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ONAFT, Odessa 2018

ODESSA NATIONAL ACADEMY OF FOOD TECHNOLOGIES

XVII INTERNATIONAL SCIENTIFIC CONFERENCE

"IMPROVEMENT OF PROCESSES AND EQUIPMENT IN FOOD AND CHEMICAL INDUSTRIES"

ABSTRACTS

Ukraine, Odessa, September 3-8th, 2018

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STUDY OF THE RADIATION COMPONENT INFLUENCE ON THE EFFECTIVE HEAT CONDUCTIVITY OF COMPOSITE-POROUS BUNDLE

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The paper deals with a number of issues related to the heat exchange processes which occur in industrial charring plants. The research is aimed to finding a calculation algorithm that can equivalently take into account the influence of the composite-porous body structure on the thermal conductivity coefficient of a bundle formed by wood logs in a trolley' space. It is shown that the phenomenological model of the heat conductivity process, which is based on the concept of solids continuity, is not suitable for use in the context of calculating the degree of material porosity contribution to its thermal conductivity. It is specified that such a model ignores not only the structural content of real materials, but also the possibility of forming anisotropic cluster formations in their thickness. It is found that simplification of the microscopic structure is not allowed for a wooden bundle that takes part in the charcoal production using pyrolysis method. There are analyzed several methods of wooden raw materials loading into a trolley and a percentage of volume that can be usefully used in each of them. The most technologically and operationally expedient way of wooden raw materials loading is chosen. A well-known calculation model, which is based on the equable solid phase distribution along the boundaries of structural element, is considered. It is established that this model demonstrates results that do not correspond to physical reality for the boundary values. The reasons of model inadequacy to real objects are revealed on the example of a wooden log bundle. An improved calculation model, which involves replacing the linear contact between the elements to the surface one, is presented. There are considered the artificial conditions of the calculated assumption that an infinitely thin material layer is located along the boundaries of a structural element, and the entire material mass is centered in the form of a square-section object. There is given a detailed algorithm for calculating the equivalent value of the wooden bundle thermal conductivity coefficient. The appropriateness of applying a new approach is confirmed based on these studies, which allows taking into account the magnitude of the radiation component effect on the total value of the effective thermal conductivity of composite-porous material.

THE INFLUENCE OF HYDRODYNAMICAL CAVITATION ON BYOLOGICAL CELLS. MECHANISMS, TECHNIQUES, APPLICATION

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The purpose of this work is to found the mechanisms of the effect of cavitation on biological cells for the creation of new technologies and equipment, as well as the improvement of existing ones. Analysis of present literature has shown that the process of cavitation is widely used in the food, chemical, pharmaceutical, and biological industries and is effective from an ecological, energy point of view.

At the same time, it should be noted that the use of cavitation in technologies significantly reduces the processing time, as well as minimizes the temperature effect, in comparison with traditional technologies, which is especially important for biologically active substances.

Cavitation processes are used in technologies of extraction of plant raw materials, sterilization of liquid media both in the food industry, and in technologies of water treatment and water purification. Despite the fact that cavitation is widely used in practice, literary analysis has shown that mechanisms of action on cells have not been fully studied.

Novel studies presents mechanisms, which ascertain fact of cell wall full or partially distruction, but not explain reasons of this. There is not explainingof the decrease in internal massexchange resistances. The article proposes mechanisms and their theoretical justification for the extraction and sterilization process, and the thermophysical parameters necessary for conducting a particular process are determined.

Cavitation intensity and mechanism of action should be determined by the properties of the target product and should be depend on the scope of application. So, for some purposes, the process parameters must ensure complete destruction of the cell, while for others it is necessary and sufficient to increase the permeability of the cell membrane to yield the target component. In this regard, there is a need for a thin adjustment of thermophysical process parameters, as well as technological equipment, respectively..

STUDY OF FLOW STABILITY OF GRAVITATIONALLY FLOWING LIQUID FILM IN A TWO-PHASE SYSTEMS

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The use of passive intensification methods in the form of surfaces with a capillary-porous coating in contact devices greatly complicates the hydrodynamic structure of the interaction of the system "surface - liquid film - gas stream". Intensifying the processes of heat and mass transfer, artificial roughness increases the working range of contact devices, by reducing the break border.

The complexity of the analytical study of the stability of the system "liquid film - gas or steam flow" by solving a mathematical model, which is a system of differential equations with corresponding boundary conditions, consists in the fact that the functional dependence for the boundary phase separation is unknown.By using the equation of the surface separation in the form of a wave function that satisfies this system of differential equations and boundary conditions, it is necessary to determine the parameters of the waves.

It is assumed that the tangential and normal components of the gas stress on the surface of the liquid film can be expressed by the dependence due to the deviation of the phase separation surface from the liquid-film-unshaked waves. Under such assumptions, the solution is reduced to considering the motion of a liquid film at given boundary conditions on the channel wall and on a free surface.

The results of the solution of mathematical model of system "liquid film - gas (steam) flow" for a smooth vertical surface are not correctly used to determine the film parameters at crisis phenomena's in the case of channels with a capillary-porous structure.

The represented analysis of results of the experimental study of the hydrodynamics of two-phase flow in the channels with capillary-porous coating, at the appropriate boundary conditions, allowed to determine the upper range of loads prior to the beginning of break on the liquid and gas phases in contact heat and mass exchange devices. An analytical solution to the task of determining the boundaries of crisis phenomena, taking into account the results of an experimental study of the hydrodynamics of a two-phase flow in channels with capillary-porous coating, at appropriate boundary conditions, allowed to determine the upper range of loads prior to the beginning of break on the liquid and gas phases in contact heat and mass exchange devices.

INTENSIFICATION OF THE PROCESS OF DRYING VEGETABLE COMPOSITION FROM SOY AND BATAT

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The constant demand for soy and soya products on both the domestic and foreign markets of Ukraine led to the expansion of the area under this plant and became one of the most profitable crops grown in agricultural enterprises. Polyunsaturated fatty acids, which are part of cellular soybean membranes and other structural elements of plant tissues, perform in the body a number of important functions, in particular, provide normal growth and metabolism, elasticity of blood vessels. Due to the existing problem of protein deficiency in people's nutrition, Ukraine is increasingly studying ways to increase the economic efficiency of soybean production, the formation and functioning of the soy market and its processing products.

Thermal effect is one of the most widely used heat engineering operations in the process of processing of plant raw materials, and heat heating in order to reduce the initial moisture content of processed material (drying) - one of the most common methods of preservation, preparation and semi-preparation of food products. Along with the advantages of the drying process, there are a number of flaws in the process, the most important of which, in modern conditions, is energy costs for the process. The drying process is one of the most energy-intensive operations, it uses up to 25% of all industrial energy. Due to problems in the environmental and energy sectors, including greenhouse gas emissions, fossil fuel depletion, etc., it is becoming increasingly important to reduce energy consumption in all industries.

The creation of plant compositions, a combination of two biochemical compositions (soybeans and sweet potatoes) compatible, makes it possible to reduce energy costs for the drying process and preserve biologically active substances during the storage of dried raw materials. In its biochemical composition, sweet potato contains carotenoids, which are natural stabilizers for soy proteins and prevent the oxidation of its lipids. Consequently, the combination of these two components can naturally increase the shelf life of raw materials. Due to the lack of information in scientific information sources on the influence of regime drying parameters (t, φ, υ) on the drying kinetics of soybean - vegetable mixture, this work is aimed at studying the process of drying soy and vegetable compositions in order to intensify the process.

THE EFFECT OF HYDRODYNAMIC CAVITATION FOR THE CHANGE OF WATER TEMPERATURE INDICATORS

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The article deals with issues related to the emergence and development of the phenomenon of hydrodynamic cavitation in the processing of liquid media. The actuality and possibilities of practical use of the effects accompanying hydrodynamic cavitation for the intensification of energy-intensive processes in various industries are shown. The mechanism of intensifying influence of cavitation effects in heat and mass transfer processes is analyzed. The advantages of static type hydrodynamic cavitators using the Venturi nozzle example are described. The results of experimental studies of the influence of the effects of hydrodynamic cavitation in the Venturi nozzle on the change of the temperature indices of tap water for the determination of rational hydrodynamic conditions of the processing process are given.

The data describing changes in temperature indices of tap water with different initial temperature are presented, depending on the duration of the process for nozzles with different diameter of the neck. It is shown that increasing the duration of processing enhances the effect of cavitation effects on the material. It was established that the decrease of the diameter of the nozzle's neck leads to an increase in the sample temperature as a result of its treatment. The largest cavitation effects arise at a diameter of the neck of the Venturi nozzle 0,008 m and 0,012 m.

The installation of an aperture overlapping the flow by 75% showed an additional total temperature increase of 3-6 ° C, as compared to the results obtained for a sample treated in a cavitation mixer without a diaphragm. The increase in temperature due to the installation of the diaphragm is due to an increase in the effect of cumulative effects due to hydrodynamic cavitation treatment.

The analysis of the results of experimental studies allowed to obtain mathematical dependence of the number of cavitation on the rate of change in temperature on which it is possible to estimate the efficiency of the cavitation mixer.

INFLUENCE OF AIR TRAFFIC SPEED ON THE PROCESS OF CONVECTIVE-THERMORADIATIVE DRYING OF APPEAL ANIMALS

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In the process of developing technical progress, the food industry requires new technological solutions to improve the quality of food products. The snack market segment is nowadays very popular and popular among consumers, but the quality of these snacks would be desirable, and the assortment is more diverse. This problem has led us to create a new product with excellent nutritional properties and a balanced chemical composition. Having a base of preliminary studies of the optimum parameters of drying snakes, it is necessary to determine the effect of the speed of air movement on the drying process. The rate of air circulation in the dryer is the most important parameter of the drying process. The higher the circulation velocity, the more equal conditions, the shorter the duration of the process, the higher the drying performance, the less uneven material drying, the greater the cost of electricity and in most cases the higher cost.

We are proposed to combine two methods of supplying heat during drying - thermal radiation and convection, which allowed to reduce the relative humidity of air and increase the motive force of the process compared with the drying of infrared rays. For this purpose, a drying plant was designed and manufactured, which allows drying by thermal radiating and convection methods both individually and in combination. The paper presents the results of studies on the influence of the circulation velocity of a drying agent on the main parameters of the drying process in a radiation-convective installation of periodic action. The mechanism and intensity of the transfer of moisture in the material depend on the interrelated complex of processes of violation of the connection of moisture with the material and the diffusion of the vapor-gas medium through the capillary-pore structure of the material. In this paper, the dependences of the main heat and mass-exchange characteristics of convective thermo-radiation drying of apple snakes on the velocity of air are determined.

KINETICS OF EXTRACTION OF COPPER SULFATE FROM A SINGLE CAPILLAR UNDER CONDITIONS OF VACUUMING OF THE SYSTEM

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The process of extracting of solid substance from cylindrical capillaries to determine the kinetics of this process was investigated. As the solid phase served sulfur sulfate, which was extracted with distilled water. Extraction of the solid phase consists of the process of dissolving of the target component and diffusion of the dissolved substance in the capillary.

The limiting stage of this process is the diffusion of a component inside the capillary, which occurs under the law of molecular diffusion of Fick. In industrial conditions, the intensification of the extraction process occurs by grinding of a solid material or increasing of the temperature. In this paper, the process of extraction under conditions of vacuuming of the system, in which occurs boiling of the fluid and formation of a vapor phase, is investigated.

The origin, growth and separation of the vapor bubbles within the capillaries leads to the displacement of the fluid, which facilitates its replacement, the creation of non-stationary conditions, the supply of fresh liquid to the surface of the dissolution.

The experimental apparatus, methodology of research and experimental results for a capillary with a diameter of 0,8 mm are given. Graphically, the dependence of the displacement of the dissolution zone in the capillary is presented for three cases at the same temperature of 75^0C: dissolution during mechanical mixing, constant vacuuming and periodic vacuuming. The highest rate of extraction corresponds to periodic vacuuming.

The effective coefficients of diffusion in the capillaries and the ratio of the coefficients of vacuuming to extraction under conditions of mechanical mixing are determined. It is shown that during the continuous vacuuming of the extraction process, the extraction rate increases in 2,8 times; for periodic vacuuming, at which there is an explosion of the vapor phase and the movement of liquid in the capillary, in 6,3 times.

PERFORMANCE CHARACTERISTICS OF ADSORPTIVE REGENERATOR OF LOW-POTENTIAL HEAT AND MOISTURE BASED ON COMPOSITE ADSORBENTS 'SILICA GEL – SODIUM SULPHATE' SYNTHESIZED BY SOL – GEL METHOD

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The performance characteristicsof the adsorptive regenerator of the low-potential heat and moisture on basis of the composite sorbents 'silica gel - sodium sulfate' synthesized by sol-gel method are studied. The mathematical model and algorithm for determining the basic parameters of adsorptive regenerator exploitive processes in the housing and communal services sector are developed.

The proposed algorithm includes calculating the volume of air passed through the layer of heat-accumulating material, the concentration of water in the flow at the exit from the regenerator, the adsorption, the heat of adsorption, the final temperature of the cold air, the air temperature after mixing the cold air from the street and the warm air in the room at the warm end of the regenerator during inflow, calculation of the final concentration of water in the flow at the cold end of the regenerator, the volume of air passing through the layer of heat-accumulating material, adsorption and heat of adsorption, the final temperature of the air at the cold end of the regenerator, the air temperature after mixing of the cold air from the street and the warm air from the room at the cold end of regenerator during outflow, determining the temperature efficiency coefficient, summarized adsorption and maximal adsorption time.

The correlation of air temperatures near the warm and cold end of the regenerator, as well as the thermal efficiency coefficients stated by the results of calculations according to the proposed algorithm and experimental way is confirmed. The mathematical modeling of the processes of operation of adsorption regenerators on the basis of 'silica gel - sodium sulfate' composites in the conditions of the typical ventilation system of residential premises is carried out. The dependences of the temperature efficiency coefficient vs. the time of switching air flows and the velocity of air flow, as well as the temperatures of external and internal air under stationary conditions are shown. The results of the research can be used in the development of energy-efficient ventilation systems and devices for residential and warehouse premises.

VACUUM MICROWAVE TECHNOLOGIES IN THE PRODUCTION OF PHYTOPREPARATIONS FROM ROSE HIPS

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In this paper are presents the results of studies of extraction processes in a microwave field under conditions of reduced pressure. The object of research are the rose hips – rich in thermolabile vitamin C.

According to previous studies, under the action of the microwave field possible reach a significant intensification of extraction processes. This is due to barodiffusion – a phenomenon that occurs in the capillaries of plant material. These principles are the base for innovative facilities designed by our scientific group: a microwave vacuum extractor and a microwave vacuum evaporator. During the sample treatment in an extractor, the temperature does not exceed 50 °C.

At these conditions saved more of vitamin C, color and taste are better preserved. The laboratory researches confirm that the high content of vitamin C is present in the extract. Compared to the technologies that are applied be pharmaceutical companies in the production of rose hips extracts and evaporators, they have several advantages: simple design, safety, reduced working temperatures, high energy efficiency, shortening of processes. With microwave extraction it is possible to obtain the extracts that contain non-typical components for aqueous extracts precisely due to barodifusion.

So, with the use of one solvent, can be obtained a polyextract on the same installation. These technologies are actual in the first place for the pharmaceutical industry and the market of health food products. The comparison of vacuum microwave and cryoconcentration technologies are performed. It is wellknown that the best way to concentrate products with high vitamin C content is cryoconcentration. Obtained in that research results indicate that the quality of the extract produced in the vacuum microwave evaporator is similarly to cryoconcentrate.

MODELLING OF SOLID - LIQUID PHASE CHANGEOF HEAT STORAGE MATERIALS AT THE STUDY OF HEAT TRANSFER PROCESS

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At present, the problem of heat storage is very relevant. The promising direction is the use of the heat storage materials with phase change. It is important to choose a material that can provide the thermal and operational parameters of the process. As a material, a mixture of 85% wax and 15% brown coal wax was suggested to be used.

This mixture is used in foundry work. In this paper, theoretical and experimental studies of the heat transfer process during solid - liquid phase change occurring during heating and cooling of the heat storage material are considered. The model of a heat storage system of capsular type was adopted to study the process.

It consists of the heat storage elements – thin-walled metallic tubular containers filled with phase change material.The heat transfer process taking into account phase change of the heat storage material is experimentally and theoretically simulated on the example of a separate heat storage element.As a result, the temperature distribution is obtained in the heat storage element during cooling (from 80 to 22 °C) and heating at contact external wall of metal capsule with heat carrier heated to 80 °C and heat carrier, which heated with a speed of 0.35, 0.77 and 1.17 K/min. from 22 to 80 °C.

It was confirmed that the convective component in the heat conduction equation can be neglected at using small volume of capsule. Comparison of theoretical and experimental results showed the adequacy of the results of calculations. Comparison of experimental and theoretical studies confirm the ability to use the principle of effective specific heat to calculate the heat transfer at the phase change and allows one to accurately predict the actual time of heating and cooling.

The results of studies also confirmed the data obtained experimentally - high heterogeneity of the temperature field is observed within the cross section during heating with high speed.It is experimentally revealed that it makes no sense to use a high heating rate. As a result, features of the kinetics of heating and cooling have been determined during the phase change. This will make it allowed to determine a rational mode of heating.

MODELING OF THE SATURATION REACTOR IN THE PRODUCTION OF PUMPKIN CANDIED FRUITS

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ChemCad's universal simulator allows you to simulate the process of saturation of pumpkin fruit with sugar. The simulation results allow the implementation of a technological process with minimal energy consumption and maximum preservation of nutrients in the finished product, in which the only preservative is sugar. With the help of the universal simulation program ChemCad, an isothermal saturation reactor for sugar pumpkin particles was modeled, which operates under the constant concentration of sucrose in syrup and simultaneously increases the concentration of sucrose in candied fruits.

Such a process was modeled by stationary with intense mixing, operating in isothermal mode and in which amount of evaporated water compensates for the amount of water extracted from candied fruit. For simulation, it was necessary to pre-analyze the mathematical description of the conditions for the implementation of the isothermal regime, to develop a mathematical support for the design of the reactor.

For simulation, it was necessary to pre-analyze the mathematical description of the conditions for the implementation of the isothermal regime, to develop a mathematical support for the design of the reactor to include:

- determination of the constant concentration of sugar in vaporized syrup at the end of the process, the flow of solution and vapor;
- duration of sucrose saturation under stationary conditions;
- definition of reactor design characteristics, diameter height and height of the liquid;

Numerical simulation values, graphical and computational relationships are obtained, the result is analyzed.

It is proved that the process of saturation of succulents with sugar in the steady state is advisable, in terms of preservation of organoleptic properties, optimum saturation of candied fruit, which will retain its properties and molds for a long time.

SIMULATION OF THE MOVEMENT OF COMPRESSED AIR BUBBLESIN THE APPARATUS WITH PNEUMATIC MIXING

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This article reviews and analyzes literary sources, which reflect the main results and directions of research of the dissolution process during pneumatic mixing. They show which problem areas of science require more detailed research. The choice of the method of dissolution during the pneumatic mixing of the solution is substantiated..The advantages of this method are considered. The advantages of using a pneumatic mixing system include the uniform and intensive mass transfer between the solid phase and the liquid. The use of compressed air for mixing simplifies the internal design of the machine. This also eliminates the pollution of the solution by products of corrosion or erosion of mixing devices.The process of formation of a separate bubble in a liquid medium from a certain depth during the slow flow of air into a liquid from a hole with sharp edges is described.

The process of bubble movement of compressed air in an aqueous solution of benzoic acid, in the apparatus for dissolution during pneumatic mixing is experimentally investigated. The process of formation of bubbles is described in the conditions of the quasi-static regime of dispersion with compressed air of a solution. Determined tear-off size of air bubbles from the bubbler apertures. The velocity of air bubbles in the apparatus is calculated and the frequency of their formation from the bubbler apertures. The fictitious velocities of bubbles of compressed air in the apparatus for different air flows are calculated. The calculations results of dissipation of energy in the apparatus for dissolution of benzoic acid are presented. The specified parameters of the bubble movement of compressed air are summarized in the form of a table and a graph. The optimal values of air flow and the time during which it is expedient to carry out the dissolution process during pneumatic mixing are determined.

MATHEMATICAL MODEL AND METHOD FOR CALCULATING THE DYNAMICS OF DRYING AND THERMODESTRUCTION OF BIOMASS

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A mathematical model and a numerical method for calculating the dynamics of heat and mass transfer, phase transformations and shrinkage during the drying of colloidal capillary-porous cylindrical bodies under conditions of equitable winding by a coolant are developed.

The mathematical model was based on the differential equation of substance (energy, mass, impulse) transfer in deformable systems. It includes the equations diffusion-filtration transfer of energy for the system as a whole, and the mass transfer of the liquid, vapor and air phases in the pores of the body.

Expressions for the intensity of evaporation of a liquid, capillary pressure, and the diffusion coefficients are presented. The relative volume strain was found by means of an analytical solution of the thermoconcentration deformation equation. Based on the explicit three-layer counting difference scheme and the procedure splitting of algorithm by physical factors, a numerical method for realizing this mathematical model is developed.

Experimental studies of the kinetics of dehydration of energy willow particles in the airflow were carried out to verify the mathematical model. Its applicability for calculating combined processes of drying and of the initial stage of thermal decomposition of biomass is substantiated. Using the previously obtained data on the activation energy values for various types of biomass, a mathematical simulation of the dynamics and kinetics of high-temperature drying in the flue gas flow of energy willow was carried out, which is accompanied by thermal destruction of hemiocellulose.

The results of numerical experiments indicate the adequacy of the proposed approach, the effectiveness of the mathematical model and the method of its implementation. On their basis, it is possible to study the dynamics of heat and mass transfer when drying particles of different types of ground biomass; determination of the temperature of the beginning and ending of the first stage of thermal decomposition; the moment when the equilibrium moisture content is reached, depending on the properties of the material and the drying agent. These data allow choosing the process parameters that are optimal in terms of energy saving and quality of the dried product.

STUDYING THE HYDRODYNAMIC CHARACTERISTICS OF PROTECTION ELEMENTS IN FOOD PRODUCTION

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An important component of the cost of food products is the elements of ensuring their safe production, one of which is the internal fire water supply, which is obligatory for installation in the premises of food production enterprises with the appropriate category for fire and fire hazard, fire resistance and the volume of the production building.With the introduction of the DBN V 2.5-64:2012 "Internal plumbing and sewage system", each cabinet, except for installed fire faucet with a diameter of 50 or 65 mm, necessarily completes an additional fire faucet with a diameter of 25 or 33 mm, which is designed for the rapid introduction of extinguishing agent in the initial stage of the development of the fire, and therefore provides a reduction of losses from it.

Additional fire faucets are completed with a sleeve (length of the sleeve - up to 30 m, diameter of the sleeve - 25 mm or 33 mm, type of sleeve - semi-rigid) and the sprayer (diameter of the outlet of the sprayer from 4 to 12 mm).The advantages of such devices include small dimensions. The use of special spray nozzles allows you to create a fine splash of water that does not damage the surroundings of speech and equipment. The flexible sleeve of the kit allows you to bypass technological installations that are found on the track. The installation of the overlapping device allows you to interrupt the work at any time and restore it as needed.

The cost of extinguishing agent and the installation itself is small.Depending on the conditions of the use of an additional fire faucet, the various characteristics of its components can provide an increase or decrease in the efficiency of its operation.Therefore, a method of determining the characteristics of components of an additional fire faucet for the specific conditions of its operation is proposed. The correct choice of parameters of components will allow, taking into account the hydrodynamic characteristics of the system, ensuring the operation of such devices, with the least economic losses, ensure the successful extinguishing of the fire and reduce losses from it.

INHIBITORS AND ACTIVATORS OF THE PROCESS OF ABSORPTION CARBON DIOXIDE BY CHLOROPHYSYNTHESIZING MICROALGAE

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The waste of modern production poses a serious threat to the environment, which prompts development of modern methods of their utilization. The content of carbon dioxide in the atmosphere has been the subject of discussion at the political level of the states of the world, whose leaders are looking for ways to reduce harmful emissions to the atmosphere from year to year. In this case, the use of biological methods are objective conditions for the use photosynthetic properties of microalgae. The use of microalgae in the process of purifying industrial gas emissions has significant advantages due to the ability to absorb dozens of times more carbon dioxide than terrestrial plants and adapt to adverse conditions: low temperatures and illumination, alkaline-acid balance, the effect of inhibitors, etc.Through the study of these factors can gain a deeper understanding of biological methods of neutralizing pollutants and the processes occurring in the investigated objects.

The products of combustion of fuel always contain a large number of oxides, the most dangerous are sulfur dioxide and nitrogen oxides. Therefore, the study of their influence on the process of photosynthesis by chlorophyllsynthesizing microalgae is important. The results of experimental studies on the process of carbon dioxide absorption from industrial gas emissions by chlorophyllsynthesizing Chlorella microalgae demonstrate the influence of sulfur dioxide and nitrogen oxides on the absorption dynamics.The phenomenon of sulfur dioxide inhibition and activation by nitrogen oxides of the process of photosynthesis is established. Reverse noncompetitive inhibition of the microalgaecell-enzyme substrate complex with dioxin sulfur was proved in accordance with the Linouiver-Burke the oryand the activation by nitro genoxi desisproved.

The permissible values of the inhibitor concentrations in the process of carbon dioxide absorption by chlorophyllsyntheszing microalgae is established. The instability constant of the enzyme complex and the enzyme substrate complex with the inhibitor is determined. The value of optimal concentration of nitrogen dioxide as an activator of the growth of the Chlorella microalgae is established.

REMOVAL OF PROTEINS FROM SEWAGE FROM FOOD INDUSTRIES BY APPLICATION OF MICROWAVE RADIATION

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The paper presents the results of investigations of the kinetics of protein extraction from the model dispersions and changes in the optical density of protein solutions as a result of influence of the ultrahigh-frequency radiation on the test dispersion. The process of denaturation of protein solutions that simulate wastewater from food industry enterprises under the influence of microwave radiation at a frequency of 2450 Hz was carried out. The samples of aqueous dispersions of albumin and casein with a mass fraction of dry matter of 5% were treated of ultrahigh-frequency radiation of the power of 800 W. Control of process of the protein denaturation was carried out by changing the optical density of the investigated samples. Experimental studies have shown that the degree of albumin excretion without application of other methods of separation was 80% and casein 35%. The theoretical dependence for calculating the temperature change of the investigated object from the power of the generator of electromagnetic waves and the time of action on the object of radiation of the ultrahigh-frequency range was derived. The basis of calculations of the kinetics of heating of electrolytes in the field of electromagnetic radiation is the relationship between the intensity of the electromagnetic field generated in the chamber of microwave resonator and the power of the microwave generator. An experimental study of the kinetics of denaturation of aqueous dispersion of the protein showed good correlation of experimental and calculated data. Application of the given equation it is possible to determine with sufficient accuracy the thermophysical parameters of the process of heating the wet objects and solutions to 100?C or for dielectrics with low moisture content. The developed method of treatment of sewage involves the introduction of a microwave module in the technological scheme of sewage treatment of biotechnological industries. This will allow for the disinfection of sewage and the effective removal of protein compounds by converting proteins into a coagulated state and increasing the efficiency of wastewater treatment.

INTEGRATION OF HEATTRANSFER PROCESS IN SUN INSTALLATION

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European countries demonstrate high opportunities for simple conversion of solar energy into thermal energy, which can be successfully used to provide various types of technological, heating and domestic needs. In addition, the commissioning of salt plants improves the ecological situation in the area of consumption of thermal energy by reducing emissions of polluting substances, which include combustion products of organic fuel used for the production of thermal energy. At present, solar installations for hot water supply and heating are already used in the southern regions of Ukraine. However, the introduction of new energy and economically advantageous plants is proceeding slowly, which is explained by rather high cost indices, both domestic and foreign installations.Thus, in our opinion, the concept of creating new solar installations that are most attractive to a potential consumer is relevant. Implementation of this concept is possible with such an option of solar installations, when the cost of generating thermal energy using these facilities will be lower than the total cost of obtaining thermal energy by traditional methods (in particular, in boiler plants). However, with this, the payback period of solar installations should be commensurate with the warranty period of their operation. To fulfill the set conditions it is advisable to develop such designs of solar collectors that would allow to minimize the costs of their manufacture, installation and maintenance. This can be achieved through the use of cheap domestic materials, the release of which is guaranteed in sufficient quantities over a long period. The development, production and implementation of dual-circuit solar installations allowed the solar collector to be operated year-round, but the capital and operating costs were at such a level that it would take more than five years to fully pay for the solar installation, since the solar collectors were made of metal. Within the framework of the formulated task, we developed and manufactured a solar collector made of polyethylene film. A double-circuit solar installation is proposed for hot water supply and heating, in which the solar collectors are made of polyethylene film. Experimental results of the installation in different modes during the year were obtained at the plant. After processing of these data, generalizing dependencies were obtained: the heat flux density from the coolant temperature in the collector, the operating time of the installation during the daylight and the flow of the coolant; coefficient of efficiency from the density of heat flow; the maximum efficiency from the maximum heat flux density; the amount of heat in convection from the rate of leakage of the wind flow from 1 to 6 m / s on the outer surface of the solar collector. Dependencies were obtained at different volumetric flows V from 0.5 to 3.0 m3 / h of the heat carrier. The maximum error in the calculations does not exceed 5%.

STUDY OF COMPOSTING PROCESSES OF MUNICIPAL SOLID WASTES' FOOD COMPONENTS WITH THE USE OF MINERAL ADDITIVES

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Efficient management of municipal solid waste is a top priority in the field of international and national environmental safety. In Ukraine, it is actually dealt with through the storage of hundreds of thousands of waste at managed and unmanaged landfills. Since up to 40% of municipal solid waste is classified as organic (food waste, market waste, households' waste, waste of municipal food network and urban green household), removing this part of waste from landfill by composting will substantially reduce the load on the actual placed and potentially planned landfill. Aerobic composting is one of the best available technologies for an integrated waste management system, minimizing anthropogenic environmental impact, complying with the latest domestic and foreign developments, economic and practical acceptance of technology.

The purpose of the pilot study was to study the possibility of accelerating the composting process of the municipal solid waste's food component through the using of mineral additives for the introduction as a conservation technology in landfills. The article presents the study results of the mineral additive's influence on the composting process of the solid municipal waste's food component in order to accelerate it in the mesophilic and thermophilic temperature regimes with controlled parameters. To improve the composting process and to compare the peculiarities of the processes the soil was used as microbiological inoculums and the mineral salts' solutes were used as a mineral additive.

It was shown that the mineral complex accelerates the composting process of the municipal solid waste's food component by 2.2 times for the thermophilic regime and by 1.4 times for the mesophilic conditions of composting process, that testifies to the efficiency of its use in the municipal solid waste' recycling processes in order to improve the overall level of environmental safety.

FORMATION OF PLANE OLIVE CLEANING TECHNOLOGIES IN MINI-SHOPS CONDITIONS

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To obtain high-quality edible oils, these should be as much as possible cleaned from concomitant substances, mechanical impurities, phosphatides, waxes, soap and hydrophobic fractions. This process can be realized on the basis of physical methods developed by us with the help of special centrifugal devices, ceramic microfilters, hydration means for purifying phosphatidic concentrate with subsequent belting filtration of mono-dibasic unsaturated acidsA complex of technical means was developed, including equipment and blocks for pressing the seed, adsorbent refinement, hydration and coagulation, centrifugation and deodorization, cleaning and microfiltration of oils. Structures of technical means allow to compose separate components of a unit (modular), taking into account the conditions of their placement in small contour workshops. In the technological process, if necessary, an ultrasonic cavitator is used to reduce the acidity of the oil. The complex formed on this principle ensures the production of ecologically pure vegetable oil in the non-waste technology and in the conditions of the farms. Oil of this quality belongs to the category of casserole products.The technological process involves pressing the seeds, then feeding to a centrifuge for purification from mechanical impurities, for removing water and lightly flowing fractions into a vacuum chamber and microfiltration and lighting in the super-cleaner unit, an ultrasonic cavitator is used to reduce the acidity of the oil. The vegetable oil retains its organoleptic qualities and the nutritional value of the product. Such an effect is achieved by the use of only the production of oils, physical and mechanical processes, without chemical treatment. The technology is implemented by a compact small-scale technical complex, executed in a modular-block type, which is easy to control.

THE INFLUENCE OF SOLUBLE SUBSTANCES ON THE WATER STATUS IN PLANT TISSUES AND THEIR KINETICS OF DRYING

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The paper presents literary data on the influence of soluble substances of different types on the process and mechanism of water binding in aqueous solutions. Using the method of differential scanning calorimetry, the state of water in the parenchyma tissues of apples and potatoes, in the root crops carrots and beet, and the woody tissues of annual willow shoots was determined.

A change in the state of water in these plant tissues during dehydration has been studied. The results of the determination of the state of water in the initial plant raw material obtained from the calorimetric experiment were compared with the results obtained from the calculation according to the hygroscopicity limit according to the assumptions of the sorption isotherms method.

It has been established that the amount of bound water in the tissues of plants obtained from the calorimetric experiment is higher than the amount of bound water obtained on the calculation from the limit hygroscopicity of plant tissues. The additional binding of water is due to the presence of soluble substances in plant juice. Using the method of synchronous measurement of mass loss of tissues during drying and the amount of heat consumed for dehydration, an experimental determination of the specific heat of evaporation of water from plant tissues during drying was performed (the drying energy curves have obtained).

Using joint analysis curves of change of the state of water in plant tissues, curves of drying energy, drying curves and drying rate curves, it was established that the critical points of the drying process are in accordance with the dynamics of changes in the state of water in plant tissues and the kinetics of the change in the specific heat of evaporation of water.

A significant increase in energy consumption for the evaporation of water was detected already in the second drying period of plant tissues. The results obtained allow us to state that this increase in energy costs is due to the beginning of the removal of water from the hydrated shells of substances dissolved in plant juice. On the basis of the research, the mechanism and sequence of water removal from the cut of plant tissues during drying has been made more accurate.

DIETARY IMMUNOTROPIC SUPPLEMENT BASED ON THEDESTRUCTION PRODUCTS OF PROBIOTIC BACTERIAL CULTURES

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The possibility of obtaining an immunotropic dietary supplement based on low molecular weight degradation products of cell wals peptidoglycans of lactic and bifidobacteria composition has been considered. Rational regimes of autolysis of biomass as the primary stage of degradation of peptidoglycans of bacterial cell walls have been established. It was shown that the most intensive lysis of cells takes place when the culture liquid is treated at a temperature of 90 °C for the 8th hour of cultivation, as indicated by the maximum accumulation of amino acids in the reaction medium (1.8 mg/cm^3).

Optimization of the destruction process of bacterial cell peptidoglycans exposed to lysis, by enzyme preparation with pancreatin, was carried out by the mathematical planning method of the multifactorial experiment. The effectiveness of enzymatic hydrolysis was determined by the accumulation of immunotropic low molecular weight peptides, depending on the concentration of the enzyme (C_E), the substrate (C_S) in the reaction mixture and the duration of the process (τ). The rational value of the factors C_E, C_S and τ that provide the maximum concentration of low molecular weight peptides (0.569 mg/cm^3) in the enzymatic hydroltsate are C_E=12.5 mg/cm^3, Cs=70.0 mg/cm^3, τ=245.6 min.

A sample of low molecular weight peptides obtained from rational degradation regimes was investigated using the IR spectroscopy method. It has been established that in its spectrum absorption bands corresponding to fluctuations of amino groups, peptide bonds are presentred, which, in fact, take place in the structure of peptides. Fluctuations of the pyranose glucose form, which is included in the muramic acid and N-acetylglucosamine of peptidoglycan, have also been observed.

The general scheme of the sequence of production processes of an immunotropic dietary supplement has been given. In animal experiments, it has been established that this additive, in accordance with the classification of chemicals substances to the degree of danger, belongs to class 4 (low-toxic substances). The effective dose of the obtaned dietary supplement is 0.06 mg/kg body weight.

JUSTIFICATION ENERGY-EFFICIENT MODES OF DRUM DRYER OPERATION IN PRODUCTION OF COMPOSITE BIOFUELS

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The article is dedicated to the development of energy-efficient modes of drying composite biomass mixtures in a drum dryer of a complex for composite biofuel production.

The aim of the work is theoretical substantiation of energy-efficient modes and measures for controlling the productivity of the drum dryer of the complex for granular biofuels production under variable humidity and disperse composition parameters of the initial mixture.

The analysis of mathematical models of drying of disperse materials in a drum dryer is carried out. The application of a semiempirical model based on the kinetic equation of drying for analyzing the modes of drum dryer operation is substantiated. The specific productivity of evaporating the moisture per volume unit of drum is used as a productivity criterion. The energy consumption per kilogram of evaporated moisture is used as an energy efficiency criterion. The calculation method is proposed.

The dependences of specific indicators of productivity and energy consumption of the process at variable initial humidity and disperse composition parameters of biomass are theoretically obtained. The analysis of influence of temperature intensification of drying process, change of speed of a drum rotation and dynamic adjustment of an angle of inclination in the range $-3\ ^\circ < \beta < 3\ ^\circ$ is carried out.

It has been established that the temperature intensification of the process when combined with the regulation of the disperse composition of the raw material does not ensure the nominal productivity of the drum dryer for extreme deviation of the initial moisture content of the raw material. The necessity of development methods for expansion of the regulation range is substantiated.

It has been established that the combination of dynamic adjustment of the angle of inclination in the investigated range and regulation of the disperse composition ensures, with minimum energy consumption for the drying process, the widest range of regulation of the specific productivity of the drum, which is 70 kg / m^3. The method can be implemented with involvement of additional crushing equipment or by regulation of the component and fractional composition of the biomass composite mixture. It has been established that the methods of dynamic adjustment of the angle of inclination of the drum with regulation of the rotation number or the temperature regime of the drying provide an expansion of the range of the regulation of the drum dryer productivity in the range of 30-85 kg of evaporated moisture per m^3 with a 10-15% reduction of energy consumption in comparison with existing technologies.

RATIONALING OF PARAMETERS OF INFRARED DRYING OF GRAIN PRODUCTS WITH VIBROWAVING CONVEYOR

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The analysis of conveyor devices to ensure the necessary moisture removal of loose agricultural raw materials allowed to substantiate the effectiveness of vibration conveyor circuits. Classic vibroconveyor machines are based on electromagnetic vibroexcitation and the use of a rigid carrier, which requires significant energy and material costs. This problem is solved by the use of mechanical vibration and undetectable transporter element inherent in vibrating conveyor devices.

Mechanical vibrators are aggregated in the support bundles of the tape mechanism, providing with sufficiently compact performance of the standing or running wave on the surface of the deformation carrier body. Necessary parameters of this wave for the appropriate promotion of bulk masses of grain products with a given speed are determined from experimental studies in the variation of angular frequencies and amplitudes of the oscillations of the drive shafts of the designated vibroscuders.

The required speed of movement of products processed on a projected wave conveyor is determined by the condition of achieving the desired level of moisture content of the raw material during its single passage along the processing zone, which ensures the continuity of the dehydration cycle and the sufficiently high productivity of the dryer. The principal scheme of the vibratory thermo-radiation dryer is presented, which allows to effectively solve the problems of sufficiently intensive and uniform treatment with minimization of energy and material costs, the moderate thermal load on the product layers and maximal preservation of its initial properties.

On the basis of experimental researches of the developed experimental model of this dryer, a criterial equation of the heat capacity was compiled, which allows the design of driers with the given parameters of the process. Among such parameters, the characteristics of the oscillation processes, which lead to the appearance of a wave on the surface of the tape, were used. This approach allows us to maximally approximate the results of mathematical modeling of this drying process to real conditions.

OPTIMIZING PHASE SEPARATION EQUIPMENT PACKAGING WITH USING OF MODULAR SEPARATION DEVICES

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This article discusses ways of the efficiency improvement, optimization and intensification of the separation processes, which takes place in stabilizer units for oil and condensate. The work includes the theoretical introduction to the separation of gas-liquid mixtures and difficulties associated with process. Investigated equipment, specifically their design features, operating principle, advantages and disadvantages was analyzed, in consequence of which the optimal equipment packaging was determined.

The non-typical approach for improvement of most commonly used separation equipment is proposed, namely method of optimizing phase separation equipment packaging, which includes using of modular separation devices. For this purpose numerical simulations of multiphase flow in the vertical phase separator internal volume and one of the modular separation devices, which implement the dynamic separation method, were carried out. The reliability of computer simulation is confirmed by verification data, which obtained from the results of numerical experiment, with the separator functioning parameters. The method of dynamic separation isn't traditional method for heterogeneous systems separation. The main feature of this method is using of hydraulic resistance automatic regulation, in this case regulating forces are the elastic forces.

For numerical calculation of the vertical phase separator hydrodynamics was used software complex namely FlowVision, which implements the finite volume method. Since, in case of the modular separation devices functioning take place the aerohydroelasticitys phenomena's, it is necessary to be consider mechanics of the gas-liquid flow motion of the on one side and mechanics of the solid deformable body on the other hand.Taking into account the above for investigations of this modular separation device was used the ANSYS Workbench software complex, namely modules, which are based on the finite volume and finite element methods, respectively Fluid Flow Fluent and Transient Structural, which combined by System Coupling module.

The presented designs of new modular separation elements and recommendations for their optimal disposition in phase separation equipment will significantly increase the efficiency and intensity of emulsions and gas-liquid mixtures separation processes, moreover it's all will improve the quality of the target components.

THE DEVICES FOR SEPARATION OF WINE PRODUCTS

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The article presents the results of research on the use of hydrocyclones for the separation of solid grapevine particles, grape seeds from squashes, as well as for the diffusion juice illumination after the extraction of grape vinegar, sewage and other contaminated liquids. Studies were conducted on the separation of grape seeds mixed with yeast bard.

To achieve the desired effect of separation on the hydrocyclone it is necessary to thoroughly analytically ground and experimentally determine the necessary parameters of the size of its parts. One way to regulate the separation of solid particles from winemaking products is to change the size of the opening of the lower drain fitting or to change the design of the conical part.

The construction of a hydrocyclone with a controlled opening of sediments was found to be used to separate solids from grape and fruit berries (juice), separation of lime vine. In addition, with this design, it is possible to determine the structural dimensions of the hydrocyclones for other products, for example, to separate the grape seed from the flow of water with squeegees.

As a result of the researches, optimal parameters of the hydrocyclones were determined at separation of various solid particles. The modes of operation of hydrocyclones, in which the maximum distribution effects are achieved, are proposed. Different structures of the hydrocyclones are used for distribution, with adjustment of the opening of sediment release with a rotary activator, and others like that. Due to the improvement of flow distribution at the entrance to the hydrocyclone, increasing the speed of the flow of the activator, the effect of cleaning the suspension from impurities increases by 15-20%.

The use of a hydrocyclone for the separation of suspensions of tartaric lime makes it possible to completely separate impurities with minor losses.

To study the efficiency of the distribution of each product it is necessary to conduct a test of hydrocyclone with increased height and diameter of the cylindrical part of the body, the conical part with different angles of conicality and the size of the aperture for the lower drain of glass.

METHOD OF CALCULATION FOOD SOLUTIONS AND EXTRACTS CONCENTRATION PROCESS IN MICROWAVE VACUUM EVAPORATOR

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Forvacuum-vaporization process intensification it is offered to provide energy supply uniform it yandexclude intermediate heat medium by using of microwave technologies. While microwave supply energy comes directly to water molecules in product, vaporization centers appear in whole volume and perform function of heating surface.

As a result of experimental modeling of sugar solutions microwave vacuum vaporization the constants of criterion equation are received.

The method of calculation of vacuum vaporization under microwave action is given. The base of the calculation method is criterion equation of vaporization under vacuum and microwave energy supply conditions, which variables are energy action criterion, dimensionless parameter of product mirror area and dimensionless pressure. The algorithm includes calculations of product thermophysical properties, vessel geometrical characteristics, water removing velocity, current dry matter concentration, necessary process duration, energy consumption and economical characteristics. Calculation cycles repeat until solution concentration in apparatus reaches the value prescribed for the final product.

The results of verification of proposed method for sugar solutions, coffe and stevia extracts are given. It is defined, that relative error for calculated water removing velocity relatively to experiment for sugar, coffee and stevia solutions is 0,2…12 %.

On the base of elaborated microwave vacuum evaporation apparatus a technology of production liquid stevia concentrate, a natural sugar substitute, is offered. Stevia extract that is being concentrated is received in microwave extractor. Dry matter concentration in final product is about 12 %.

INNOVATIVE SOLUTIONS FOR «DEWATERING» TECHNOLOGIES

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Removing moisture from food raw materials is one of the key and most energy-consuming tasks of food technology. The most common technologies of dewatering are evaporation and drying.At the same time, the energy efficiency of the drying process is 2 or more times less than the efficiency of the evaporation process. One of the ways to improve the process of dewatering is the use of technologies for targeted energy delivery, in which the boundary layer is not formed, and the concentration of the solution ceases to be critical for the dehydration of raw materials, which allows raising the final concentration of solids in the product to 92%. The application of the technology of targeted energy delivery during drying allows us to use a powerful mechanical potential instead of a weak diffusion potential, which is capable of intensifying the mass transfer process. This is due to the increase in pressure in the microcapillary structure of the raw materials, as a result of which the vapor-liquid mixture is ejected. The problems of modern vacuum dryers are solved by the proposed innovative design with a two-phase evaporation-condensation circuit for supplying heat to the raw material and condensation system of water vapor directly in the drying chamber. Such an energy supply system allows maintaining a stable and uniform product temperature, and removing from the chamber not steam but condensate will significantly reduce the hydrodynamic resistance of the line of removal of the moisture to be removed. A model of dehydration processes in vacuum devices with an electromagnetic energy supply has been developed, which made it possible to develop and construct innovative vacuum dryers. The test of the developed dryers was carried out on a different kind of food raw material. With the help of thermal imaging, the process thermograms indicating the uniformity of the heating of the raw materials were obtained. A specific way of supplying energy requires the searching for new methods for evaluating the effectiveness of such devices. It is proposed to use approaches, which take into account energy costs per unit of product, for the estimation of energy efficiency.

INCREASING THE EFFICIENCY OF THE WATER PURIFICATION PROCESS BY BLOCK FREEZING METHOD

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For the period from 1900 to 1995, freshwater consumption in the world increased six-fold. Scientists predict that by 2030, 47 % of the population of the Earth will have difficulty with access to drinking water. In that regard, the development of energy-efficient methods for obtaining purified water is of practical and scientific interest. 96% of total desalinated water in the world is obtained with distillation desalination plants, 2.9% – with electrodialysis plants, 1% – by reverse osmosis plants, and 0.1% – with the share freezing and ion exchange desalination plants.

There is a growing interest in the technologies of block freezing for water cleaning. Systems of this type are characterized by simplicity of design, compactness, and energy efficiency. Over the last years, the interest in intensification of the processes which use ultrasonic radiation has been increased. Despite a wide range of studies, the use of moderate and low power ultrasound to crystallize and separate water is still insufficiently studied.

The objective of this work is to study the influence of the low power ultrasound on the processes of heat and mass exchange in block freezing units. In experiments, an ultrasonic generator with variable frequency (from 10 to 80 KHz) and power used. The use of ultrasonic field has been proved to be an effective method of controlling energy flow during block freezing. It has been established that ultrasound increases the mass of ice, and intensifies the freezing process. It has been observed that the ice block mass increases when the weight ratio increases by 15-20 %, and the salt content in the drains and the ice block porosity decrease by 40 % and by 22 %, respectively. It has been determined that there is dependence of the separation and crystallization kinetics of the ice block from the ultrasound power and frequency.

Low temperature separation under the influence of ultrasonic fields characterized by significantly lower energy consumption compared with traditional distillation. To summarize the obtained experimental data, the methods of similarity theory have been used. The dependence $St_w(Eu_w,Gr)$ has been obtained which can be used for optimization and design calculations of block freezing units with ultrasonic intensifier within the frequency range of 20 KHz to 60 KHz.

RESEARCHING OF PROCESS ENERGY TECHNOLOGIES DEVELOPMENT OF VEGETATIVE RAW MATERIALS

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The world tendencies in the dried products and concentrates market are considered. The energy technologies of the basic processes of dehydration (evaporation and drying) are analyzed. Modern dehydration technologies are compared and the scientific and technical contradictions of the processes of evaporation and drying are discussed. The energy advantages of the evaporation and the limitations by the final moisture content of the finished product are shown. Models of material balances with combined technologies of "evaporation - drying" are given. Innovative developments in dehydration engineering are presented - a thermomechanical unit and a microwave vacuum evaporator. The constructive variants of the unit are discussed, the possibilities of solving in it the tasks of crushing, flattening, mixing and transporting the product in parallel. The mechanisms of intensification of the process of heat and mass transfer in a thermomechanical aggregate are justified. The values of the heat transfer coefficients in thermomechanical aggregates are given for the processing of raw materials in canning, dairy, food-concentrates and wineries. The specific energy costs in a thermomechanical aggregate and in traditional belt and cylinder dryers are compared. Innovative technologies of dehydration in electromagnetic fields are investigated. The prospects of dryers with electromagnetic energy supply of the microwave range are shown. Evaporation processes are studied in conventional apparatuses and in vacuum microwave ones. Models of transformation, transport and energy losses in the traditional technology of tomato paste production and in a device with a thermomechanical unit with a rotary thermosyphon are presented. It is shown that the innovative technology allows to intensify the process of evaporation by 40% and to reduce the energy consumption by 35%. The prospects of stepwise dehydration schemes of "evaporation - drying" are substantiated. Energy management methods have been developed to study energy efficiency based on a new number of similarity – the number of energy actions.