of the influence of foreign ions on the sorption of fluoride ions on the sorbent showed that all the studied ions to some extent worsen the defluoridation efficiency.

The use of the proposed sorbent will allow solving the following environmental issues: replenishing the list of cheap Ukrainian sorbents for fluoride removal and utilization of sludge from iron removal stations.

Keywords: fluoride ion removal, iron, granular adsorbents, water treatment sludge, kinetic models, isotherms.

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EXPRESS METHOD FOR DETERMINING POWER OF EQUIVALENT DOSE IN RADIATION-CONTAMINATED TERRITORIES OF RADIOACTIVE TAILINGS STORAGE FACILITIES

pages 48–55

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Operation of radiation-hazardous facilities, such as tailings facilities of the former uranium production of the Prydniprovsky Chemical Plant (PCP, Ukraine), with buildings, structures, observation points, communications, technological equipment, etc. located on their territory, is impossible without a system of physical protection and radiation monitoring. Operation of such facilities in peacetime allows for fairly rapid data collection in the operating mode at the radiation-hazardous facility itself using the method of walking gamma imaging on the perimeter of the tailings storage facility. In conditions of martial law and under certain restrictive circumstances, it is not possible to go directly to the industrial site and conduct full-scale measurements. For this, express methods of mathematical forecasting can be used. Based on the conducted research, the dynamics of observations is calculated, and the predictive model allows determining the regulated radiation parameters (RRP), one of which is the equivalent dose rate, without using radiation control devices with specialists who will conduct measurements.

For ten years, the actual values of radiation doses to personnel at the tailings storage facilities of the former uranium production of the PCP were determined. The article presents the developed universal mathematical model for determining the equivalent dose rate of gamma radiation for personnel conducting one-time measurements at a radiation-hazardous facility. The developed mathematical model for measuring the equivalent dose rate values is used for 2D modeling in places where dusty particles with radionuclides settled from the leeward side in the summer in places where the tailings mirror surface decreases. This makes it possible to predict the further radiation situation that will occur in the coming years and improve the system for calculating the total effective dose to a person.

Keywords: mathematical model, equivalent dose rate, tailings storage facility, radiation-hazardous facility, γ-radiation.

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DETERMINATION OF THE INFLUENCE OF RAW MILK β-CASEIN POLYMORPHISM ON THE EFFICIENCY OF MAKING COTTAGE CHEESE

pages 56–62

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The positive functional features of A2 milk and the increase in the percentage of animals with the A2A2 genotype will contribute to expanding the choice of dairy products, in particular, cottage cheese. It is expected that determining the influence of the protein composition of raw milk on the quality and yield of cheese will allow for effective selection of dairy breeds of cows. The object of the study is the technological process of producing cottage cheese, produced by the classical acid method of coagulation of milk proteins from cows with different β-casein genotypes (A1A1, A1A2, A2A2). Subject of the study: physical and chemical characteristics of raw milk (A1A1, A1A2, A2A2); yield and quality of cottage cheese. It was experimentally established that the milk samples have a typical composition and comply with DSTU 3662:2018. The average dry matter content in milk from cows with the A1A1 genotype was 12.73%, with the protein-to-fat ratio varying within 0.76–0.83. In raw material samples from animals with the A1A2 genotype, the average dry matter content was 12.72%, and the protein-to-fat ratio was 0.66–0.68. For milk from cows with the A2A2 genotype, the average dry matter content was 13.14%, and the protein-to-fat ratio was in the range of 0.62–0.82. A study of the quality indicators of cottage cheese samples showed that the genetic variation of β-casein does not affect the sensory properties of the final product. The moisture, protein, and fat contents in cheese from milk from cows with the A1A1 genotype were on average 72.27%, 9.77%, and 15.47%, respectively. In samples of cheeses from cows' milk with A1A2 genotype, the average moisture content was 67.17%, protein – 18.30%, fat – 14.37%. For cheeses from cows' milk with genotype A2A2, the average moisture content was 67.47%, protein – 15.30%, fat – 15.40%. It was found that the efficiency of cheese production from cows' milk with A2A2 genotype is the highest and on average is 141.26%, which exceeds similar indicators for A1A1 milk by 13.18% and A1A2 by 2.21%.

Keywords: cottage cheese, cheese yield, quality, β-casein, A2 milk, raw milk.

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INFLUENCE OF ENRICHED INGREDIENTS ON THE FUNCTIONAL PROPERTIES AND NUTRITIONAL VALUE OF BREAD

pages 63–68

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The object of research is the organoleptic properties and nutritional value of bread enriched with various functional additives. One of the most problematic areas in the technology of bread from refined types of flour is the low biological value of bread. Unrefined and gluten-free types of flour, which have a higher biological value, negatively affect the consumer properties of bread, the structural and mechanical properties of dough, and increase production costs. During the study, standard methods for analyzing the organoleptic and physicochemical parameters of bread were used. Enriched bread recipes were developed. Sample 1 – from rye hulled flour, premium wheat flour and the food supplement "Live Grains Dark", containing quinoa, chia, flax, sunflower seeds, hop infusion and dry sourdough. Sample 2 – based on high-grade wheat flour, whole grain flour, dried cranberries and walnuts. Sample 3 was made from a mixture of gluten-free flour (quinoa, rice, flax, buckwheat, oat, psyllium). A positive assessment was received ("good" and "very good" for all organoleptic indicators). Sample 1, noted by the tasters, had well-developed uniform thin-walled porosity, regular shape and dark brown color, due to the type of main raw material. It contained the most fiber (6 ± 0.05 g/100 g). Sample 2 had the highest nutritional value (859.2 ± 0.05 kJ/100 g). This is due to the fact that it contains a significant amount of carbohydrates (45.87 ± 0.05 g/100 g). Sample 3, made from gluten-free raw materials, contained more proteins (5.8 ± 0.05 g/100 g) and fats (1.6 ± 0.05 g/100 g), had the highest moisture content (46.7%). But its nutritional value was the lowest (828.4 ± 0.05 kJ/100 g). Due to the use of functional plant ingredients, the nutritional value of bread changes, it has unique organoleptic properties. Compared to bread made from refined flour, the proposed types have additional functional properties and contain more biologically active components.

Keywords: enrichment, rye hulled flour, whole grain flour, gluten-free flour, functional additives.

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DETERMINATION OF THE INFLUENCE OF MOISTURE OF DEHULLED HEMP SEED KERNELS ON STORAGE QUALITY INDICATORS

pages 69–75

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The object of research is the regularities of the process of storing dehulled seeds of industrial hemp, seed moisture, storage packaging, structure of dehulled hemp kernels. The effect of the moisture content of the kernels of industrial hemp seeds of the "Glesia" variety on their storage period was studied. It was noted that hemp seeds are a source of easily digestible vegetable protein and contain a wide range of phytonutrients important for the health of cells, blood vessels and internal organs of a person. The kernels of industrial hemp seeds are a ready-to-use product.

The shelling of seeds (separation of the shell from the kernel) was carried out mechanically by a centrifugal sheller of our own design. The diameter of the sheller impeller was 162 mm, the gap between the impeller and the reflecting deck was 80 mm, the impeller rotation speed was 2000 min^{-1}.

The influence of humidity (21.6%, 16.3%, 12.0% and 8.8%) of hemp seeds on the storage period and quality indicators of kernels obtained from it was studied. Whole and crushed kernels without husks were stored in polyethylene bags without access of air from May to August under normal room conditions. It was found that kernels with a humidity of 21.6% became unusable after 15 days of storage due to the appearance of visible traces of mold. On the 30th day of storage, the mass in the bag turned into a white homogeneous mixture. It was noted that a whole kernel with increased humidity deteriorates faster compared to crushed ones. It was found that kernels with a seed humidity of 16.3% did not have visible signs of mold growth on the 15th day. However, mold was found in the bags on the 30th day of storage. In packages with whole kernels, it is more actively developed, and in packages with crushed kernels – insignificant traces. At seed moisture content of 12.0% and 8.8% after three months of storage, the packages with kernels remained unchanged. Visually, no visible signs of the appearance and reproduction of mold were found in these packages.

Logistic dependencies of the probability of kernel suitability for consumption have been established depending on seed moisture, storage duration, and kernel structure. The importance of controlling the initial seed moisture content to ensure the proper quality of the final product was noted.

Keywords: industrial hemp, seeds, dehulling, kernels, storage, processing, humidity, mold, packaging, nutritional value.

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APPLICATION OF POWDERED DUTCH CHEESE IN WHEAT FLOUR BREAD TECHNOLOGY

pages 76–83

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Bakery products made from wheat flour occupy a leading position in the assortment. Consumption of such products in the amount of the daily norm (277 g) allows to provide a person's daily protein requirement by 40.0–43.0%. Wheat

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bread is a basic product in the diet of the majority of the population, therefore there is an objective need to expand its assortment with products with increased nutritional value, as well as to diversify its taste properties through the use of additional non-traditional raw materials.

The object of research is the technology of bread from wheat flour using powdered Dutch cheese to increase the nutritional value and consumer characteristics of the finished product.

It was established that powdered Dutch cheese is characterized by a good dissolution rate, low tendency to lump formation and a whiteness index corresponding to high-grade flour. The chemical composition of dry hard cheese is mainly represented by protein and fat, which will contribute to the enrichment of bakery products with milk proteins and milk fat.

It was established that according to the complex quality indicator, the optimal dosage of powdered Dutch cheese in the recipe for wheat flour bread is 4.0% by weight of flour. At such a dosage, a bright color of the crust of the product and a lighter color of the crumb are noted compared to the control. The bread acquires a pleasant creamy taste and aroma.

It was established that in the case of dosing powdered Dutch cheese in an amount of 4.0% by weight of flour, the fermentation process is intensified, gluten is weakened, it becomes loose and a strong weakening of the dough is observed during proofing. This is the basis for reducing the duration of dough ripening.

As a result of the research, a recipe for "Cheese" bread was developed, which has an extended shelf life and a lower value of crumb porosity, compared to the control by 21.8% – in the case of storage for 72 hours and provides the human body's need (women aged 18–29 years, I group of labor intensity) for proteins by 14.3% and fats 2 times more compared to the control sample.

Keywords: wheat flour bread, powdered Dutch cheese, consumer properties, taste, nutritional value.

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DETERMINATION OF THE DEPENDENCE OF THE PHYSICO-MECHANICAL PROPERTIES OF ALFALFA SEED PODS ON MOISTURE CONTENT

pages 84–90

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The object of research is the physical, mechanical and thermophysical characteristics of the alfalfa seed crop mixture as factors of the drying process. This issue is of great importance for the energy efficiency of the drying process, as it directly depends on the temperature of the drying agent. Determining the physical, mechanical and thermophysical characteristics of the material will significantly simplify the procedure for determining the maximum permissible temperature of the drying agent. This, in turn, significantly simplifies the procedure for conducting energy and ex-energy analysis of the process.

The study presents the results of experimental investigations focused on determining the thermophysical characteristics of alfalfa seed mass, including heat capacity and thermal conductivity, under varying moisture content. Graphical dependencies illustrate the influence of moisture content on these parameters, demonstrating that the heat capacity and thermal conductivity of alfalfa beans increase as moisture content rises. During the study, standard and original methods were used, which allowed to obtain the dependences of the main physical-mechanical and thermophysical characteristics of the components of the harvest mixture of alfalfa seeds on humidity. In particular, it is determined that the thermal conductivity coefficient of alfalfa beans has a maximum value in the region of 25–30% humidity. This anomaly can be explained by the transition of internal moisture from a free to a bound state.

The research findings contribute to a better understanding of heat and mass transfer mechanisms in biological materials, which is crucial for optimizing drying technologies in agricultural production. The results can be used to improve the efficiency of drying equipment, reduce energy consumption, and enhance the quality of dried alfalfa seeds. The study highlights the importance of selecting appropriate drying parameters to maintain product quality while ensuring energy-efficient processing. The obtained results will allow to significantly simplify and increase the accuracy of determining the rational parameters of the drying process of alfalfa crop mixture. Also, the obtained data will allow to determine the result of the energy and ex-energy drying process much more accurately.

Keywords: alfalfa seeds, thermal conductivity, heat capacity, thermal diffusivity, density, convective drying, humidity of the material.

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