



CHEMICAL AND TECHNOLOGICAL SYSTEMS

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INVESTIGATION OF MECHANISMS OF THE CRYSTAL GROWTH PROCESS (KOSSEL MODEL)

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The object of this research is the mechanisms of crystal growth processes. As a model of investigation, a plane-faced crystal in the form of cubes is taken. Two mechanisms of crystal growth are investigated. With the first mechanism in the process of crystal growth, the growing surface moves due to the lateral displacement of the steps, while the second one – a continuous displacement along the normal to the surface of the crystal occurs. A problematic issue when growing crystals with these mechanisms from the melt is the preservation of the purity of the metal itself, especially if it is in a molten state. It is shown that when using the «layer-by-layer» mechanism of crystal growth, the problem of the formation of two-dimensional «embryos» is a problematic moment. This process is quite sensitive to supersaturation, and the probability of its carrying out at rates below 45–50 % is quite small. In the course of the research, statistical analysis methods are used to determine the positive and negative aspects of the use of crystal growth mechanisms, analyze the results of studies to determine the dynamics of the use of a particular mechanism for growing crystals. The hypothetical-deductive method is used in the process of acquaintance with the actual material of research in the field of crystal growth, which additionally requires in-depth analysis of information sources and also a method of generalizing the results to establish the general properties and trends characteristic of the crystal growth mechanisms under study. It is justified that if the thermal conditions of the processes are not observed, it is difficult to achieve the desired orientation and configuration of the crystals. It is shown that the «normal» crystal growth mechanism is effective provided that the condition that there are enough «energetically favorable» sites for fixing the atoms on the surface, which is not always feasible.

Keywords: growth mechanisms, layer-by-layer mechanism, normal mechanism, Kossel model.

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SYNTHESIS OF NEW BIOLOGICALLY ACTIVE COMPOUNDS BASED ON 6-METHYLURACIL-5-SULFOCHLORIDE AND ALKYLAMINES

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The object of research is 6-methyluracil-5-sulfochloride (MUSCH) and syntheses based on it mono- and disubstituted sulfonamides. A number of new compounds have been synthesized, which are not described in the literature, therefore, it is possible that among the synthesized compounds there are also such compounds that will exhibit, to varying degrees, biological activity.

There were two problems that were solved during the research. The first problem relates to the fact that most of the previous works were characterized by a low yield of methyluracil sulfochloride and this inhibited its wide application in organic synthesis. By selecting the appropriate synthesis conditions, that is, by reacting the reaction

of methyluracil with chlorosulfonic acid in an inert organic solvent (dichloroethane, carbon tetrachloride, chloroform), it was possible to obtain methyluracil sulfon chloride in excess of 96 %.

Another problematic area was the interaction of MUSCH with amines. It turned out that in order to increase the yield of the reaction product, synthesis is conveniently carried out in a medium of inert organic solvents (dioxane, dimethylformamide, dimethylsulf-oxide) in the presence of bases (soda, potash, sodium acetate). Good results were obtained by carrying out the reaction in pyridine, which simultaneously serves as a solvent and a base.

Physical and chemical analysis methods (IR and NMR spectroscopy) as well as elemental composition data were used to confirm the structure and composition of the compounds obtained.

A number of new sulfonamides, not described in the literature, have been obtained. This is due to the fact that the proposed method has a number of features, in particular, a new method of introducing a sulfochloride group into aromatic compounds has been proposed. Thanks to this, it is possible to obtain new organic preparations that can be used in a variety of industries. In comparison with similar known methods, this provides such advantages as an increase in the yield of the final reaction products, their purity and individuality, and the availability of the synthesis method.

Keywords: biologically active compounds, 6-methyluracil-5-sulfochloride, primary and secondary alkylamines, disinfectants, reactivity.

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STUDIES OF THE EFFECTIVENESS OF THE USE OF BIOSORPTION COMPLEXES FOR PURIFICATION OF OIL POLLUTED SANDY SOILS

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The object of research is the created biosorption complex preparation for cleaning oil-contaminated sandy soils. Cleaning of soils

contaminated with oil and oil products has particularities, because of the large adsorption capacity, the soil accumulates a pollutant. One of the most problematic is the method of cleaning sandy soils with poor biocenosis from old oil contamination. A promising area in the purification of soils from oil pollution is the use of microbiological technologies. The use of special microbial drugs can accelerate the oil destruction. Existing drugs have their own peculiarities of application and disadvantages. They lose destructive activity over time and are not very effective in eliminating old oil contamination with high concentration. The biosorbent complex (biosorbent) based on the ecological matrix sorbent of light color and immobilized on its surface of active microorganisms-destroyers of petroleum of natural origin makes possible to purify light sandy soils from old concentrated contaminants. The introduction of aerobic and anaerobic microorganisms into the biosorbent composition allows the biodegradation of oil both on the surface under aerobic conditions and in depth. Immobilized on the sorption material, microorganisms have a great destructive potential. Immobilization preserves the viability of microorganism cells and significantly increases the effect of their use. Optimal parameters of obtaining an oleophilic sorption matrix from various types of raw materials and obtaining microbial biomass with high destructive activity to oil hydrocarbons are established. The operational characteristics of the obtained light-colored bioactive adsorbents based on moss and glauconite, technological features and techniques for their use in the purification of sandy soils have been studied. The studies show

the change in the concentration of oil contamination of sandy soil from 30–40 % to 1–5 % of oil in the process of biodegradation after 140 days. Conducted tests of light-colored biosorbent at the industrial site of the tank farm during cleaning of sandy areas with obsolete oil pollution showed a cleaning efficiency of up to 90 %.

Keywords: purification of oil-contaminated sandy soils, microorganisms-destroyers of petroleum of natural origin.

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EVALUATION OF THE ENVIRONMENTAL STATUS OF AGRICULTURAL RESOURCES IN THE TERRITORY OF UKRAINE UNDER CONDITIONS OF CLIMATE CHANGE

page 21–32

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The object of research is agro-climatic resources of Ukraine, characterized by a combination of agro-climatic factors acting on the growth conditions and plants development, forming the productivity of agricultural crops. These factors are quantitative and determined by agroclimatic indicators, indicating the relationship between climate factors and growth conditions, plants development, crop formation.

One of the most problematic climate assessment issues for agricultural production is the processes of heat and water exchange in the soil-plant-atmosphere system, where biophysical and physiological processes take place. In addition, we must take into account the environmental conditions for the plants: minimum and critical temperatures of air, soil; total temperatures required for crops ripening; the amount of moisture.

Models to forecast potential impacts of climate change on agricultural productivity, adaptation to these changes were used in the study. Agro-climatic resources of the territory were assessed on the indicators of heat supply, where the sum of active and effective temperatures was calculated. Index of climate stability was used in the assessment of the ecological status of agro-climatic resources. Due to elevated heat supply an increase in the duration of agricultural crops growing season is expected.

The example of Kharkiv region was further characterized by the main features of the current temperature-humidity regime. It has been established that the greatest increase in the air temperature has been recorded since the mid 70-ies of the last century.

It is established that during the annual course the air temperature will increase with an average linear trend of 0.3–0.4 °C for 10 years. The amplitudes of air temperature fluctuations are significant enough to destabilize climatic conditions in the north. The southern and south-western parts of the region have a higher index of weather resistance due to the established air temperature regime and the nature of the underlying surface.

This ensures that measures can be taken to adapt agriculture to modern changes in agro-climatic resources. The proposed measures of agriculture adaptation to modern climate change can be successfully applied in neighboring countries, in particular, Moldova, Belarus.

Keywords: agroclimatic resources, hydrothermal index, bioclimatic potential, adaptation to climate change.

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SUBSTANTIATION OF ENVIRONMENT PROTECTION MEASURES OF NATURAL AND MAN-MADE LANDSCAPES IN THE ZONE OF WASTE STORAGE

page 33–38

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The theoretical approaches to mathematical modeling the process of migrating substances interception with anthropogenic physicochemical barriers in nature conservation ameliorative measures have been displayed.

The object of research is ameliorative measures for protection against pollution of territories and water objects in the waste storage zone, improvement of approaches to substantiation of their type, composition, structure and parameters.

One of the most problematic places in the waste storage area is the emergence of unpredictable physical, chemical and biological processes, the products of which are numerous toxic migratory chemical compounds in various aggregate states, which adversely affect the state of the environment and human health.

During the study, methods of passive and active experiment were used. Field studies on existing production facilities for waste storage, as well as laboratory studies of filtration and sorption characteristics of reclamation sorbent and filling of drainage accumulating networks are carried out in appropriate certified laboratories, performed according to current standard methods with the processing of the obtained results in accordance with generally accepted statistical methods.

The basic constructive element of drainage-accumulative networks – drainage trench-absorber has been developed. The character and level of dependencies between the parameters of the concentration of the filtrate solution and the capacity of the ameliorant-sorbent is obtained, on which the justification of the norm of its introduction into drainage trenches-absorbers for neutralization of pollutants in filtration waters can be carried out.

The developed complex of measures provides the necessary level of protection of territories and water objects in the waste storage area in compliance with modern economic, environmental and social requirements.

Keywords: protection measures, natural and man-made landscapes, municipal solid wastes, physicochemical barriers.

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THE GEOCHEMICAL ESTIMATION OF THE GEOECOLOGICAL STATE LEFT IN FLOWS OF PODOLSK PART OF THE DNISTER RIVER

page 39–44

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A research object is water, ground sedimentations and soils from the banks of the left tributaries of Podolsk part of the river Dnister (Ukraine). One of problem places of this research is absence of the analogical complex watching maintenance in water, ground sedimentations and soil from the banks of the left tributaries of Podolsk part of Dnister of the investigated area. It hampers finding out of geochemical features of the ground sedimentations and soils. The tests of soils from the banks of currents for ecological and geochemical researches were selected for GOST 17.4.4.02-84 and investigational

with the use of quantitative spectrology of gross maintenance of elements. It allowed to compare inter se maintenance of elements in soils and ground sedimentations. It is set that on mechanical composition prevail psammites among the ground fallouts of the rivers, and insignificant maintenance of argillaceous-silt constituent in the ground sedimentations does not assist an accumulation in them contaminants.

It is set that on mechanical composition prevail psammites among the ground fallouts of the rivers, and insignificant maintenance of argillaceous-silt constituent in the ground sedimentations does not assist an accumulation in them contaminants. The table of contents of most elements in water of the rivers does not exceed possible concentrations maximum. Only in the district of Mogilev-Podolsky in Derlo maintenance of potassium and iron in 13.28 and 7.4 times exceeds MPC accordingly. In general maintenance of the investigated elements in water is ordinary does not exceed not only, and and considerably less MPC both sanitary requirements and MPC of standard of Worldwide organization of health protection.

Research of maintenance of Cr and Pb in the ground sedimentations of the rivers of Zhvan, Lyadova, Nemiya, Derlo and Dnister, and soils of their banks allowed to find out that maintenance of lead and chrome in the investigated standards usually does not exceed a median value for the investigated currents. In general maintenance of the investigated elements in water is ordinary not only does not exceed but also considerably less MPC, both sanitary requirements and MPC of standard of Worldwide organization of health protection.

In general the geoecological state of the left tributaries of Podolsk part of the river Dnister is satisfactory. Contamination chemical elements has point character. It is recommended to create the joint international program of realization of the geoecological monitoring not only Dnister but also his left and right tributaries within the limits of Podolsk part.

Keywords: the geoecological state of the river Dnister, transfrontal current, hydrochemical mode, ground sedimentations.

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FOOD PRODUCTION TECHNOLOGY

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INVESTIGATION OF PROPERTIES OF SEMI-FINISHED PRODUCTS FOR SMOOTHIES DURING LOW-TEMPERATURE STORAGE

page 45–49

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The object of research is a semi-finished product for smoothies, made from strawberries, dried apples and oat flakes. During low-temperature storage and smoothie, quality indicators may deteriorate (loss of vitamins and antioxidants, decrease in organoleptic parameters, namely, color change and loss of aroma). Perspective is the complex assessment of color and aroma, which form the organoleptic parameters of the semi-finished product for smoothies.

During the study, pH and titratable acidity are determined by potentiometric titration. These indicators affect the color and stability of the samples of the semi-finished product. Color stability is determined by spectrophotometric method, and the content of aroma-forming substances is determined by the results of oxidation-reduction titration.

It is established that the pH value for fresh semi-finished and semi-finished products after 270 days of low-temperature storage has similar values, namely 3.441 and 3.410. The indicator of titratable acidity in the samples does not change during the storage period and is 13.00 ± 0.02 mmol H⁺/100 g. This indicates the stability of organic acids and sugars included in the semi-finished product for smoothies. It is proved that at the end of the storage period the color intensity of the semi-finished product is 99 % of the initial value. It is determined that the content of aroma-forming substances in the freshly prepared smoothie semi-finished product is 43.6 ml of Na₂S₂O₃/100 g, and after the storage period of 22.7 ml of Na₂S₂O₃/100 g.

Thus, during storage for 270 days at a temperature of –18 °C and defrosting in the open air at a temperature of 23 ± 1 °C, the semi-finished product remains stable in terms of physicochemical parameters and color intensity. The content of aroma-forming substances remains at the level of 52 % of the initial value.

The production of this semi-finished product will allow to expand the range of frozen products and increase the base of local processing industry, the development of which will contribute to the development of agricultural production in the region.

Keywords: semi-finished product for smoothies, low-temperature storage, natural color, aroma number, functional products.

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RESEARCH ON INFLUENCE OF INULIN MADE FROM CHICORY ON THE QUALITY OF WHEAT BREAD

page 50–54

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The object of research in the work is wheat bread. One of the major disadvantages of the chemical composition is that with high content of carbohydrates in it low content of food fibers. The solution of the problem of enriching wheat bread with soluble dietary fiber is possible using inulin. The best source of inulin is chicory root crop. The limiting factor for the use of soluble chicory processing products is the provision of coloring products and the bitterness inherent to it. Therefore it is expedient to use in the technology of bakery products to provide them with health and preventive properties directly inulin, isolated from chicory.

During research, inulin made from in chicory «Cosucra» (Belgium) was used. This raw material has the appearance of a white powder, barely sweet to taste.

It was established that the inclusion of inulin made with chicory into the wheat dough formulation activates the fermentation activity of the dough flora, promotes a reduction in the durability of the production of dough preparations. The introduction of inulin improves the organoleptic and physico-chemical properties of finished products and prolongs the preservation of freshness.

The obtained results are related to the improvement of nutrition of the yeast microflora of the dough due to the content of sugars in

the inulin powder with chicory. The more intense color of the crust of products is due to the fact that fructose more actively reacts to melanoid formation. The deceleration of the drawing of products with inulin is obviously due to the improvement of the elastic properties of the product's mildew and the slowing down of starch retrogradation due to higher hydrophilic properties of inulin.

Due to the intake of inulin with chicory in the amount of 2 and 4 % to the mass of flour in the daily rate of consumption of bread, the content of inulin is provided at a rate of 27–54 % of its daily intake. This allows the wheat bread functional properties, due to the enrichment of soluble food fibers. The introduction of bread with inulin made with chicory will contribute to the expansion of the range of products with healing properties.

Keywords: wheat bread, inulin made from chicory, activity of the dough microflora, bread freshness.

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STUDYING THE INFLUENCE OF YEAST STRAINS ON THE AROMA OF WINES MADE FROM GRAPE OF ZAGREY VARIETY

page 55–59

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This work considers data on the impact of strains of yeast on the aromatic and redox properties of white dry wine materials, made from grapes of the new generation of Zagrey variety, bred at the National Scientific Center «Institute of Viticulture and Wine Making named after V. E. Tairov» (NSC «IV&WM named after V. E. Tairov», settlement of Tairove, Odessa Oblast, Ukraine) under conditions of micro wine making.

The Zagrey grape variety was bred by crossing the varieties Aligote and Ovidiopol in order to extend the assortment of Ukrainian grapes; however, the lack of research into its use for winemaking hinders its widespread utilization in manufacturing.

Materials contained white dry wine materials, made from grapes of Zagrey variety using the strains of yeast *Vitilevur 58W3*, *Sauvignon*, *Elixir*, *EC1118*, *Cross Evolution* (France). These strains of yeast are characterized by a varying capability to the synthesis of aroma-forming substances that affect the formation of a wine bouquet and reveal the aromatic potential of the grape variety.

We studied organoleptic characteristics in wine materials based on an 8-point scale, using the descriptor system, mass concentrations of substances in an aroma-forming complex, phenolic compounds, the level of redox potential, and other indicators of the oxidation-reducing state of wine materials.

It is established that using the yeast strain *Vitilevur 58W3* makes it possible to detect the varietal features of the Zagrey variety grape, rendering it a floral-fruit note. The strains of yeast races *Elixir* and *Sauvignon* diversify aroma of the variety, rendering it the subtle citrus notes of lemon and grapefruit, linden shades and other exotic fruits. Data on the organoleptic characteristics of wine materials that we obtained are in a good agreement with the results of studying the substances that compose the aromatic complex of wine materials. Thus, the wine materials that employed the strain of yeast *Vitilevur 58W3* were dominated by terpene alcohols, and those with *Elixir* and *Sauvignon* – by esters.

It is proven that the use of different of strains of yeast nature does not affect essentially the oxidation-reducing potential and the content of phenolic compounds.

Results of our research allow us to recommend the yeast strains *58W3*, *Elixir* and *Sauvignon* for the production of high-quality local white wines from the Zagrey grape variety, selected at the NSC «IV&WM named after V. E. Tairov».

Keywords: grape of Zagrey variety, strain of yeast, aromatic potential of grape variety, white dry wine materials.

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