

CONTENTS, ABSTRACTS AND KEYWORDS OF PAPERS

QUALITY ASSURANCE OF THE PRODUCTION PROCESS BUCKWHEAT

A. Yu. Kozlyuk, A. G. Ovcharenko, A.V. Frolov, M. O. Kurepin

Buckwheat is the most important grain crop and is one of the economically available and full of foodstuffs, has high nutritional properties and good taste. In this work, studies have been conducted to develop recommendations for ensure the quality of the buckwheat production process on the example of the agricultural holding "Goodwill". In the process of research, simple quality control tools used in the food and processing industry were used. The use of simple means of quality control allowed to conduct a detailed analysis and identify the most vulnerable places in the technological process, to offer improvements to ensure the quality of the process of processing of buckwheat. The analysis of the Pareto diagram shows that factors such as the damaged core and split core for buckwheat are the most significant signs of poor quality products. To construct the Ishikawa diagram, the problem of "marriage" is considered and the mnemonic method "5 M" is used: "Materials", "Technology", "Measurements", "Equipment" and "Personnel". With the help of employees of the organization brainstorming and expert evaluation of proposals were carried out. The using of Pareto and Ishikawa diagrams made it possible to perform a detailed analysis of the causes of marriage and to identify the most vulnerable places in the technological process, to offer ways to ensure the quality of buckwheat processing. To assess the state of the production process of buckwheat control cards were built on the results of operational and quality control for damaged and split buckwheat kernels. Recommendations are formulated to ensure the quality of buckwheat production. The proposed method is simple and can be used in various grain processing plants.

Keywords: quality assurance, production process, buckwheat, Pareto diagram, Ishikawa diagram, control chart.

THE QUESTION OF SAFETY OF RAW MATERIALS AND PRODUCTS PROCESSING VENISON

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The article gives an assessment of the quality and safety of reindeer and a processed product - soy-souffled sausage "Prazdnichniy". Meat of reindeer is not only high-protein raw material, it contains water-soluble vitamins, it has structural and technological features. Raw materials passed veterinary and sanitary examination in the bodies of the state veterinary service and was accompanied by a corresponding form of the veterinary accompanying document (form No. 2). The microbiological safety of reindeer, grown in conditions of the Far North, showed the conformity of raw materials of animal origin to hygienic norms. According to the fatness, young deer are classified in the first category. According to the organoleptic indicators, venison entered fresh, without foreign odor. Brief technology for obtaining a raw product from venison is given: preparation of raw materials - defrosting, boning, vein; slicing venison into pieces, spiny ridge - on strips, freezing raw materials; preparation of stuffing; preparation of spices, garlic, preparation of the shell, filling the shell with minced meat, sediment; smoke treatment; drying of sudzhuk, cooling; quality control; packing, marking, transportation, storage. The conducted safety assessment of the processed product - syzhzhuk "Prazdnichniy" sausage sausage for microbiological and other studies has shown compliance with the existing regulatory requirements.

Keywords: venison, safety, quality, microbiological indicators, technology, raw sausage products, sudzhuk.

THE FACTORS FORMING CONSUMER PROPERTIES SPECIALIZED PRODUCTS

L. A. Mayurnikova, S. V. Novoselov, T. V. Krapiva

The development of industries is one of the reasons for the increase of harmful factors of the working environment in these conditions. It is generally accepted that effective way to prevent alimentary-related diseases, including the treatment and preventive food on the basis of specialized food products (Sppp), and it is enriched with micronutrients. It is important to identify and systematize the factors that ensure the consumer properties of new specialized products at the development stage in the framework of an innovative project. Systematization of the factors forming consumer properties of specialized products is carried out on groups: forming, preserving and stimulating within technical and technological and organizational and economic decisions of development of a new product. The features of the innovative project of a specialized product are shown. The classification of consumer properties of specialized products on the example of soft drinks, from which the functional properties as an object of preventive efficiency of Spp in relation to the body of workers in harmful working conditions. This description of the characteristics of factors that must be considered when shaping the functional properties of Sppp at the development stage.

Keywords: factors, specialised foods, micronutrients, consumer properties, functional properties, non-alcoholic drinks, harmful working conditions.

STRUCTURE OF THE ASSORTMENT AND QUALITY OF THE SALMON TROUT CREAM IN THE CONSUMER MARKET CITIES OF CHELYABINSK

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Salmon caviar belongs to delicacy products, has unique organoleptic properties and high nutritional value, is an attractive product for forgery, which means that the risk to purchase poor-quality goods is high enough. The aim of the research was to study the structure of the assortment and quality of salmon caviar, sold in the consumer market of the city of Chelyabinsk. The material was used: information obtained during marketing research; samples of caviar salmon of first grade "Kamchatka fish", "Putina", "Russian savory", a sample of imitated salmon caviar "Russian miracle". It is established that by the number of names in the market of the city of Chelyabinsk the imitated caviar prevailed, from the grainy caviar - salmon roe and salmon roe in a metal container, net weight from 90 to 140 g, calculated for a buyer with different levels of income, from Moscow suppliers. The marking of all samples of the test caviar did not meet the requirements of the regulatory documentation: State Standard 18173-2004 and Technical Regulations 022/2011, 040/2016. According to the organoleptic and physicochemical indicators, the requirements of the State Standard 18173-2004, which are applied to the first grade, corresponded to the salmon roe "Kamchatka fish". The microbiological and toxicological safety of the selected samples of salmon roe conformed to the norms of Technical Regulations 021/2011, 040/2016 and sanitary rules and norms 2.3.2.1078-01.

Keywords: salmon caviar, caviar, imitated, assortment, marking, quality, safety, manufacturers.

THE DYNAMICS OF FOOD CONCENTRATES INDUSTRY

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This article discusses the latest achievements of the food industry in the development of food products (baby food and grain bases, food concentrates first and second lunch dishes, breakfast cereals with use of wheat, buckwheat, rice, corn and soya flour, rye flour and Lupin, catering to soldiers, tourists, geologists, builders, Russian crews of the ISS). Currently, scientific units of the Institute staged the work for producing aromatic blends, spices and food supplements on the basis of domestic vegetable raw materials, improved formulation analogues coffee drinks, coffee, tea. Of particular importance at the present time, acquire production dietary breakfast cereal with low content of salt and sugar, with added protein, fiber dressers. Application of the method of microfiltration can lower loss of biologically active components in food concentrates, broaden the scope of the practical application of natural biologically active additives to food. New types of equipment are developed taking into account modern advances in technology, using the automated control systems of technological processes on the basis of microprocessor and computer technology, increased service life, reduction of metal and energy density, the downsizing of the workforce. Implementing the directions for creating a new technology and modernization of existing equipment, as well as the introduction of new technologies will meet the challenge of retooling and will facilitate the transfer of branch on the intensive way development on the establishment of a new line of food products including dietary orientation.

Keywords: food concentrates, infant food, extrusion products, sublimation drying products, diet, concentrates instant cooking, natural biologically active food supplements, protein treatments, dietary fiber.

TECHNICAL DEVELOPMENT OF ACCELERATED TENDERIZATION AND SALTING

Elshan Farayiz oglu Abdurakhmanov

In order to improve the efficiency of production of meat dishes, preserve the nutritional value of raw materials, the proposed technical development is a device for tenderizing meat semi-finished products (UTMP-1). Its principle of operation is based on the use of the shock wave method for uniformly ramming intermuscular connecting tissues and tendons of the structure of the meat semi-finished product while preserving the nutrients of the raw material. The duration of the discharge can be adjusted in steps of 50-100 μ s by changing the power capacity of the storage capacitor of the installation stepwise. Electro-hydraulic shock from a spark creates a high pulsating pressure, both in brine and in meat juice of portion pieces, which destroys the structure of the meat. The pressure in the area of the spark discharge and at some distance from it (2...3 cm) can reach several hundred kgf/cm², which significantly exceeds the strength of not only the pulp, but also any tendons and cartilage. In contrast to the well-known mechanical devices due to electro-hydraulic shock imposed on portioned meat semi-finished products, placed in a brine, provides not only the intensification of the preparation of semi-finished meat products, but also a 2-fold reduction in the salt and spice content in the applied brine due to their better dissolution to a molecular state; reduction of shear forces by 32 ... 35% and effort to break 22 ... 25%; increasing the mass and volume of servings, preserving the nutrients of the raw materials and increasing the nutritional value of meat dishes by 10 ... 12%.

Keywords: meat semi-finished product, tenderization, nutritional value, maturation acceleration.

IMPROVED SPRAYER FOR DRYING FOOD SUSPENSIONS

G.V. Alekseev, D.S. Mikheev, I.I. Uzun

One of the most important requirements for industrial production is the compliance with energy and resource saving, with a sparing impact on the environment. From this point of view, modern food production, all in large volumes, use both the raw material itself (for example, dried milk) and biologically active additives (for example, pectin and inulin) in the form of food powders. These powders themselves are obtained by drying food suspensions, the mechanism of which is that moisture is removed from the surface of the material being dried. Moreover, as the moisture is removed from the product, the rest of it, due to an increase in the adhesion forces, is kept stronger. As a result of the increase in resistance to the movement of water, the drying rate decreases, and the amount of evaporated moisture ceases to be proportional to the drying time. The solution to this problem is possible by increasing the drying temperature or large dispersion of the material being dried. Thus, the drying rate is decisively influenced by the size of the evaporation surface (heat transfer surface), that is, the size of the working surface of the fluid being dried by air, and to increase the evaporation surface it is necessary to find means of maximal spraying of the material.

Keywords: drying, food suspensions, increasing the drying temperature, dispersion, surface of the dried liquid, means of spraying the material.

RHEOLOGICAL PROPERTIES OF DOUGH FROM THE MIXTURE OF WHEAT FLOUR AND LUPIN FLOUR

L.V. Anisimova, E.S. Serebrenikova, V.E. Bondarenko, V.Yu. Basov

The rheological properties of dough were produced from flour mixture of wheat and lupin flour has been studied. In the studies used the seeds of white lupin variety Dega were grown in the Altai region. Lupin flour was obtained using seed scarification, causing mechanical damage to the shells. After that, the seeds were treated by hydrothermal treatment, including operations steaming, drying and cooling. The separation of seed shells were carried out using a laboratory centrifugal de-hulling machine. The hulled seeds were milled in a laboratory mill. The flour was collected by passing through sieve No. 045. To preparation of flour mixtures were used high grade wheat flour. The rheological properties of dough were studied on a Farinograph® AT Brabender (Germany).

It has been established that replaced of wheat flour by lupin flour lead to significant change in the rheological characteristics of dough, such as: Water absorption, Farinograph quality number, development time. In addition to, dough stability and degree of Softening were changed.

It is recommended to replace part of high grade wheat flour by no more than 10% of lupin flour in flour mixture. It should be noted that, the dough from this flour mixture had the best degree of softening (12 minutes after the maximum) and Farinograph quality number in comparison with the dough sample from high grade wheat flour. The dough stability and degree of softening (10 minutes after the start) were almost at the level of similar indicators for dough made from high grade wheat flour.

Keywords: wheat flour of the highest grade, lupin flour, scarification, hydrothermal treatment, rheological properties of dough, water absorption, farinogram.

TO THE QUESTION OF ASSESSING THE QUALITY OF THE DISTILLATES FROM STARCH-CONTAINING RAW MATERIALS

L.N. Krikunova, E.V. Dubinina

The aim of the work was to identify the features in the composition and ratio of the main volatile components that characteristics of distillates from different types of starch-containing raw materials and to determine the degree of influence of individual components and their ratios on the tasting evaluation of the product. 10 samples of malt distillates produced from barley and 18 samples of grain distillates were used as objects of research. The qualitative and quantitative composition of volatile components were determined by gas chromatography. Mathematical processing of experimental data was carried out using the methods of mathematical statistics using the program Excel. The results of the correlation analysis were estimated from the table data of the critical values of the Pearson coefficient. It had been established, that for the evaluation of distillates from different types of starch-containing raw materials should be used different characteristic indicator of the composition. It has shown, that the following parameters are recommended for high-quality malt distillates: the mass concentration of acetaldehyde and methanol is not more than 200 mg/dm³ a.a. and 70 mg/dm³ a.a., accordingly, the content ethyl acetate – 100-120 mg/dm³ a.a. concentration of enanth esters is not less, than 40 mg/dm³ a.a., ratio enanth esters and ethyl acetate of 0.4 – 0.5. For the evaluation of grain distillates it is recommended to determine the following indicators: isobutanol concentration (not more than 1200 mg / dm³ a.a.), enanth esters (not less than 50 mg / dm³ a.a.) and the ratio of propyl and butyl alcohols (not less than 0.5).

Keywords: malt and grain distillates, the composition of volatile components, scores of organoleptic testing, criteria of assessing the quality.

REGULATION OF ANTHOCYANINS COMPOSITION DURING THE PRODUCTION OF WINE FROM BLACK CURRANT

S.S. Makarov, S. Y. Makarov, A.L. Panasyuk

The aim of this work was to study changes in qualitative and quantitative composition of anthocyanins of black currant during of wine making with use of enzymatic maceration of the pulp and determining the most effective ways of increasing their concentration in the finished product. The pulp of black currant was treated according to four schemes, using the heat maceration; heat maceration in combination with the processing by different enzyme preparations; enzymatic maceration at the optimum temperature for enzyme activity; enzymatic maceration at low temperature. Was identified 11 anthocyanins of black currant juice, most of which is glycosides of delphinidin and cyanidin. The highest extraction of anthocyanins observed in the processing of pulp by enzyme preparation Fructozim Kolor at a temperature of 22-23 °C during four hours. Heating the pulp to a temperature of 45°C and above led to intensification of redox processes and formation of insoluble complexes of anthocyanins with the nitrogenous compounds, resulting in their total concentration was reduced. It is established that in the process of fermentation, the anthocyanin concentration decreased on 18.7 % - 58.1 %, depending on the race of yeast used. Recommended for fermentation of blackcurrant wort to use race of yeast Moscow 30, Blackcurrant 7 and UWY SP1. Marked that increase of the antioxidant properties of wort and wine materials from black currants with increasing total concentration of anthocyanins.

Keywords: qualitative and quantitative composition of blackcurrants anthocyanins, enzymatic maceration of pulp, fermentation, races of wine yeast, antioxidant activity of the blackcurrant wine.

INFLUENCE OF BACTERIAL MEDICINE ON AN EXIT OF MEAT RAW MATERIALS

E.I. Mashkina, E.S. Stepanenko

Delicacies from meat were always in demand on counters of shops. For production of meat products a lot of time for enzymatic processes is spent, at this time there is a formation of new flavoring and biologically necessary qualities of a smoked product. Under the influence of bacterial medicines comes improvements of quality of cooked smoked products from pork. At the use and uses of consciously chosen strains of bacteria are intensified the technological moments of preparation: ambassador, structurization, tsvetoobrazovaniye. The purpose of researches studying of efficiency use of bacterial medicine - the starting culture of Bactoform F-SC – 111 by production of a tselnokuskovy smoked and boiled product "Gammon pork fat-free". Size pH – is of great importance by production of smoked products. Bactoform F-SC – the 111th is the medicine used for production of the fermented sausages and tselnokuskovy meat products when fast decrease pH is required environment. Medicine consists of a combination of carefully selected strains of Lactobacilluscurvatus and Staphylococcuscarneus. The higher pH at a salting, the moisture connecting ability of meat and consistence of a ready-made product is higher will be more juicy. Results of researches show that use of Bactoform F-SC – 111 as starting culture increases acidity of meat raw materials at all stages of a salting. In samples of meat of pilot batch optimum size pH has been reached for the 4th days of a salting in a brine and it leads to reduction of process of preparation and accelerates technological processing by 1,5 times in comparison with often applied technology. Inclusion in posolochny mix of starting culture Bactoform F-SC – 111 promoted increase in mass of raw materials after a salting on 2,4 kg and an exit of finished goods has increased by 2,1%.

Keywords: meat raw materials, meat delicacies, the ambassador, starting culture, a smoked and boiled product, bacterial medicine, size pH, the water connecting ability, reaction of the environment, a product yield.

EVALUATION OF THE CONTENT OF SELENIUM IN WHEAT GRAIN, EXTRACTED ON SOILS OF KRASNODAR TERRITORY AND ROSTOV REGION

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Recently, interest in studying the content of this microelement in the environment and in biological objects is increasing not only in connection with the study of the effect of its excess or deficiency on the organisms of plants, animals and humans, but also in connection with the possible prevention and correction of pathological conditions involving this an item. The content of selenium in food products is small and varies depending on the origin of raw materials. The main reason for the insufficient content of selenium in food products is its low content in soils. One of the main sources of selenium in human nutrition are cereals, especially wheat and buckwheat. This work is part of a continuous monitoring of the determination of selenium in wheat grain grown on soils from different regions of Russia. The results of studies on the content of selenium in wheat grain grown on the soils of the Krasnodar Territory and the Rostov Region are presented. The fluctuations in the content of selenium in grain of wheat grown in these regions are close in importance, which is explained by the close conditions of cultivation of this crop: soil types, agrochemical and climatic features.

Keywords: microelement of selenium, grain of wheat, type and acidity of soil, atomic absorption spectroscopy with electrothermal atomization, modifier of solution matrix.

RESEARCH OF THE INFLUENCE OF PRE-PORE FORMATION ON THE KINETICS OF THE DRYING PROCESS WHILE PRODUCING SNACKS OF CARROTS

A.A. Yashonkov, M.E. Kurdoglo

One of the main factors affecting human health is a proper and balanced diet. Unfortunately, in recent years the diet of modern man does not comply with the principles of nutrition. An important role in proper nutrition is taken by the plant raw material rich in vitamins. At the same time, the Russian Federation has a huge territory with a diverse climate, but the cultivation of fruits and vegetables is concentrated in the southern and some Central regions of the European part of the country. Short shelf life of fresh vegetables and fruits requires agricultural producers to use various methods of preservation. One of these methods is drying to semi-finished or finished products. The article deals with the production of dried carrots snacks. By analogy with the fish raw material, the hypothesis is put forward that the use of preliminary porosity before vacuum drying will increase the surface area of moisture evaporation and intensify the drying process. In addition, the use of vacuum drying at a temperature of 55 ° C will improve the safety of thermolabile vitamins of raw materials. We experimentally proved method of obtaining snacks by chopping carrots on a particle size of 0.2...0.5 mm. Given a description of the laboratory setup. The results of experimental studies of changes in raw material moisture and drying rate are presented. The obtained data were compared with the data for vacuum drying without porosity, it was found that the drying rate due to pre-porosity increases by 10% during a constant drying rate, and the duration of the process decreases by 11%.

Keywords: processing of vegetable raw materials, snacks, carrots, vacuum drying, porosity, drying curve, drying kinetics, drying rate, experimental studies, thermolabile vitamins

SELF BALANCING OF VIBRATING DRIVES OF MACHINES FOR SEWING FLOUR AND SUGAR

I.P. Popov, S.YU. Kubareva

We consider the mechanisms of machines for sifting flour and sugar, the working bodies of which make linear vibrations with a high frequency for their mass, which leads to the development of significant unproductive mechanical reactive inertial power, which can exceed the productive (useful) dissipative power by an order of magnitude. Neutralization of the inertial power leads to a significant increase in the energy efficiency of the mechanism. Self-neutralization of inertial power is realized in mechanisms with a constant reduced moment of inertia due to the displacement of the phases of oscillations of working organs, the number of which can be any. For a mechanism with two operating elements, the phase displacement is $\pi/2$, and with three – $2\pi/3$. Practical use of the mechanism with a constant reduced moment of inertia with two massive working bodies is complicated due to the imbalance of the mechanism. The degree of balance (or imbalance) of the mechanism is directly related to the "degree" of the central symmetry of the figure (star) formed by the cranks. The aim of the work is to establish the conditions for self-balancing vibratory drives of machines for sifting flour and sugar with a constant reduced moment of inertia with four and three working bodies. It is shown that the "stars" formed by cranks of mechanisms with a constant reduced moment of inertia with a number of working organs of more than two possess a central symmetry. Such mechanisms are balanced. It is established that the minimum number of working organs performing linear oscillations in a balanced mechanism with a constant reduced moment of inertia is three.

Keywords: machine for sifting flour and sugar, oscillations, phase, inertial power, auto-balance, central symmetry, mechanism, momentum of inertia, crank, force, corps.

RESEARCH OF INFLUENCE OF THE BLOWER CHARACTERISTICS TO THE PNEUMATIC CONVEYING PROCESS OF BULK MATERIALS

V. P. Tarasov, K. A. Mukhopad

The pneumatic method of transportation is a promising type of transport for many bulk materials, it is widely used, including in the food industry, for example, for the transport of flour, granulated sugar, starch, grain and its elaboration products. Blower is the main source of the hydraulic energy on pneumatic units; its characteristics largely determine running conditions of pneumatic transport systems. According to the conducted numerical experiment, carried out on the previously offered and approved physic-mathematical model describing the work of pneumatic system, and computer calculation program, the influence of blower characteristic to the parameters of pneumatic conveying process is analyzed. At the same time it is considered that process parameters are changing not only along the length of transporting rout, but also in time. Pneumatic conveying system is presented as a system of interrelated equipment. When it operates, destabilizing factors occur – disturbances caused by uneven supply of the transported material from the receiving-feeding device to the material pipeline. The simulated disturbance is a short-term increase in the capacity of a pneumatic conveying system. The comparison of characteristics was carried out for two systems of pneumatic transport of flour. Blowers of these systems had various characteristics, but allowed for the equal operating conditions in steady modes. The results of the realized computer based simulation made it possible to determine an influence degree of the general hydraulic characteristic of the blower to the pneumatic conveying system operating conditions. It was confirmed that the process stability of pneumatic conveying will be provided under otherwise equal conditions in a greater degree, if the pneumatic conveying system is equipped with the blower of the hardening (steep) characteristic.

Keywords: food industry, pneumatic transport, blower, non-steady processes, hydraulic characteristic, disturbing actions, simulation, stability, productivity, overpressure, air speed.

INVESTIGATION CULTIVATION PROCESS OF PURE YEAST CULTURE AT SHELL-AND-TUBE JET INJECTION APPARATUS

D.D. Temershin, A.G. Novoselov, Y.N Gulyaeva, E.V. Shuvaev

The process of cultivation of pure beer yeast culture in a shell-and-tube jet-injection apparatus (STJIA) was studied. For the cultivation, yeast of the upper fermentation Beer Vingem BVG-D / 01 was chosen. As a nutrient medium, a beer wort with a solids content of 12% was used. The volume of beer wort and seed was 15 liters and 3 liters, respectively; the concentration of yeast in the seed was ~ 90 million / ml. The experiment was carried out in 4 modes, in which the flow rate of the supplied air and the temperature of the culture were regulated: 1) the flow rate 2 m³ / h at 30 ° C; 2) flow rate of 1 m³ / h at 30 ° C; 3) flow rate 2 m³ / h at 25 ° C; 2) the flow rate of 1 m³ / h at 25 ° C. The duration of each experiment was 8 hours. After each hour of the experiment, a sample was taken, and the concentration of yeast cells and the content of dry substances were determined. According to the data obtained, yeast growth curves, the dependence of the solids content on time, as well as the fraction of the fission rate and the time necessary for one fission cycle were constructed. 1 m³ / h. Due to the fact that you plan to carry out an air flow of 1 m³ / h. Investigating the effect of the cultivation temperature on the final amount of yeast showed that a decrease in temperature from 30 ° C to 25 ° C significantly reduces the yeast yield from ~ 240 million / ml to ~ 180 million / ml, respectively.

Keywords: shell-and-tube jet-injection apparatus, pure culture of yeast, wort, horse yeast, cultivation, growth curve, injection, constant-the speed of division, aeration, camera Goryaeva, time division.

DEVELOPMENT OF DIETARY EXTRUDED PRODUCTS CONTAINING FLAX

S.A. Urubkov, A.A. Korolev, I.S. Koptyaeva, L.Y. Korneva

This article presents some results of research on the development of food concentrates such as "Breakfast cereals", obtained on the basis of the extrusion process of multicomponent grain mixtures with the addition of flax. The dependences of the ratio of the components of the extruded mixture, as well as their structural and mechanical properties on the organoleptic and physical characteristics of the finished product and the technological parameters of the extrusion process are determined. The percentage ratio of the components of the extruded mixture is selected, in which, along with the quality characteristics of the final product, rational economic indicators of the process are provided. Technological modes of extrusion are determined depending on changes in the specific energy consumption of the process and the frequency of rotation of the extruder screws and the mass of the model mixture in the extruder channel. The dependence of the performance and energy consumption of the extrusion process on the parameters of the mixture components. Recipes and technological scheme of production are developed.

Keywords: flax, food concentrates, multicomponent grain mixtures, Breakfast cereals, extrusion.

DEVELOPMENT OF THE COMPOSITION AND TECHNOLOGY OF BIOLOGICALLY ACTIVE FOOD SUPPLEMENTS BASED ON MEDICINAL PLANTS

O.F. Fazullina, M.I. Lyndina

*The article presents the results of the development of the composition and technology of biologically active food additives based on dry extracts of pharmaceutical plants: Eleutherococcus prickly (*Eleutherococcus senticosus* (Rupr. ex Maxim) Maxim), liquorice (*Glycyrrhiza glabra* L.), milk Thistle (*Silybum marianum* (L.) Gaertn.), Chinese ginseng (*Panax ginseng* C. A. Mey.), Echinacea purpurea (*Echinacea purpurea* (L.) Moench.), Rhodiola rosea (*Rhodiola rosea* L.), Rhodiola safflower or Rhodiola safflower (*Stemmacantha carthamoides* (Willd.) Dittrich or *Leuzea carthamoides* (wild.) DC.) and purified Shilajit (mumie). The method of moisture-activated granulation with excipients was used to improve the unsatisfactory technological characteristics of dry extracts. Granules were obtained using 20% aqueous solution of ethyl alcohol as a granulating liquid. Lactose and Aerosil were used as auxiliary substances. The characteristics of the mixture of dry plant extracts and mumie, auxiliary substances used in the granulation process, the resulting granulate were evaluated according to the following parameters: humidity, flowability, angle of natural slope, free bulk density, bulk density after shaking, granulometric composition of the granulate. The following results were obtained for the granulate: humidity - $(3,2 \pm 1,0)$ %; flowability - $(8,4 \pm 0,2)$ g/s; content of dust fraction (particles passing through a sieve 100 microns) - $(3,4 \pm 0,02)$ %; angle of natural slope - $(35,0 \pm 2,0)^\circ$; free bulk density - $(0,53 \pm 0,03)$ g/cm³; bulk density after shaking - $(0,58 \pm 0,02)$ g/cm³. As a result of the work, the composition and technology of obtaining a granulate of a mixture of dry plant extracts and mumie with satisfactory technological characteristics suitable for encapsulation in solid gelatin capsules were obtained.*

Keywords: biologically active food supplements, pharmaceutical plants, dry extracts, mumie, granulation, excipients.

TO EXAMINE THE EFFECTS OF DIHYDROQUERCETIN ON THE MICRO-STRUCTURE OF MEAT CHOPPED SEMI-FINISHED PRODUCTS

N. N. Shagaev, V. A. Pchelkina And S. V. Kolobov

The paper concentrates on examine the effect of dihydroquercetin (DHA) on the homogeneity of the structure of meat chopped semi-finished products from moose. For the experiment samples of semi – finished products weighing 75 g of moose meat with a concentration of dihydroquercetin from 0.01% to 0.09% of the mass of raw materials after technological impact-freezing at a temperature of PE-18oC and heat treatment (roasting) were used. Control sample – cut prefabricated steel-cut meat of a moose without added DHA. The microstructure of the samples was studied by histological examination. The study of histological preparations was carried out on the light microscope "AxioImaiger A1" (Carl Zeiss, Germany) with the help of connected video camera "AxioCam MRc 5". Image processing was performed using a computer image analysis system "AxioVision 4.7.1.0", adapted for histological studies. As a result of histological studies of semi-finished product samples with DHA application in different amounts, it was found that the structure of the samples is homogeneous, similar to the control, the fine-grained protein mass tightly adheres to the muscle fibers, which stabilizes the minced mass. After heat treatment, the structure is slightly compacted due to technological impact. The introduction of DHA does not affect the histological characteristics of the meat components of minced meat. It is also confirmed that the addition of dihydroquercetin in the formulation of meat semi-finished products does not affect the organoleptic quality of the product

Keywords: meat, meat semi-finished products, meat of wild animals, moose meat, meat histology, meat microstructure, meat cutlets, dihydroquercetin, antioxidant, food additives.

COMBINED MICROCHANNAL REACTOR FOR PARTIAL OXIDATION OF METHANE

L.L. Makarshin, D.V. Andreev, A.G. Gribovskii

The process of partial oxidation of methane (POM) for producing synthesis gas in a combined catalytic microchannel reactor (MCR) consisting of two successive zones - zone 1 of a small volume and zone 2 of a larger volume, interconnected by heat transfer, is studied. It is established that for large input streams (above 1000000 h⁻¹) of the reaction mixture in zone 1, the exothermic reaction of total oxidation of methane predominates, and in zone 2, endothermic reactions of steam and carbon dioxide methane conversion take place. Such a combination of the zones in a microchannel reactor allows one to reduce the temperature rise at the front edge of the microchannel plates, usually occurring during the POM process. It is shown that the process of POM in a combined MCR, when the reaction mixture passes through zone 1 and zone 2, significantly increases the depth of the POM process and increases the synthesis gas yield at the output due to transferring heat from zone 1 to zone 2. Thus, at 750 °C and the gas hourly space velocity of 240000 h⁻¹, the concentration of hydrogen and carbon monoxide at the output is 30.1 and 23.7% by volume, respectively. Whereas, a POM process in only one zone 2 of MCR results in a concentration of hydrogen and carbon monoxide of only 23.2% and 20.1% by volume, respectively.

Keywords: partial oxidation of methane, total oxidation of methane, methane steam reforming, methane dry reforming, synthesis gas, hydrogen, carbon monoxide, microchannel catalytic reactor, microchannel catalytic plates, heat transfer.

EQUIPMENT OF FILM TYPE FOR PROCESS OF NITRATING IN LIQUID PHASE (survey of designs)

M.S. Vasilishin, A.A. Kuhlenko, A.G. Ovcharenko,
O.S. Ivanov, A.G. Karpov, D.B. Ivanova, S.E. Orlov

The demands shown to hardware-technological registration of nitrating process in liquid phase are analyzed. It is noted nonalternative uses for these purposes of the continuous act equipment. The demands providing completeness of chemical transformation in conditions of liquid phase nitrating are formulated.

The leading-out is drawn on perspectives of use of mass transfer equipments of film type. With application of criteria equations of mass transfer at a film current of a liquid possibility of substantial growth of mixing efficiency of phases for the account of heavy gradients of speed in a stream and an intensification of nitrating process is shown.

Survey of the apparatuses designs providing interacting of reacting phases in the flowing down film is spent. Rather low efficiency of a mass transfer owing to its considerable thickness, small relative speed of traffic of contacting medium and instability of hydrodynamic flows is noted.

It is observed small-size nitrator of the rotor type, deprived of a part of noted deficiencies. However, it does not provide the secured reception of homogeneous finely dispersed emulsions and possesses the downgraded operating characteristics.

The design of the centrifugal mass-transfer apparatus realizing a principle of a preliminary dispersion of one of phases is analyzed. The apparatus differs the raised technological efficiency and can carry out functions of transporting device in addition. On the basis of the analysis of equipment samples some trends are revealed at their designing. The estimation of possibility to use of separate designs in the capacity of the base equipment for nitrating process in liquid phase is executed.

Keywords: mass transfer equipment of film type, process of nitrating in liquid phase.

STUDY OF THE INFLUENCE OF THE PARTICLE SIZE OF AMMONIA BORANE ON THE HYDROGEN GENERATION RATE DURING ITS HYDROTHERMOLYSIS

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In this study high efficiency of hydrothermolysis of NH_3BH_3 is demonstrated. Hydrothermolysis of ammonia borane consist of two subsequent steps (hydrolysis and thermolysis) and characterizes by the high H_2 generation rate at external heating of 90 °C. XRD has shown that the smaller the coherent-scattering region's size, the higher the reactivity of the hydride. We also found out that varying the NH_3BH_3 particle size from 0.2 to 0.9 mm has not an influence on the rate of NH_3BH_3 hydrothermolysis, but it is inefficient to use the NH_3BH_3 particles >1 mm because of the absence of the coupling of hydrolysis and thermolysis in this case. The thermolysis of water-covered particles of NH_3BH_3 is the 10 times faster than the thermolysis of neat NH_3BH_3 , moreover, the induction period decreases and the H_2 yield increases. Probably, such acceleration may be caused by the formation of boric acid (NH_3BH_3 thermolysis initiator) on the first step of the process, by the increase of the NH_3BH_3 dispersion and by destabilizing action of polar water molecules. Addition of aqueous solution of CoCl_2 or NiCl_2 ($\text{H}_2\text{O}/\text{NH}_3\text{BH}_3 = 2$, $\text{NH}_3\text{BH}_3/\text{MCl}_2 = 500$ in moles) instead water to the less reactive large particles of NH_3BH_3 leads to the formation of the nanosized catalyst in the reaction zone, resulting in the increase of the rate of the first highly exothermic hydrolysis step, which initiates the next fast thermolysis step.

Keywords: ammonia borane, hydride, hydrogen storage, hydrogen production, hydrothermolysis, thermolysis, hydrolysis, coupling of processes, particle size, nickel chloride, cobalt chloride, catalysis.

THE DECREASE OF KINEMATIC VISCOSITY OF A LIQUID BY A HIGH-FREQUENCY FIELD

P.V. Lykov, V.I. Dudkin

The problem of increasing the productivity of pipeline transport by reducing hydrodynamic costs during the transportation and transfer of viscous liquids is of great technological interest. In the present research work, a directional change (decrease) in the kinematic viscosity of glycerin is demonstrated experimentally by the action of a low-power high-frequency electromagnetic field in the frequency range from 30 to 200 MHz. Duration of field exposure is 60 minutes. Maximum change in kinematic viscosity up to 23%. Relaxation of the viscosity occurs about 200 hours. The kinematic viscosity of samples of glycerin exposed to the HF field does not return to the original one. It has been experimentally established that the surface tension of glycerin does not depend on the frequency of the field effect. The results of IR spectroscopy of glycerol showed that the effect of high-frequency electromagnetic field can not lead to the rupture of chemical bonds, due to the low power of the high-frequency electromagnetic field. The results of the research make it possible to use a high-frequency electromagnetic field for investment in pumping and transportation of viscous liquids through pipelines.

Keywords: glycerin, kinematic viscosity, viscous fluids, reduction of kinematic viscosity, high-frequency electromagnetic field, liquid transport.

ADAPTATION OF THE CONDITIONS OF THE 1-BUTYL-3-METHYLIMIDAZOLIUM CHLORIDE SYNTHESIS OBTAINED BY MICROCHANNEL REACTOR FOR A FLOW TUBULAR REACTOR

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I.V. Tertishnikov, N.Yu. Adonin

The work is devoted to the actual problem associated with the development of effective approaches to the production of organic compounds in flow conditions. The aim of the work was to study the possibility of using flow-through microreactor devices to obtain the kinetic parameters of chemical reactions required in the development of chemical processes occurring in flow-through conditions. Using the kinetic parameters of the N-alkylation reaction of 1-methylimidazole obtained by us using a flow-through microreactor installation equipped with a submillimeter-sized microchannel reactor with a capacity of up to $0.15 \text{ mmol} \cdot \text{h}^{-1}$, and given geometric characteristics of the tubular reactor the heated part — 2.4 m) a theoretical evaluation of the necessary linear and volumetric flow rates of the reactants in the preparation of ionic liquid 1-butyl-3-methylimidazolium chloride, which is the starting material for the synthesis of a significant number of other ionic liquids was performed. In addition, an assessment of the hydraulic resistance of the flow tube reactor that occurs during the process and the amount of heat exchange surface required was made. Based on the obtained data, a flow tube reactor with a heated length of 2.4 m of a steel capillary with a diameter of 3 mm, equipped with a metering pump at the inlet and a pressure regulator with a pressure gauge at the outlet, through which we demonstrated the possibility of using the main technological parameters obtained using a submillimeter-sized microreactor flow unit with a capacity of 0.15 mmol h^{-1} , to develop a continuous process based on the use of tubular reactor performance millimeter size to 10 mmol h^{-1} was produced.

Keywords: flow microchannel reactor, a tubular flow reactor, the technological parameters of the process, the kinetic parameters of the reaction, scale chemical processes.

CONTROL OF CAVITATION SLIPPING ZONE BUBBLES IN THE VALVE STABILIZER

D.V. Loginov, S.A. Sukhov, A.V. Fominykh, I.R. Chinyaev

The use of gate valves to regulate the flow of fluid (not intended) leads to the destruction of the valve components. The device and operation of the gate valve of the locking and regulating valve with a stabilizer that allows you to control the location of the collapse zone of cavitation bubbles are described. The stabilizer is pressed against the end surface of the gate with a spring. Preload provides their joint movement until they stop the stabilizer arms into the body. The lower end radius surface of the gate and the counter surface of the stabilizer are provided with a number of grooves. The grooves divide the fluid flow into separate jets and directs them to the outlet, which reduces the erosion and cavitation wear of the valve components. Calculations in the ANSYS program showed that when the pressure drop across the wedge valve is 0.8 MPa in the zone behind the gate. For the proposed gate valve with a stabilizer, saturated vapor pressure can be achieved at the entrance to the grooves between the gate and the stabilizer and at the exit from them with a differential pressure of 0.45 MPa. It can be concluded that in these processes begins with what happens behind the wedge, and in the proposed valve in the outlet pipe in the area of the flanges, and this is especially important in the initial stage of opening. Accelerated tests of the proposed valve were carried out in production conditions with a pressure drop of 17 MPa. After eighteen months of operation, the tightness and control function of the MKTR valve are preserved. Under these operating conditions, the blocking wedge valve loses tightness after three months.

Keywords. Valve, gate, saddle, gate, stabilizer, fluid, cavitation, destruction, pressure, velocity plot, ANSYS calculations, production tests.

THE DEVELOPMENT OF A UNIVERSAL METHOD OF PRODUCING 6-(ARYLAMIDINE)-2,4-DIAMINO-SIMM-TRIAZINES

Y. V. Popov, T. K. Korchagina, V. S., Lobachenko, I. B. Beech, N. In. Nemtseva

This article describes a method for producing 2,4-diamino-SIMM-triazines containing a diphenyl oxide fragment and possessing potential biological activity. On the basis of the previously used methods, a universal method was developed and the optimal parameters of the process of obtaining the substituted 2,4-diamino-triazines were selected. The proposed method can significantly simplify the stage and increase the yield of the target product selection. For this method of obtaining the mechanism of formation of the target product was given. Having a potential biological activity-anti-inflammatory, anti-allergic, this determines the relevance and need for the use of this synthesis on an industrial scale. For substances-2,4-diamino-triazines, which can be obtained by this method, a principal technological scheme for obtaining one of the possible target products - 6-(3-Phenoxyphenyl)-2,4-diamino-SIMM-triazine was developed and described. This single-reactor method of production allows to achieve a high yield, reaching up to 90 %. The synthesis is carried out in the presence of a solvent – DMF for 10 h, and then the product is recrystallized and purified of impurities. The developed scheme of production is suitable for other derivatives of triazines, which can be obtained by this method, which proves its practical importance and industrial applicability.

Keywords: biological activity, heterocyclic compounds, diphenylol-led aminoether, nitrile, reactor system, a method of producing, technology, technological scheme, triazine

STUDY OF SYNTHESIS REACTION OF N-BENZYL-N'-HYDROXY-1,2-ETHANEDIIMINE

A. V. Roslyuk, S. G. Il'yasov, M. V. Chikina

Previous studies on the reaction between N,N'-di-tert-butyl-1,2-ethanediimine and hydroxylamine showed the formation of N-tert-butyl-N'-hydroxy-1,2-ethanediimine. It was therefore expedient to consider the preparation of other glyoxime derivatives. N-benzyl-N'-hydroxy-1,2-ethanediimine resulted from glyoxime and benzylamine; this diimine had previously been obtained from 3,3-dichloro-N-hydropropane-1-imine. The identification of the resultant compound was done by IR and NMR spectroscopies. UV spectroscopy showed the compound had two absorption peaks at 230.0 and 207.9 nm. In the course of the study, optimum reaction conditions were down-selected in order to enhance the yield of N-benzyl-N'-hydroxy-1,2-ethanediimine: molar ratio, reaction time and temperature. The reaction was found to take place in a glyoxime/benzylamine molar ratio of 1:3. To identify the optimum reaction time, experiments were performed to vary the time from 1 to 7 hours. The highest yield of the target product was achieved when the reaction time was 5 h, otherwise the product yield was decreasing as the time was increased. The reaction temperature range was between 15 and 55 °C. The optimum reaction temperature was found to be 45 °C.

Keywords: N-benzyl-N'-hydroxy-1,2-ethanediimine, transimination, N-tert-butyl-N'-hydroxy-1,2-ethanediimine, glyoxime, N,N'-di-tert-butyl-1,2-ethanediimine, hydroxylamine, benzylamine, 3,3-dichloro-N-hydropropane-1-imine, nucleophilic substitution.

THE EFFECT OF ELECTROMAGNETIC WATER TREATMENT ON THE VISCOSITY AND OPTICAL CHARACTERISTICS OF THE CARBOXYMETHYL CELLULOSE SODIUM SALT SOLUTIONS

I. E. Stas, A. V. Michalis

An increase in the kinematic viscosity of dilute Na-CMC solutions prepared on water exposed to a low-intensity electromagnetic field has been established. It is shown that the degree of change in the solution viscosity depends on its concentration, frequency of the electromagnetic field and the duration of the field effect on water. The maximum effect is observed as a result of exposure to a field with a frequency of 170 and 240 MHz and increases with increasing exposure time to 3 hours. A further increase in the time of irradiation of water does not lead to an increase in viscosity. Increased viscosities of polymer solutions persist for a month or more and are most pronounced for 0.5% solutions. An increase in the activation energy of a viscous flow of solutions prepared in irradiated water has been established. The study of the optical properties of polymer solutions showed that Na-CMC solutions prepared on water subjected to electromagnetic treatment are characterized by a higher turbidity and larger particle size compared to control samples. An increase in the viscosity of polymer solutions, the activation energy of a viscous flow, and turbidity indicate a change in the conformation of the macroions of the polymer due to a change in the intermolecular interaction in a solvent reorganized due to the electromagnetic field.

Keywords: electromagnetic field, frequency, kinematic viscosity, carboxy-methylcellulose sodium salt, viscous flow activation energy, turbidity, particle size, conformation of macromolecules.

ESTIMATION PROCEDURE FOR BURNING SURFACE AREA OF PROPULSION SYSTEMS

A.A. Trubnikov, V.O. Popov, N.A. Alekseeva

Numerical simulation of intraballistic performance of propulsion systems powered by a high-energy filler is one of the most crucial steps in designing and testing. In estimating the operation parameters of the items, the direct problem of internal ballistic is solved that consists in finding gas-dynamic characteristics (chamber pressure, thrust, flow velocity, exhaust product density, etc.) depending on the known variables such as burnt web and filler burning surface area. Here we report a procedure for estimating the burning surface area and as a function of the burnt web magnitude. This procedure relies on three-dimensional simulation and can considerably cut labor inputs and computation time thanks to the automated measurement of the surface area and other parameters.

Keywords: propulsion system, intraballistic performance, high-energy filler, burning surface area.

DEVELOPMENT OF THE MATHEMATICAL MODEL OF THE DESUBLIMATION PROCESS AND ITS TESTING FOR A MULTI-CHAMBER APPARATUS

I.Yu. Rusakov, V.L. Sofronov, V.N. Brendakov

This paper presents the research on the design of a nuclear-safe desublimator for condensing highly enriched uranium hexafluoride vapor from a gas-vapor mixture. The desublimation process of this product in the apparatus of the proposed design is studied using the mathematical model. The designed desublimator is a vertical annular apparatus with heated walls, the inner cave of which is divided into a series of successively connected chambers by transversal partitions. The developed physical and mathematical models for the desublimation process in the proposed desublimator consider the conjugate problem of hydrodynamics and heat exchange, whose solution allows to calculate streamline patterns of the gas-vapor mixture and temperature fields in each chamber of the desublimator under given boundary conditions. The result of the calculation is the desublimator excluding the loss of the target product in the form of aerosols, especially radiation-dangerous substances, which include uranium hexafluoride.

Keywords: uranium hexafluoride, surface desublimation, volume desublimation, desublimator, physical model, mathematical model.

TECHNOLOGY OF CHEMICAL-BIOLOGICAL CLEANING OF WASTE WATER METALLURGICAL ENTERPRISE

E.O. Kozlova, L.V. Shcherbakova

The article is devoted to the technology of chemical and biological wastewater treatment of a metallurgical plant from heavy metals. The principle of operation of the sewage treatment plant of a metallurgical enterprise is considered. A calculation is made of the cleaning efficiency on the basis of which conclusions are drawn about the existing cleaning system. A further technology is proposed for purifying water on a barrier with higher aquatic vegetation. Wastewater treatment technology using higher aquatic vegetation is usually carried out using amphibious plants. Studies have shown that the root system of these plants has a high accumulating ability with respect to heavy metals. The accumulation of heavy metals in root systems far exceeds their content in the aerial phytomass. This circumstance contributes to the disposal of contaminants in the bottom sediments, preventing their secondary entry into the water. The results of the treatment of wastewater in the swamp are given, taking into account the toxicity of heavy metal ions with respect to plants. As a result of research, a promising technology of wastewater treatment of metallurgical enterprises was proposed.

Keywords: purification technology, wastewater, pollution, heavy metals, additional treatment, water resources, metallurgical enterprise, biological barriers, higher aquatic vegetation.

EXPERIENCE OF PRODUCING BIOETHANOL FROM NITRIC ACID-PRETREATED OAT HULLS BY NON-ISOTHERMAL FED-BATCH METHOD

G.F. Mironova, E.A. Skiba

*The low concentration of ethanol in the mash leading to unprofitability of its distillation and rectification is a problem in the bioethanol production technology, almost whatever cellulosic feedstock is used. This is attributed to the common factor by which the cellulose bioconversion efficiency decreases as the concentration of dry matters in the reaction mass increases. One of the ways to overcome this challenge is to use feeding with a substrate and/or enzymes and/or yeast in the combined enzymatic hydrolysis and alcoholic fermentation. The product from the nitric-acid pretreatment of oat hulls is known to be promising, but the ethanol concentration does not exceed 3 vol.% so far. This study was aimed to examine the non-isothermal fed-batch process for bioethanol from nitric acid-pretreated oat hulls. The process was run in a fermentor with an initial reaction mass of 6 L in volume, at an initial solid loading of 60 g/L. The feeding was performed by introducing pretreated oat hulls 30 g/L each feed, and the relevant quantity of the enzyme cocktail (0.04 kg CelloLux-A/kg solid and 0.2 kg BrewZyme BGX/kg solid) in 4, 8 and 16 h from the onset of enzymatic hydrolysis until the substrate concentration of 150 g/L. The *Saccharomyces cerevisiae* Y-1693 yeast was inoculated after the reaction mass was cooled to 28 °C and when the substrate degree of conversion into reducing sugars coming up to 51%. The alcoholic content of bioethanol in the mash was consequently 5.1 vol.%, which is equivalent to the common technical-economic limit for bioethanol distillation and rectification.*

Keywords: bioethanol, oat hulls, nitric-acid pretreatment product, enzymatic hydrolysis, alcoholic fermentation, non-isothermal process, feeding

PHYSICOCHEMICAL AND RHEOLOGICAL FUNDAMENTALS OF DEVELOPING POLYMER COMPOSITE MATERIALS TO FABRICATE COMPOSITE CYLINDERS BASED THEREON

D.E. Zimin, A.N. Blaznov

Experimental studies were done to design a formulation of epoxy resin binders for the production of high-pressure cylinders by the wet winding technique. Rheological and physicochemical properties of composites based on ED-20, EHD and UP-610 epoxy resins were measured as a function of the curing agent content. It was found that in order to achieve the acceptable gelation time of about 6 min, the IMTHPA curing agent content (isomethyltetrahydrophthalic anhydride) should be within 130-140 parts by weight and the UP 606/2 accelerator content within 1-1.5 parts by weight. To examine the physicochemical behavior, the cured specimens were tested in tension and three-point transverse bending. For composites based on the nitrogen-containing UP-610 epoxy resin, the tensile breaking strength slowly increased with increasing IMTHPA content, and the bending strength was the highest when the IMTHPA content was 140 parts by weight. For EHD resin-based composites, the breaking strength increased with increasing UP 606/2 content, and in the three-point bending tests, after having reached the maximum at 0.4 parts by weight, the breaking strength decreased with a further increase in the accelerator content. The maximum tensile and bending strengths of the ED-20 resin-based composites were attained when the UP 606/2 accelerator content was about 1.5 parts by weight. Proceeding from the obtained rheological and physicochemical properties of the polymer composites, binder formulations are suggested herein for the fabrication of composite cylinders by the wet winding technique.

Keywords: epoxy resin binder, curing agent, accelerator, viscosity, gelation time, breaking strength, bending strength, composite cylinder.

POSSIBILITY OF STRESS-CORROSION DEFECTS DEPTH ESTIMATION BY EXTERNAL PARAMETERS IN WALLS OF MAIN GAS PIPELINE PIPES

A.V. Afanas'ev, A.A. Mel'nikov, D.V. Savin, D.V. Zhukov, M.I. Vas'kov

More than a third (36%) of accidents on the main gas pipelines of the Unified Gas Supply System (UGSS) belonging to PJSC Gazprom occur due to the development of stress corrosion (SCC) defects. At the same time, the number of newly detected SCC defects on UGS facilities is increasing annually, along with the improvement of diagnostic tools. According to experts, the current trend is aimed at increasing the number of detectable defects. SCC fractures of different depths are detected in more than a million tube sections, and this figure is likely to increase with next surveys. The development of systematic methods of counteracting stress corrosion negative manifestations, namely the identification, evaluation and targeted removal of critical defects that can subsequently lead to an accident in the near future, repair of insulation in other defective areas is an urgent task.

The main purpose of this work is to determine the parameters that allow estimating the depth of cracks. The paper considers the data obtained during inspection and repair of the main gas pipeline section. The studies were carried out by methods of nondestructive testing, metallographic methods and electron microscopy. The relationship between the geometric parameters of defects is described, which makes it possible to estimate the depth of cracks by external parameters. Cracks in the pipeline wall loaded with internal pressure were modeled by the finite element method.

Keywords: Stress corrosion; Nondestructive testing; electron microscopy; detectable geometric parameters of cracks; crack opening width; depth of defect; finite element method; modeling a semi-elliptical crack; change in the opening of stress-corrosion cracks.

THE EFFECT OF FILLERS ON THE PROPERTIES OF BIODEGRADABLE COMPOSITE MATERIALS BASED ON POLY(ETHYLENE SUCCINATE)

A. G. Potapov

The composites of biodegradable poly(ethylene succinate), containing 5-40 % of chalk or corn starch, or 5-33 % of technical carbon as the fillers, were prepared. The effect of the fillers on mechanical properties and decomposition rate of the composites in soil was studied. Poly(ethylene succinate) has elastic modulus of 650 MPa, elongation at break of 200 % and tensile strength of 18 MPa. In the presence of the fillers the elastic modulus increases in 2-3 times and the elongation at break increases in 1.5-2 times in comparison with poly(ethylene succinate). Technical carbon shows the largest effect on the elastic modulus. At high (33-40 %) content of the fillers the elongation at break decreases to 3-4 % for technical carbon and chalk, and to 70 % for starch. The starch shows smear effect on poly(ethylene succinate) and promotes deformative strengthening of the polymer. The poly(ethylene succinate) is slowly decomposed in soil in the absence of specific microorganisms and loses about 6 % of its own mass in an year. The decomposition rate of the composites in soil is essentially reduced in the presence of the technical carbon and manifold increased in the presence of starch. The chalk influences weakly the decomposition rate of the composites.

Keywords: poly(ethylene succinate), biodegradable, aliphatic polyesters, fillers, composites, technical carbon, starch, mechanical properties, elastic modulus, decomposition rate.

EFFECT OF MECHANICAL ACTIVATION ON THE STRUCTURAL-PHASE STATE OF THE TI-AL POWDER MIXTURE

A.Yu. Myasnikov, A.V. Sobachkin, A.A. Sitnikov, V.I. Yakovlev, M.V. Loginova

The work is devoted to the study of the influence of mechanical activation on structural-phase state of the powder mixture of Ti-Al system. Ti and Al powders were used as the object of study. During the study, mechanical activation of powder mixture was carried out with varying parameters of planetary ball mill AGO-2S (such as energy intensity and exposure time). The energy intensity of ball mill varied from 20 to 60 g. The time of mechanoactivation exposure ranged from 1 to 13 minutes. The mass ratio of initial powder mixture to mass of grinding media was 1:20. Structural-phase analysis of the samples was carried out on x-ray diffractometer general-purpose DRON-6. Diffractograms of all samples were recorded under identical conditions, which allowed more correct comparison of obtained values. In the course of the work it was found that mechanical activation process requires an excessively long exposure at the energy intensity of ball mill 20 g. With the energy intensity of ball mill 60 g, the product is rapidly poisoned. Thus, according to the results of research, the most optimal mode of mechanical activation of powder mixture of Ti-Al system was established, consisting in the energy intensity of ball mill 40 g and the time of mechanical activation of 7 minutes.

Keywords: powder mixture, mechanical activation, titanium aluminides, structural states, mixture preparation, energy intensity, time of mechanical activation, exposure condition, mechanocomposite, SHS.

DETERMINATION OF FRICTION ANGLES AND COEFFICIENTS FOR CARBON NANOMATERIALS

V. F. Pershin, T. H. K. Alsayyad, T. V. Pasko, A. A. Pasko

When developing the technological process of functionalizing carbon nanotubes, one should know their characteristics (in particular, angles and friction coefficients) that determine their motion and affect the geometric and operating parameters of the equipment. Methods for assessing the angles and coefficients of friction of bulk materials are considered herein, and their advantages and disadvantages are analyzed. The choice of methods and equipment for determining angles of repose, collapse, static and dynamic friction, as well as coefficients of external static and dynamic friction is justified. The specified characteristics for the: "Taunit", "Taunit-M", "Taunit-MD" carbon nanomaterials are defined. The relationship between individual characteristics is analyzed. It was established that the experimental values of the angles of static and dynamic friction have smaller standard deviations than the angles of repose and collapse: therefore, these angles are recommended to use when designing equipment for two-stage feeding of carbon nanomaterials.

Keywords: functionalization; bulk materials; carbon nanomaterials; external friction; internal friction; friction angle; static and dynamic friction

EVALUATION OF THE EFFECT OF ALLOYING ELEMENTS ON THE STRUCTURE AND MECHANICAL PROPERTIES OF GRAY IRON

D. A. Habets, A. M. Markov, A. V. Gabets, O. E. Chertovskikh

In modern conditions of industry development, an effective method of increasing the operational reliability of gray cast irons operating in complex modes of shock-friction wear is their complex alloying. The use of alloying technology allows to achieve a significant increase in mechanical properties due to changes in the structure and distribution of graphite in cast iron. The purpose of this study is to establish the dependence of the influence of alloying elements on the performance properties of gray cast iron operating under shock-friction wear. The article deals with the whole complex of mechanical tests of Nickel-and molybdenum-doped wear-resistant cast iron CHMN-34M in comparison with the base cast iron SCH35, designed for parts operating in conditions of shock-friction wear. Eaten research the limit of strongly-STI in tension and compression is presented the microstructure of cast iron CHMN-35 after the read-ing test on a break. Thus, the ultimate strength of the developed wear-resistant cast iron ranges from 395 MPa to 450 MPa, and the hardness ranges from 276 to 318 HB. It was found that the use of doping technology contributes to the formation of structures with a more uniform distribution of graphite inclusions, which contributes to the increase in the value of the tensile strength of the alloy and compression. The analysis of the results of fractographic dynamic destroyed samples, the mechanism of destruction of serial and alloyed cast iron is the same, the destruction of samples occurs on brittle ti-PU with a clear predominance of intergranular destruction, the surface of destruction in alloyed cast iron is homogeneous.

Keywords: iron Alloying, impact-friction wear, wear resistance, Nickel alloying, molybdenum alloying, wear-resistant cast iron, graphite, compression strength.