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VII INTERNATIONAL SCIENTIFIC-PRACTICAL CONFERENCE

" INNOVATIVE ENERGY TECHNOLOGIES "

ABSTRACTS

Ukraine, Odessa, September 9-13th, 2019

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VII INTERNATIONAL SCIENTIFIC-PRACTICAL CONFERENCE
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CHOICE CRITERIA OF ADSORBENTS FOR HEAT ENERGY CONVERTERS IN VENTILATION SYSTEMS

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The criteria of adsorbent selection for adsorption transformers of thermal energy in ventilation systems are considered. The main characteristics of adsorbents that affected the structural parameters of the adsorption module are revealed. The method of determining the mass of the adsorbent and the volume of the adsorption unit in ventilation systems has been developed. The main factor affecting the volume of adsorbent is confirmed to be maximal adsorption. The advantages of 'salt in the porous silica gel matrix' composites are compared with traditional silica gels. On the example of an adsorption regenerator of low-potential heat and moisture, the greater effectiveness of the composites "silica gel-sodium sulphate" is shown in comparison with the composite 'silica gel - sodium acetate'. According to the experimental data on the operation of the adsorption regenerator of heat and moisture on the basis of the composite 'silica gel – CH_3COONa', the adequacy of the proposed algorithm for determining the temperature efficiency factor has been confirmed.

Suggested algorithm includes the calculation of the air volume passed through the layer of heat-storage material, water concentration in the air at the exit from the heat accumulator, adsorption, heat of adsorption, the final cold air temperature, air temperature after mixing cold air from the street and the warm air in the room at the inlet, the calculation of the concentration of water in the flow at the exit from the heat regenerator, the adsorption and heat of adsorption, the final temperature of the warm air, the air temperature after mixing the cold air from the street and the warm air from the room during the discharge, determination of the temperature efficiency factor, total adsorption and time to achieve the maximal adsorption. The efficiency of the processes of operating adsorption regenerators based on composites 'silica gel - sodium sulphate' and 'silica gel-sodium acetate' in the conditions of the typical ventilation system of housing premises was compared.

The parameters that correspond to the maximum value of the temperature efficiency factors: the humid air velocity is about 0.22 - 0.32 m/s and the time of switching of the flows up to 5 minutes. The influence of meteorological conditions on the efficiency of the adsorption regenerator has been confirmed. The higher efficiency of adsorption regenerators based on 'silica gel - sodium sulphate' composites is explained, which is explained by higher values of maximal adsorption, which results in increasing the heat of adsorption. The results of the research can be used for the selection of adsorbents for energy-efficient heat energy converters in ventilation systems for residential and warehouse premises.

THE EFFICIENCY IMPROVEMENT OF HEAT GENERATION PROCESSES IN MUNICIPAL HEAT-ENERGY AND DRYING TECHNOLOGIES ON THE BASIS OF COMBINED COGENERATION-HEAT PUMP TECHNOLOGIES

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The most effective technology for electric and heat energy generation for the needs of municipal heatpower and heat technologies is combined power generation (CPG) using modern cogeneration plants based on gas piston engines (GPE) and gas turbine plants (GTP) which work on natural gas or biogas. CPG on such a base significantly reduces fuel costs in comparison with the traditional separate generation of electric power at heat condensing power plants (HPP) or on combined heat and power (CHP) and heat at boiler.

Further noticeable increase in energy efficiency of heat generation processes for the needs under consideration can be achieved by including heat pump plants (HPPs) in the process, which is development of combined cogeneration and heat pump plants. They will have the highest fuel efficiency in comparison with all existing in the traditional heat power industry. This is due to a number of factors. Modern CGP based on GPE and GTP have electric efficiency higher than HPP or CHP – 30–45% and 28–35%, respectively. In heat recovery boilers, high-temperature waste heat of engines is more efficiently used, resulting in a total efficiency of installations reaches 85–88%. Such facilities ensure decentralization of electric and heat production, therefore, on autonomous CGPs are much lower, and sometimes there are practically no losses in electric and heat networks, reaching 8–12% and 15–30% in centralized systems, respectively. Another important thing is that they increase the reliability of the entire facility, making it independent of external networks. Inclusion in the heat generation process of HPSs causes a significant increase in its energy efficiency, increasing fuel efficiency, thanks to using of almost free low-grade heat of natural, industrial or domestic origin, as well as high conversion efficiency in this HPP heat into higher-potential heat using CGP electric power.

The aim of the work is to evaluate the prospects for the use of combined cogeneration and heat pump plants (CG-HPS) based on GPE and GTP to improve energy efficiency and energy saving in generating heat in municipal heat and heat engineering, in particular, in drying processes.

EXPERIMENTAL DETERMINATION OF THE QUALITATIVE COMPOSITION OF CHLADONE EXTRACTS OF BAY LEAF

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The features of the use of laurel leaf extracts in food production are considered. The characteristics of the main substances contained in the leaves of the Noble laurel are listed. The chemical composition of Noble laurel proves the prospect of using extracts in food production. The extraction and environmental advantages of extraction with liquefied gases were analyzed, traditional methods of extracting vegetable oil, as well as their comparative characteristics were given. The stages of the technological process of extraction of laurel oil using liquefied chladone are shown, the organoleptic characteristics of the final product are evaluated. In the process of chemical analysis of the refrigerant extract, it was determined that the use of the modern method of chladone extraction with liquefied gases allows extracting the extract with a significantly larger amount of aroma-forming substances. The obtained values of the number of aroma are compared with the indicators of aqueous-alcoholic extract, which exceed the latter several times. Studies of extracts by gas chromatography have been described, as a result of which more than 50 components have been identified, among which fatty acids and ether derivatives are of particular interest. It was revealed that the chladone extract of laurel leaves retains the color, smell and taste of the original plant materials. The results of gas chromatography were compared with literature data on the qualitative composition of bay leaf extracts obtained by microwave extraction and supercritical fluid extraction, as a result of which it was established that chladone extract of bay leaf has the same dominant compound 1,8-cineole. Of particular value are eugenol derivatives, which can act as antioxidant supplements in the treatment of cancer.

DEVELOPMENT OF KEY ELEMENTS OF THE RESOURCE AND ENERGY EFFICIENCY SYSTEM

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In the modern world, hotels and restaurants are increasingly in demand. This is due to the high occupancy and active life of a modern person. The above-mentioned institutions in the process of their functioning bear irreversible environmental impacts. Studies conducted reveal a complete picture of the problems associated with the functioning of the hotel and restaurant complex, including the impact on the atmosphere, the hydrosphere and the lithosphere; consumption of resources; accumulation of solid waste and risks. In the course of the research the factors that influence and cause additional environmental burden are estimated. For the investigated hotel and restaurant enterprise the ecological policy is formed, the introduction of which will reduce the negative impact of the enterprise due to the formation of the organizational, technical and technological component. The influence of the hotel-restaurant complex on the environment by the method of relevant tables or the Leo-polda matrices is analyzed and evaluated.

The register of environmental aspects of the hotel-restaurant complex, namely input, output and risk, has been developed; Subdivisions and processes that have a significant impact on the environment are identified. According to the results of the study, it was concluded that significant environmental impacts of sewage water pollution, which are contaminated with synthetic detergents. It was determined that the main pollutants entering the environment in the process of functioning of the hotel-restaurant complex are fluoro-chloro-organic compounds. The work identifies the environmental aspects of the enterprise and provides recommendations for improving the level of environmental safety of the hotel and restaurant business. In the course of research, it was determined that the hotel and restaurant company has a significant negative impact on the environment.

EXPERIMENTAL VERIFICATION OF VELOCITIES DETERMINATION METHOD IN FALLING-FILM APPARATUS

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The paper considers the vertical channel of a regular packing for a falling-film apparatus with a countercurrent gas flow. The mathematical problem of the motion of a gravitational film with a countercurrent gas flow is formulated on the basis of the Navier Stokes equation. The mathematical problem includes, the steady flows in the vertical channel of a circular cross-section, a laminar motion of a smooth film is considered, which include the equality of tangential stresses on the boundary between the phase, the condition of adhesion on a solid surface. This mathematical problem is solved analytically, the given solution results allow us to estimate the local velocities of the falling-film and a countercurrent gas flow. An experimental stand with working channel was used for the experimental verification of mathematical results. The working channel like a double pipe has a height of 1 m and internal / external tube diameters of 17/36 mm. A test experiment determines the thickness of the falling-film and compares this to the Nusselt formula. Accuracy of test experiments on an experimental stand - up to 15%. Several series of experiments were carried out under the condition of the laminar-wave regime of falling-film and the laminar motion of air Re film / Re air = 200/2150. The deviation of the experimental results for the local velocities of the phases from the results of the solution of the mathematical problem increases with the growth of phase velocities and makes up 19-30% for the laminar-wave mode of motion of the film in the vertical channel of the contact apparatus. The proposed solution of mathematical problem determines the local velocities in the vertical coaxial channel of the falling-film apparatus and allows to provide high accuracy of local velocity calculation at the laminar air movement.

SOLUTION OF ENERGY-ECOLOGICAL PROBLEMS OF CEREAL PRODUCTION

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The article shows the advantages of production of fodder mixtures from the waste of grain mills, the reasons for reducing the production of feed mixtures, problems in grain processing enterprises, which are due to the lack of efficient waste disposal. The production of solid biofuels from secondary material resources (flour and husk) has been proposed. Different methods of producing solid organic biofuels are analyzed, and it is shown that there are deficiencies in finished products such as briquettes and pellets obtained without the use of binders, one of which is the problem of transporting over long distances, during which a considerable amount of compressed biofuel is destroyed at the expense of increasing humidity and, consequently, reducing their calorific value. Fuel pellets (pellets) are mainly produced without the addition of binders, while for the production of briquettes with improved quality indicators, various additives and binders are used.

Theoretical and experimental researches substantiated the component composition of paled-in granules, determined the physical properties of finished products. It is suggested and grounded as a CR to use starch-based raw material - a flour. On the basis of experimental studies, it has been proved that the most effective method is to prepare a paste of barley flour with a content of dry substances of 15 %, followed by its introduction into biofuels in the amount of 5 %. The article suggests and substantiates the complex technology of the processing of the production of grain mill products into pressed products (fodder mixtures and biofuels), which includes the following technological lines: a pipeline preparation line; line of preparation for the CL; line of preparation of macro components; granulation line; briquetting line. Fuel pellets resulting from this technology will have a density of 1.13 t/m^3, fragility up to 10 %. The principal technological scheme of obtaining granulated feed mixture and fuel pellets is given. The developed integrated technology of waste processing of crushed plants is universal, does not require significant investments and will allow not only efficiently to process secondary raw materials, to get rid of problems with their utilization, but also by way of organizing recycling at the industry enterprises to solve both energy and environmental problems.

HYDRODYNAMICS OF GAS-LIQUID FLOWS AT THE CAPILLARY-POROUS STRUCTURES

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A promising direction of increasing energy efficiency and reducing the mass and dimensions of heat and mass transfer equipment used in chemical, food and other industries are the application of methods that provide optimization of process parameters in the equipment. One of the main principles laid down in the design and operation of contact heat exchangers is to ensure the stability of the interaction of the liquid film and the flow of gas or steam.The nature of the interaction is determined by the crisis phenomena associated with the violation of the flow regime of the film at high velocities of the gas stream, which is accompanied by intense drift of droplets and the beginning of the break process.

The presented research results show that the use of capillary-porous coating of the surface of the channels of contact devices affects the wave processes in the film and contributes to lowering the lower boundary of the beginning of the break process under certain conditions.

The influence of the geometrical characteristics of the coating on the intensity of the processes of heat and mass transfer in the contact apparatus is investigated. Using the results of an experimental study of the hydrodynamics of a two-phase flow in channels with a capillary-porous coating allowed to clarify the analytical solution of the problem of determining the boundaries of crisis phenomena.Geometrical characteristics of the coating of the heat-exchange surface, significantly affect the interaction of the contact surface and the film of the working fluid and the intensity of the processes of heat and mass transfer in the contact apparatus.

Analysis of the presented results shows that in the temperature range in which conducted the studies, the intensity of the evaporation of the fluid increases with an enlarged cell size from 10^{-4} m to $5 \cdot 10^{-4}$ m. With an increase in the size of the cell from 10^{-4} m to $6{,}3 \cdot 10^{-4}$ m, the intensity of the evaporation of the liquid is somewhat reduced due to the fact that the work of adhesion forces are not enough to hold thin films for a long time in large cells until their full evaporation. Analysis of the results of the study showed that the beginning of the break process occurs at a much greater thickness of the film, which is a significant positive moment in the operation of contact heat and mass transfer devices.

THERMAL DECOMPOSITION OF GRANULATED WOOD IN THE CONDITIONS OF VARIABLE GASEOUS ATMOSPHERE

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At present, the widespread use of renewable energy sources and, in particular, biofuels is relevant. It is important to study the process of thermal decomposition for determine the suitability of biomass as a fuel. Wood is a common type of biomass. Pine wood sawdust is used as material for research. Both dispersed raw materials and samples in the form of pressed granules were used. The paper presents the results of the study of thermal properties of wood by method of derivatography. Investigations were conducted with the change in the quality of the atmosphere in the zone of thermal decomposition to study the behavior of samples in different conditions. The behavior of the samples was studied in its own, oxygen-enriched, inert and oxygen-deficient gaseous atmosphere. Temperature intervals of dehydration and thermal decomposition of organic compounds, average rates of thermal decomposition of organic compounds, humidity, organic matter content and ash content are determined for biofuel. It is shown that for fuel granules, compared to dispersed fuels, the temperature of maximum peak of the water removal rate and thermal absorption is shifted in the direction of lower temperatures. It is found that the process of thermal decomposition of fuel granules is faster and in a more narrow range of temperatures. It was established that the gaseous atmosphere significantly affects the kinetics and the course of thermal decomposition of the organic matter of wood. The endothermic effect was detected in the interval between the maxima of heat emission during decomposition of wood in its own gaseous atmosphere. It accompanies the removal of gaseous products. It is shown that the enrichment of the oxygen in the decomposition zone causes an intensive progress of decomposition processes, which leads to an increase in the reaction rate and a narrowing of the temperature interval of the thermal decomposition of biofuels. It is determined that the inert or oxygen-deficient atmosphere in the decomposition zone significantly reduces the intensity of its processes and, accordingly, expands the temperature interval of decomposition. It is found that thermal decomposition is carried out according to the scheme of wood pyrolysis in the inert and oxygen-deficient atmosphere.

ACTIVATORS OF THE PROCESS OF ABSORPTION CARBON DIOXIDE BY CHLOROPHYSYNTHESIZING MICROALGAE

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Changing the planet climate leads to devastating consequences for the planet Earth and makes this problem one of the most important in the field of environmental protection. There are many ways to solve this problem, one of which is the reduction of CO_2 concentration with the use of biological methods for the purification of industrial gas emissions using the photosynthetic properties of microalgae.The main source of carbon dioxide (CO_2) is combustion of fuel, solid, liquid or gaseous.

Consequently, by-products of combustion are sulfur dioxide (SO_2), nitrogen dioxide (NxOy) phosphorus oxide (P_2O_5) and other. Certainly, the presence of these gases will affect the absorption efficiency of CO_2 chlorophyllsynthesizing microalgae of the Chlorella type. Therefore, it is important to study the effect of NxOy and P_2O_5 on the absorption efficiency of carbon dioxide chlorophyllsynthesizing microalgae of the Chlorella type. Previously, we defined that sulfur dioxide is an inhibitor of the process of absorption of carbon dioxide (photosynthesis). It needs to be say that inhibition is the reverse, and so it is possible to control the processes of absorption of greenhouse gases in the presence of SO_2.

In this article, the phenomenon of activation by oxides of nitrogen and phosphorus in the process of absorption of carbon dioxide are established. The established values of activator concentrations (NxOy and P_2O_5) in the process of absorption of carbon dioxide by chlorophyllsynthesizing microalgae. Based on the decision of the mathematical model and the experimental results obtained, graphs of the dependence of the absorption of carbon dioxide on the chlorophyllsynthetic microalgae were constructed in the presence of phosphorous oxide and nitrogen oxides. The values of optimal concentration of nitrogen oxides and phosphorus oxides as enhancers of growth of microalgae of the Chlorella type were determined.

INNOVATIVE TECHNOLOGY AND EQUIPMENT FOR OBTAINING SUPPOSITORIES

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Currently, the reason for the purchase and use of imported equipment is the applying of outdated technologies and equipment for the manufacture of suppositories in Ukraine. The actual task is the hardware and technical re-equipment of existing production lines, the creation of new production facilities in the pharmaceutical industry. A method and installation of thermal contact heating and melting for the preparation of bases in the manufacture of suppositories, as a complex multicomponent dispersed system, is proposed. The experimental studies of the method of thermal contact heating and melting were carried out to select the optimal parameters for the melting process, and a graph of the melt volume dependence on the heater temperature was obtained. Intensification of the melting process is achieved by selecting the required temperature of the heater, as well as creating a uniform temperature field on the surface of the thermal contact heater due to the chosen design. The using Ti-160 thermal imager made it possible to trace the heater movement along the length of the tank, as well as the temperature distribution on the surface of the thermal contact heater and inside the metal drums of the manufacturer. The thermograms show uniform heating of the thermal contact heater and the entire volume of the melt as it moves down the drum and melts the base. Due to the low thermal conductivity coefficient, the bases are in the initial viscous state, and they heat and melt upon contact with the heater. The convective flows are observed at the end of the process, which helps to maintain the temperature of the melt at a certain level. The use of homogenizer-dispersers with the method of discrete-pulse input of energy is proposed for mixing the base with medicinal substances. The proposed technology and equipment allows to obtain the necessary consistency of suppository dosage forms, as well as to intensify the process of their manufacture and rational use of energy.

INFLUENCE OF HEAT AND MOISTURE TREATMENT ON THE KINETICS OF DRYING PECTIN-CONTAINING PRODUCT

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The article presents the properties of raw material, which is a source of pectin, in particular apples, the spectrum of physiological action of pectin substances and the advantages of pectin-containing dried products. The purpose of the work was to determine the effect of different types of preliminary heat treatment of apples before drying on the kinetics of the dehydration process and the amount of soluble pectin in chips.

The results of both theoretical and experimental investigations demonstrate that hygrothermal processing of parenchymal tissues is a sine qua non for processing pectin-containing raw material. The curves of drying and curves of drying rates of apples subjected to various types of preliminary heat treatment before dewatering are presented in the work. Studies have shown that the duration of dehydration of all blanched specimens is reduced compared to untreated apples. The drying time of apples blanched with steam to residual moisture of 6 % is the smallest. The process of dehydration proceeds in the period of incident speed, on the curves of drying there is no period of constant speed. The maximum speed of drying occurs in steam blanched apples.

It is determined that the soluble pectin amount in fresh apples is 35 % of the total pectin amount and increases to 58 % after hygrothermal processing. Some insignificant loss 2...4% of the total amount of pectin substances and grows of soluble pectin amount by 2...5 % in the course of drying process are observed.

According to the results of investigations, the stepped modes of dehydrating pectin-containing materials are determined. They promote a reduction of process duration by 25 % and saving in the energy resources by 20 % as well as guarantee a high level of conservation of pectin and biologically active substances.

DEVELOPMENT OF INNOVATIVE HEAT AND MASS EXCHANGE EQUIPMENT FOR PHARMACEUTICAL TECHNOLOGIES

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The influence of the complex of hydrodynamic, hydroacoustic and vibrational effects realized in rotary-pulsation disk-cylindrical apparatus on the rheological, structural and texture characteristics of disperse systems with structures of complex coagulation and condensation-coagulation type is investigated in the work. The researched systems have a strong, highly developed structure with abnormal rheological behavior, which consists in the coexistence of different flow regimes in the studied range of shear rates. It was discovered that a system with a coagulation structure is capable of full thixotropic recovery after removal of the load and a system with a mixed structure only partially. The last is sensitive to shear deformations, the influence of which sharply increases in the process of structuring and leads to loss of fluidity of the system, complicating the technology for producing such systems. It was determind that during hydrodynamic processing dispersion increases on the one hand and textural changes, in particular, the redistribution of the porous space occur on the other, which leads to a change in functional properties including adsorption capacity.

The time and spatial factors of influence on the system depend on the design features of the apparatuses and must be agreed with the physical and chemical properties of the system components. Flow apparatuses with two rotor-stator pairs in a vertical version and with three pairs in a horizontal version, which can be used both in one circulation circuit and operate in autonomous modes were proposed to obtain structured disperse systems. The installation was developed and created for obtaining structurally homogeneous functional products such as enterosorption pastes and application gels as the result of the research. Technologicality of the proposed installation is the possibility to carry out a complete cycle of operations for obtaining the finished product.

RESEARCH OF CAVITATION EFFECTS IN DIFFERENT TYPES OF PUMPS

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Pumps are widely used in most technological processes of the chemical and food industry, including for the intensification of the process of obtaining micro- and nanoemulsions due to the effects of the hybrid dynamics cavitation. Applied cavitation technologies can increase the productivity of technological processes; provide significant energy savings and high-quality processing of disperse systems. The efficiency of technological processes and the quality of food products depends on the reliable operation of all equipment. However, uncontrolled cavitation can lead to serious failures in the operation of equipment and even the destruction of the structure. In technological schemes of cavitation devices, pumps of different types are used. Creation of cavitation effects in them leads to negative consequences resulting decreasing of productivity and efficiency of the entire device and the destruction of the surfaces of working bodies. The most used are dynamic centrifugal and volumetric (screw or gear) pumps. The operation of centrifugal pumps is based on the general principle - the power interaction of the impellers of the rotor with the surrounding fluid flow, which is constantly connected to the pump inlet and outlet nozzles. Stable operation of the centrifugal pump is provided in such a mode, when the absolute pressure at all points of its inner cavity is greater than the pressure of saturated vapor of the pumped liquid at a given temperature. If this condition is not met, then the development of hydrodynamic cavitation and its associated effects begins, which leads to a decrease in the productivity or even the termination of the pump operation. In volumetric gear pumps, the working fluid is provided, from the working volume intermittently, portions are displaced from the specified volume by the force elements in such a way that in these hydromachine the input is constantly and very tightly disengaged with the output, by a strong and hermetic contact of gears teeth with each other. Such a method of work in general does not provide conditions for discontinuities in the flow and the occurrence of cavitation, but under certain conditions in the gaps between the teeth of the gears, local areas of reduced pressure may occur.

The paper presents the results of research on the appearance of cavitation effects in dynamic centrifugal and volumetric gear pumps by changing the temperature and electrochemical parameters of water as a result of processing. The analysis of the results of studies of temperature indices showed differences in the principle of the operation of selected pumps for their influence on the processed environment. In a dynamic centrifugal pump, the temperature indices rapidly increase, unlike the volume gear, in which, for 20 minutes, the temperature increase practically did not occur. As a result of the active dynamic effect at the molecular level, when the liquid passes through a centrifugal pump, the pH level increases with the first seconds of processing. The value of the electrical conductivity of the water for a dynamic centrifugal pump varies the same way. The obtained results indicate the activation of water with the formation of electron-excited states of molecules. Thus, it is established that cavitation occurs in a dynamic centrifugal pump under certain conditions and parameters of its operation.

ARTIFICIAL MICRO RNA (AMIRNA): A POTENT TOOL FOR GENE SILENCING IN PLANT BIOTECHNOLOGY

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RNA Interference (RNAi) is a potent technology which is used in crop development, plant's tolerance to abiotic and biotic stresses, resistance against bacteria, virus and fungi, resistance against many pests and insects. RNA interference (RNAi) is a promising gene regulatory approach in functional genomics which has a significant impact on crop improvement which permits down-regulation in gene expression with greater precise manner without affecting the expression of other genes. The ability of interfering RNA to silence genes was discovered in the 1990s by American scientists Andrew Z. Fire and Craig C.Mello, who shared the 2006 Nobel Prize for Physiology or Medicine for their work. Fire and Mello successfully inhibited the expression of specific genes by introducing short double-stranded RNA (dsRNA) segments into the cells of nematodes (Caenorhabditis elegans). The dsRNA segments underwent enzymatic processing that enabled them to attach to molecules of messenger RNA (mRNA) possessing complementary nucleotide sequences. The attachment of the two RNAs inhibited the translation of the mRNA molecules into proteins. RNAi is advantageous over other approaches as more than one gene can be targeted and silencing is sequence specific. The ambit of gene silencing can be controlled so that only essential genes are silenced at a particular stage in a particular tissue. Since there is no transgene protein expression found in RNAi approach so there is extra metabolic load on transgenic plant.

TEMPERATURE REGIME OF MONOGRANULATION IN THE PRODUCTION OF IMITATED FOOD PRODUCTS

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Due to the scarcity and high cost of products from valuable species of fish, there is a need to produce their analogues, which in terms of nutritional value and taste would not be inferior to natural products. One of the methods for producing analogue of black caviar consists in the monodisperse crushing of a jet of solution prepared on the basis of the protein of chicken eggs with natural fish additives and black food coloring. Drops of the solution are sent to the granulation column, where they are heated to the temperature of the beginning of thermal coagulation of its protein component. The creation of isothermal conditions in the granulation column and the reduction of heat losses from its surface in order to increase the energy efficiency of the production are important problems encountered in the production of granulated products using this technology. To solve these problems, the temperature regime of the granulation column in the production of imitated monogranular food products has been studied using a numerical simulation method. By numerical solution of the system of equations of hydrodynamics and heat transfer for the flow of the forming liquid, the velocity and temperature distributions in the granulation column are obtained. The distance that a particle must pass in the granulation column to complete its gelling process has been found. The effect of thermal insulation of a column on heat loss from its surface is shown.

DEVELOPING OF ENERGY EFFECTIVE DRYING MODE OF FITOESTHROGENIC RAW MATERIAL

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Soybean protein products are the ideal source of amino acids important for the body, supplementing the proteins of cereals and are able to completely replace animal products. Soya - a natural source of plant phytoestrogens. One type of soy processing is drying. During the energy crises caused by energy-consuming technologies and equipment, there is a need for research and further development of energy-efficient drying regimes. In this article, there is a description of the recommended steps of the preliminary hygrothermal preparation of raw materials for drying, which allows inactivating the anti-food components in soy beans. As a result of the previous hygrothermal treatment almost complete inactivation of the trypsin inhibitor occurs, after the hydro-thermal treatment it remains only 4%. The expediency of creating a soybean - spinach mixture was substantiated and the energy - efficient drying of phytoestrogenic mixture was proposed. Experimental studies on drying of a soy-spinach composition at temperatures of the coolant-temperature of 60˚C and a step-by-step change in the temperature of the coolant 100 / 60˚C (at a temperature of 60 °C in the middle layer of the material, the temperature of the coolant was reduced from 100 °C to 60 °C) showed that the drying time of the material in the mode of the coolant-temperature 100 / 60˚C decreases by 25% compared with the duration of the process at 60˚C. The results of studies on the effect of heat carrier temperature on the change in the acid number of soybean - spinach mixture show that, when combined with carotene - containing raw materials, spinach, the nature of the change in the acid number is similar to the nature of whole soybeans. Studies were conducted of restore the resulting soy - spinach powder. It has been established that soy - spinach powder is recovered more than 2 times the standard (dry milk protein). As a result of the research, it was found that the creation of phytoestrogenic mixture of soya and spinach allowed to reduce energy consumption by 20-25% for the preparation of raw materials for drying. On the basis of the conducted research the heat-technology for drying phytoestrogenic plant material was proposed.

DEVELOPMENT OF ENERGY-EFFICIENT TECHNOLOGY FOR UTILIZATION OF WASTE OIL AND FAT INDUSTRY

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Modern technologies of production of oilseed fat products involve filtration using viable clays. Depending on the technology, 12-15 kg of bleaching clay are used per 1 ton of vegetable oil. Every year, about 80 tons of waste clay accumulates at the oil refinery with a capacity of 100 tons / day of oil. Depending on the technological process, the oil content in the bleaching clays after their mining can reach 65%. This sorbent is used once, so it is accumulated in large quantities at combines as a by-product. This material is classified as hazard class IV for its self-ignition ability. Therefore, the issue of solving the problem of its utilization is relevant. And biotechnological processing of these wastes into useful products is the most expedient and effective in terms of energy-efficient, ecological and economic requirements.

The article deals with the state of the Ukrainian market, the classification of waste of the oil and fat industry, the directions of low-waste and non-waste technologies. The biotechnological potential of microbial lipases is shown, perspective and expediency of application of biotechnological method of utilization of fat fraction of waste using enzyme preparations. The conditions of fermentolysis of the waste of hydrogenated fat and margarine production of Rhizopus japonicus lipase, in particular its thermal stability, are considered.

The obtained results of the study indicate the prospect of hydrolysis with Rhizopus lipase. It has been established that the content of free fatty acids in the hydrolyzate reaches the level of saturation after 72 hours of enzymatic hydrolysis, and the concentration of triglycerides is reduced to a minimum value. The thermal stability of lipase Rhizopus japonicus reaches a maximum at 40 ° C. The results of research should be used to improve the technology of processing waste oil and fat industry food and processing industries.

USING THE ELECTROMAGNETIC FIELD AT HYDRATING VEGETABLE OILS

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The possibility and prospects of using physical fields for the process of sunflower oil cleaning are considered. An analysis of existing studies on the use of liquid food processing by the electromagnetic field has been carried out. In the context of the influence of the process of separation between two or more inhomogeneous media in systems, liquid-liquid and liquid-solids. The mathematical model describing the process of the influence of this physical field on vegetable oils during their purification after obtaining is developed. With the help of the presented mathematical description one can characterize the effect of the intensity of the electromagnetic field on vegetable oils, which proceed in the experimental installation, depending on its geometric dimensions. On the basis of this, an experimental plant for hydration of vegetable oils was developed with the micaceal treatment of the electromagnetic field. Experimental studies of this process are presented. Which were conducted with the aim of intensifying and increasing the release of phosphorus-containing substances, fatty acids, waxes and other concomitant substances. With varying tensile strength of the electromagnetic field, the temperature of the micelles and the time of hydration of vegetable oils. The results of experimental studies confirmed positive expectations. The graphic material that describes the physical experiment is given. The result is the receipt of the recommended parameters of the use of the electromagnetic field at which the maximum effect on the removal of concomitant substances is achieved and, accordingly, the intensification of the hydration process takes place. Under these conditions, high quality oil is obtained. Due to the intensification of the process, a reduction in energy costs is obtained. Comparing the implementation of the classical technological process of hydration of oils with the proposed, removal of phosphorus-containing substances increased by 15%.

THE INTRADIFFUSION MASS TRANSFER INTENSIFICATION AND COMPLETE SATURATION OF THE THERMAL AGENT AS METHODS OF INCREASING THE ENERGY EFFICIENCY OF THE DRYING PROCESS

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In Ukraine the most common types of biomass are waste raw materials from crop fields. Sunflower biomass, especially sunflower stems as lignocellulosic by-products, are of interest because they are not currently exploited but they can be successfully used as a raw material for solid bio-fuel production. Taking into account the high initial humidity of sunflower biomass as a raw material for the production of solid biofuel, which is about 60%, and the energy intensity of the drying equipment, the cost of drying process is significant in technological line of fuel production.

The expediency of conducting the scientific research that aimed to intensify the intradiffusive mass transfer during the drying process of plant biomass with high initial humidity values as well as to increase the dynamics of the thermal agent saturation with moisture was justified in the article. Due to the complexity of the filtration drying mechanism, the necessity of the effective diffusion coefficient determination has been proved, which totally takes into account all kinds of moisture diffusion speeds and gives an opportunity to describe the process of mass transfer according to the Fick's laws. The temperature effect on the effective diffusion coefficient has been examined and graphs for effective diffusion coefficients determination have been obtained.

Equations which allow to calculate theoretically the effective diffusion coefficients for the grinded outer and inner sunflower stem tissues within the temperature range of 293–373 °K have been deduced. Experimental results of the thermal agent saturation with moisture at different temperature range during grinded sunflower stems drying which allows to recommend optimal process conditions in view of reducing energy costs also have been presented in the work.

RATIONALE OF PARAMETERS OF THE PROCESS OF DRYING SUNFLOWER GREEN IN THE VIBROUSUSCARBLE ON THE BASIS OF INFRARED RISK

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One of the promising areas for the development of the food industry is the expansion of the range and quality of food. In this case, special attention is paid to the safety and quality of raw materials. Sunflower seeds are a valuable raw material for a range of food and feed products.

The freshly harvested sunflower seeds are very resistant to storage, especially at high humidity, temperature and debris. Therefore, seeds should be dried immediately after harvesting and cleaning. Currently, widespread drying of food materials by infrared (IR) radiation. Despite the large amount of scientific literature on drying, including on IR-installations, practical issues of designing infrared dryers have not been worked out. Well-known studies are exclusively private.

The prospects of using infrared drying of freshly harvested sunflower seeds are due to the fact that this drying method is quite high intensity, economical and allows you to maintain the nutrient and seed quality of the seeds. In addition, there is no need to use air as a thermal agent, which significantly reduces the energy consumption of the drying process. Promising in this sense is a combination of infrared heat conduction and active contact of seeds with unheated air, which provides, for example, a vibro boiling layer. The use of infrared heat removal for the drying of sunflower seeds is also facilitated by the black husk color and the relatively small thickness of sunflower seeds, which, under certain regime parameters, can provide infrared rays penetration into the central layers of the nucleus.

The technological features of drying sunflower seeds by means of infrared energy supply are described, and the prospect of vibration monolayer drying of sunflower seed in a trap vibration dryer is substantiated. The specific energy costs are determined for the process of infra-red drying of the product.

INNOVATIVE SOLAR DRYER BASED ON SOLAR THERMAL AIR COLLECTORS

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Currently, alternative energy sources are very important for preservation of the environment. In the food industry one of the most common types of storage products is the drying. When using gas and electricity, this process becomes very expensive. We have designed specially driers that work exclusively on solar energy. They used for drying various foods - fruits, vegetables, herbs, berries, mushrooms, etc. For the drying process are used solar thermal air collectors (STAC) which made by us on the basis of our selective absorbent coating. The research of the thermal characteristics of the STAC was carried out on a specially constructed experimental stand. As a result of the tests it was confirmed that the fans of the system can support air supply in the range of 20-120 m^3/h. In the summer, at a temperature of 25-35^{0}C, the temperature of the flow of air at the outlet from the collector can reach 70-75 °C.

For all-time drying there are developed special innovative energy storage batteries at National Technical University of Ukraine "Kyiv Polytechnic Institute". Batteries can be charged from solar panels, have a shorter charging time, the possibility of charge-discharge at low and high temperatures, higher reliability, are safe and durable.

At present, for such types of solar dryers we are developing special devices for controlling and regulating the temperature and humidity of drying, which is very important when drying medicinal herbs, cereals, fruits, mushrooms, etc. Indeed, the deviation of a few degrees during the drying of such products can significantly change their consumer characteristics.

Our innovative and efficient solar dryers systems provide a very easy installation, with the ability to fit in the garden, on any area or indoors. In this case, a person does not bear any costs and additional charges for maintenance during their operation, as they fully work from the energy of the sun.

INNOVATIVE ENERGY INSTRUCTIONS FOR DRYING THERMALABLE RAW MATERIALS

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Causes of growth of volumes of drying of plant material are caused. The actuality of search and research of new methods of power transfer in processes of drying of plant material is determined. The main advantages of microwave drying are shown in comparison with conventional drying technologies. The main drawbacks and limitations of microwave drying are determined. The relation between the topic of the research and the directions of the scientific work of the department is shown. The working hypothesis on the interaction of the microwave field with moisture in the capillary - porous structures is chosen. The differences in the process of energy transfer during microwave and convection drying are determined. The basic design constraints for the design of microwave drying machines are determined. The scope and content of previous studies are described. A generalized analysis of the results of microwave drying for different types of plant material is given. The choice of equipment scheme for plants for drying of plant raw materials in the flow is grounded. The basic design decisions and constraints determining the design of a microwave drying plant for plant materials are determined. The design and principle of the experimental microwave drying device created for the research is described. The procedure for conducting experimental microwave drying of sunflower seeds is described. The basic dependences of the process of microwave drying of sunflower are determined. The dependence between the velocity of moisture reduction and the power of the electromagnetic energy supply is investigated. The dependence between the rate of moisture reduction and the power of the electromagnetic energy supply as well as the drying time is investigated. The main advantages of combined drying using the microwave and infrared radiation are determined. The design and principle of operation of the installation for the study of the process of moisture reduction during infrared drying are described. The basic dependencies of the process are determined. The analysis of the obtained results is given. Substantiation for the next stage of the research is given.

STUDY OF LIQUID DEGASSING IN CAVITATING FLOWS. PROBLEMS OF MODELING

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Hydrodynamic cavitation is used in degassing technologies as an effective method for removing dissolved gases and/or free gas in the form of bubbles from various liquids. Mathematical models of the degassing in cavitating flows are not yet developed and presented in the literature quite insufficiently. Therefore, development of a reliable model for simultaneous cavitation and liquid degassing is an important fundamental and applied task. Key issues that make it difficult to create a reliable mathematical model for the degassing of liquids are considered. In order to develop the mathematical model of liquid degassing, computational experiments on water deaeration were performed using the profiled Venturi nozzle as a hydrodynamic cavitator. The aim of the present investigation is to find a correlation between global hydrodynamic flow characteristics and cavitation induced undissolved gas fractions generated behind generic flow constrictions such as an orifice or Venturi tube. Evolution of the cavitation cluster and the level of the dynamic cavitation effects in liquid flow within a Venturi nozzle, depending on the design features and the mode of operation of this type cavitator, are considered. A system is described for rapidly remove dissolved gasses or volatile contaminants from a liquid, which is forced at a sufficient pressure and velocity through a Venturi nozzle, designed and operated in a fashion to produce vapor- gas micro-bubbles. The outlet of the cavitator is connected through a short pipe with a vacuum tank, in which a constant pressure is maintained close to the saturated vapor pressure of the processed liquid at a given temperature. It was shown, that in any cavitation degassing study the liquid must be monitored by measuring the number of nuclei present in the liquid. The influence of the initial size of gas nuclei and the concentration in the liquid on the intensity of the cavitation degassing process is considered.

The results of this study may be useful in selecting and justifying the rational design of the cavitation degasser and the optimal modes of its operation.

EXPERIMENTAL MODELING OF PROCESS OF WATER SOLUTIONS EVAPORATION IN THE VACUUM AND MICROWAVE FIELD CONDITIONS

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A comparative analysis of traditional methods for the food solutions concentration is given. The main problem of classical evaporators is identified, which is associated with the impossibility of obtaining high concentrations of the finished product due to a sharp increase in its viscosity and temperature through the formation of a boundary layer. A scientific and technical hypothesis has been formulated, representing a possible solution to this problem by providing a volume supply of energy directly to the moisture of the product. Thermophysical scheme of evaporation processes by traditional and innovative methods is considered. Their fundamental differences are highlighted and the relevance of the development of an innovative evaporation method is substantiated. The scheme of the innovative evaporator is presented, which allows to obtain the finished product in the solid phase with a final concentration of up to 90 °brix. By the example of apple juice, experiments were conducted to study the effect of pressure of the electromagnetic field on the steam output of the apparatus. Dependencies that indicate a constant evaporation rate throughout the entire process, up to a concentration of 80-85 °brix, were built. The product temperature did not exceed 35-40 °C, which may indicate its high nutritional value. The above data confirm the formulated hypothesis about the possibility of transition in the process of evaporation from the boundary conditions of the 3rd type to the boundary conditions of the 2nd type by the using microwave energy. On the basis of the obtained results, a model in the criterial form was obtained, which makes it possible to accurately calculate the performance of a microwave vacuum evaporator in certain ranges of the number of energetic action and the obtained dimensionless complex.

MATHEMATICAL MODELING OF DYNAMICS OF HEAT AND MASS TRANSFER IN THE PROCESS OF FRYING OILSEEDS

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A mathematical model and a numerical method for calculating the dynamics of heat and mass transfer and phase transformations in the process of wet-heat treatment of crushed, oilseed raw materials in multipanel roasters of cylindrical configuration with conductive heat transfer are developed. Wet and heat treatment of crushed oilseeds is an integral part of the process of manufacturing vegetable oil. It is accompanied by certain biochemical and structural changes in the material, aimed at increasing the yield and quality of oil. The main condition for the achievement of the necessary qualitative changes in the pulp is the observance of the given temperature-humidity regime during processing. The mathematical model was based on the differential equation of substance (energy, mass, impulse) transfer in deformable systems. The model includes the energy transfer equation and the mass transfer equation of the liquid, vapor and air phases in a dispersed colloidal capillary-porous system describing the heat and mass transfer in each vessel of the apparatus. It is closed by the formulas for the intensity of the phase transformation of the liquid and the vapor, the diffusion coefficients, taking into account the activation nature of these processes. The boundary conditions for the system "hot wall - moist layer - wet air" are formulated. A numerical calculation method is developed based on an explicit three-layer recalculated difference scheme M.I. Nikitenko, who possesses properties of explicit and implicit difference schemes.

The calculation of the dynamics and kinetics of roasting of the reciprocal pulp and the verification of the results are carried out. They indicate the adequacy of the mathematical model, the efficiency of the numerical method and the expediency of their use in developing and optimizing the roasting regimes in the corresponding conditions of different types of oilseed crops.

MODEL OF WARM MASS TRANSFER PROCESS FOR CONVECTIONAL DRYING MEAT PRODUCTS

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The article considers the model. the solution of the actual problem in the field of technics and technology of drying meat products, which is associated with the factors of studying and deepening the idea of the physical nature and the pattern of energy transfer and substance transfer under different drying methods for the creation of scientifically substantiated method of technical and economic assessment drying facilities for drying meat products .. The mathematical modeling of the process of drying the surface moisture from the products after the appropriate technological treatment is relevant, since it defines the terms of long storage tion. The problem of evaporation of the liquid from the surface of the capillary-porous body is considered in three aspects, and the general task of modeling the processes of heat and mass transfer with convective drying of meat products with additional inflammation of infrared energy is considered in two components. The first one when the mathematical model describes the period of a conditionally constant drying rate and is associated with the removal of free moisture from the product surface until it reaches the air-dry equilibrium state. The second one describes a period with a decreasing drying rate, when the moisture evaporation front enters the product. The differential transport equations for the coolant are recorded at the flow of the surface of the product by flow in the boundary layer when considering the gradients of velocity, temperature and moisture content. Considered the period of decreasing drying rate, when the front of evaporation penetrates into the material. Experimental studies were carried out and after their processing, some criterion equations were obtained for describing the process of drying meat products. Based on the analysis of moisture variations in the material, it was established that the process of drying at higher temperatures is characterized by lower values of moisture-city fluctuations than at lower temperatures.

MODELING OF THE INFLUENCE OF B-CYCLODEXTRIN AS A STRUCTURAL SUPPLEMENT ON THE DRYING KINETICS FOR MUSHROOM SHIITAKE SUSPENSION

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The influence of the structural additive on the kinetics of drying droplets of aqueous suspensions of the Shiitake mushrooms and the morphological, thermoplastic and adhesion characteristics of the dried particles were studied. Investigation of the process of drying drops of mushroom suspension (MS) with introduced β-cyclodextrin (CD) in the amount of 10% and 25% by dry substances was carried out on a stand in a stream of heated heat coolant (air).

The obtained dependences of the relative duration of the evaporation and drying periods showed that the temperature increase from 140°C to 160 °C in different ways affects the kinetics of drying of droplets of the MS depending on the amount of CD. At 140 °C the ratio of evaporation and drying periods for MS + 10% CD is 0,55/0,45, and at 160°C it is already 0,43/0,57.. For MS + 25% CD, this ratio is on average 0,46 / 0,55. With an increase of temperature from 160oC to 180 ... 200oC for MS + 10% CD this ratio remains almost unchanged (0,43 / 0,57), and for MS + 25% CD the relative duration of the evaporative period increases on the contrary, and the dryer decreases to the values of their ratio of 0,54 / 0,46.

An increase in the relative duration of the drying period occurs due to resistance to the processes of moisture transfer from the surface of the crust. In MS + 10% CD at a temperature of the coolant 160 ... 200oC it is explained by the insufficient content of the structuring additive for effective structuring and moisture transfer. In MS + 25% CD at a temperature of 140 ... 160 ° C this is due to insufficient supply of heat.

The rate of warming up of droplets in the stage of formation of the crust and drying significantly depends on the content of the CD. For MS + 10% CD, raising the temperature from 140 to 200 ° C leads to a gradual increase in the rate of warming up of droplets. For MS + 25% CD, temperature increase from 160oC to 180oC leads to an increase in the rate of heating of drops by 2 times. The warm-up rate of the MS + 25% CD is 25% higher than the heating rate of the MS + 10% CD. This indicates a lower moisture content of drops of the MS + 25% CD due to the better structuring of the surface crust and more efficient flow of the moisture transfer process.

Lowering the rate of warming up of droplets of the MS + CD in comparison with the MS without CD indicates a deterrent effect of CD, which, despite the slight lengthening of the drying time of drops of MS +

CD, helps to avoid overheating the product and to preserve all valuable components of the mushroom during drying.

On the basis of the obtained results it was determined that in order to improve the structurally and drainage properties of the material during dehydration, the

content of CD in the MS should be more than 10% but less than 25% and the temperature of the coolant - not less than 180 ° C, but up to 200 ° C.

It was established that the introduction of CD provides greater strength and density of dried particles and, thus, improves the structural and mechanical characteristics of the powder. Increasing the thermal stability of the material in conjunction with the achievement of the microcapsulation effect of microparticles of the thermoprotective component of the fungus during spray drying allows obtaining a high quality mushroom powder.

MODULAR PRINCIPLE OF PELLETS FROM VEGETABLE RAW MATERIALS PRODUCTION SETUP

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The work solves the problem of creating in Ukraine a modern-level project of an enterprise for tonnage production of biomass pellets. The main technical concept of such project is the block-modular principle of a complete set of a process line, a raw material receiving station and an energy complex. The project used advanced ideas of economical functioning of complex energy-intensive industries - alternative energy sources and deep utilization of heat-carrier heat, returning their energy to the technology. The main energy source of production is own-produced pellets. As thermal utilizers, devices on thermosphones are designed. It is these devices that have no alternatives in modern systems of utilization of the heat of gases for heating air currents. Decomposition of the production line, the structure of the modules grounded technologically, energy and economically. For this, the modern classification of the pellet market, its three most capacious segments, is considered.

The classification of quality characteristics of vegetable pellets, the requirements for their certification are considered. The analysis of modern technologies for the production of alternative fuels from biomass is given Revealed global trends in the development of pellet technologies. The trends of the pellet market in different segments, across Europe are studied. It is shown that at present the demand for pellets exceeds supply. The problems and scientific and technical contradictions of the pellet technologies are identified. On the one hand, there is a growing need for powerful plants for the production of alternative fuels from biomass. On the other hand, the sources of raw materials are unstable. And this is a serious barrier for the construction of large plants. The solution to this contradiction in the proposed innovative project is the transition to a block-modular principle. Within the module, technological tasks are solved that require equipment corresponding to the type of raw material. Modules for mechanical processing, drying, and granulation are proposed. Pre-crushing of raw materials is carried out by the original disintegrators of the authors design. The proposed project allows in the shortest possible time to install equipment, relocate it to another raw material area, increase the production tonnage, and transfer it to another type of raw material.