

## CONTENTS, ABSTRACTS AND KEYWORDS OF PAPERS

### ANALYSIS OF LOADING OF IZMELCHITELNY DEVICES FOR PREPARATION OF "SMOOTHIE"

G.V. Alekseev, L.V. Minayeva, A.G. Leu

*Strength calculations often are a basis of creation of new samples of processing equipment. Success of such calculations is often caused by the fact that as model for them choose a design previously undergone testing in trial conditions. Authors used such reception, having taken for the settlement model skilled installation for crushing of foodstuff. They described one of grinder design options for use at preparation of the new to the Russian market and widely used abroad carbonated drink on the basis of fruit or vegetable raw materials - "smoothie". The new principle of action supported by the security document FIPS allowed to create a sample of the domestic competitive food equipment. Methods of mechanics of a solid body led authors to receiving statically indefinable task which had to be added with some analytical conditions, made it not solvable analytical methods. Overcoming these difficulties forced them to make the settlement and graphic analysis by means of a package of application programs Mathcad. Estimated settlement data on design features of new development as are provided in statically certain conditions, at action of the concentrated moments, and in statically uncertain operating conditions of the equipment.*

*Keywords: the competitive equipment, strength calculations, statically uncertain model of a shaft, import substitution, fruit, vegetables, the distributed torque.*

### RHEOLOGICAL PROPERTIES OF DOUGH WERE PRODUCED FROM MIXTURE OF WHEAT FLOUR AND WHOLE OAT FLOUR

L. V. Anisimova, Soltan Osama Ismaeil Ahmed

*The rheological properties of dough were produced from mixture of the first grade wheat flour and whole oat flour was investigated. Oat flour was produced by using of hydrothermal treatment with intensive moistening of the grain in vacuum unit, by resting and drying. The hydrothermal treatment can significantly improve the efficiency of grain hulling. In comparison of the hydrothermal treatment for oats with the common method (steaming of grain and drying), the hydrothermal treatment were preserved the native properties of whole oat flour were obtained from oat grain. This study was performed on oat grain were grown in the Altai region. It has been established that the introduction of whole oat flour into mixture instead of the first grade wheat flour leads to significantly changes in the properties of the dough: Water absorption has increased, the dough development time and Farinograph Quality Number have increased, the dough Stability and the Dough softening degree have changed.*

*It is recommended to introduce into mixture no more than 10% whole oat flour instead of the first grade wheat flour. In this case, according to the Farinograph Quality Number, the dough Stability and the Dough softening degree, the recommended mixture is superior to wheat flour, which is taken as a control.*

*Keywords: whole oat flour, wheat flour, hydrothermal treatment, vacuum unit, rheological properties of the dough, water absorption of the dough, Farinograph.*

## **DEVELOPMENT OF TECHNOLOGY OF MANUFACTURE OF SPECIALIZED FOODSTUFFS FOR THE POPULATION OF THE ARCTIC**

V.G. Popov, S.A. Belina, O.S. Fedorova

*The mechanism for realizing the return of Russia to the Arctic is presented in the resolutions "The Strategy for the Development of the Arctic Zone of the Russian Federation and Ensuring National Security for the Period to 2020" (Government Decree of April 21, 2014), No. 296 "On the Land Regions of the Russian Federation". To improve the efficiency of development of the Arctic territories, measures are being developed to adapt the newcomers, to preserve and strengthen their health. The most important measure is to provide a full, affordable and specialized food. For indigenous people, deer meat is one of the staple foods. In 2017, the Yamalo-Nenets Autonomous District (YNAO) will allocate 782 million rubles for subsidizing reindeer husbandry. The main article of subsidies is "development in the region of deep processing of reindeer". The authors present the results of research on the development of technology for obtaining specialized food products based on by-products from venison enriched with an integrated natural system (KPS).*

*Keywords: Arctic, offal, venison, complex natural system (premix), marshmallow, leaves and berries.*

## **MODELING OF STRUCTURAL AND RHEOLOGICAL PROPERTIES OF EDIBLE VEGETABLE OILS**

S.M. Volkov, A.G. Novoselov, A.V. Fedorov, B.A. Kulishov, A.A. Fedorov

*The article refers to edible vegetable oils (EVO), a complex multi-component structure. The content of the same components in some vegetable oils of the same name can differ by hundreds of percent. The change in the concentration of identical components in vegetable oils, including those of the same name, is inevitably associated with a change in the numerical values of the physical properties of the EVO. One of these physical properties is dynamic viscosity. An analysis of the available rheological data for EVO has shown that the development of a methodology for systemic studies of the dynamic viscosity of vegetable oils on modern research equipment, as well as modeling the structural-rheological properties of vegetable oils, are still topical problems. The aim of the work was to determine the structural-rheological model of food vegetable oils. To achieve this goal, rheological studies of model EVO were carried out using rotational viscosimetry. As a result of the conducted rheological studies, a model of "pseudoplastic fluid" was justified for EVO.*

*Keywords: rheology, modeling, edible vegetable oils, pseudoplastic liquid, sunflower oil, high-oleic sunflower oil, olive oil.*

## **УСТОЙЧИВОСТЬ РАБОТЫ ПРЕДПРИЯТИЙ ПИЩЕВЫХ ПРОИЗВОДСТВ В УСЛОВИЯХ ФИНАНСОВО - ХОЗЯЙСТВЕННОЙ НЕСТАБИЛЬНОСТИ**

Г.В. Алексеев, С.А. Романчиков, А.Г. Леу, И.И. Холявин

*Большинство экономических парадигм постиндустриального общества, как на одной из основных аксиом, построено на стабильности и финансово-хозяйственном благополучии промышленного производства. Не вызывает сомнения при этом то, что предприятия пищевых производств находятся в первых строчках, анализируемых экономистами всех стран отчетов об экономическом развитии за год. Может быть, именно эти обстоятельства и являются основной причиной того, что инновационное развитие промышленности в этих странах, стоит не так остро, как в России. Острота этой проблемы усилилась в последние годы в связи с так называемыми «экономическими санкциями» и объективно назревшими вопросами освоения новых территорий для эффективного пополнения развивающихся промышленных производств сырьевыми ресурсами. В предлагаемой работе авторами сделаны попытки анализа ответственности государства и руководителей пищевых производств, значительная часть которых принадлежит в настоящее частному бизнесу, за сохранения стабильности финансово-хозяйственного положения предприятий и, тем самым, предотвращению возникновения условий для социальных волнений. В качестве основного показателя экономически ответственного за решение поставленной задачи авторы выбрали объем безубыточного производства. Формализуя задачу для расчетно-графического анализа ее решений в качестве наиболее значимых варьируемых параметров авторами выбраны: объем производства продукции  $X(n)$  в текущий период, собственные резервные финансовые средства  $S_{срс}(n)$ , привлекаемые кредиты  $S_{кр}(n)$ , выручка от продажи ранее изготовленных изделий, а также переменные затраты  $U(n)$ , приходящиеся на одно изделие, от продажи изделий, изготовленных в текущий период и реализованных в этот период. Проведенный расчетно-графический анализ одного из расположенных в районах Арктики хлебозаводов позволил сделать очень важные выводы: определенное снижение государством налога на добавленную стоимость позволяет рыночным механизмам установить такую цену товара, при котором финансово-хозяйственная стабильность предприятий пищевых производств будет обеспечена.*

*Ключевые слова: стабильность, финансово-хозяйственное благополучие, предприятия пищевых производств, инновационное развитие промышленности, «экономические санкции», освоения новых территорий.*

## **CONSUMER PROPERTIES OF BAKERY PRODUCTS WITH FLOUR FROM PUMPKIN SEEDS**

E. Ju. Egorova, S. S. Kuzmina

*Bakery products – one of the groups of foods that from the point of view of technology it is easy to enrich, this determines the urgency of developing new formulations and the need for research when implementing non-traditional for the industry of raw materials. The aim of this work was the study of consumer properties of bakery products enriched of flour from pumpkin seeds. The authors have studied basic regularities of change of consumer properties of the buns made with partial replacement of wheat flour for flour of pumpkin seeds. It is established that with increasing dose of flour from pumpkin seeds decreased the potential of water absorption, however, preserved the plasticity of dough and form dough pieces in the proofing process and baking. The buns goods retain good organoleptic characteristics, with slight increase in the acidity, reduced porosity and dimensional stability. The introduction of pumpkin flour promotes nutritional value of buns by increasing the proportion of protein, polyunsaturated fats, dietary fiber and minerals. According to the research, optimal for baking the buns the ratio of wheat flour and pumpkin flour is 85-90 % : 15-10 %.*

*Keywords: bread, bakery products, buns, flour of pumpkin seeds, flour mixture, modification of the formulation, quality, nutritional value.*

## **IMPROVEMENT TECHNOLOGIES FOR MANUFACTURE OF SPECIALIZED MEAT PRODUCTS A RABBIT**

V.G. Popov, O.S. Fedorova, S.A. Belina

*At the beginning of the XXI century. at the state level, the promotion of a healthy lifestyle, one of the elements of which is a correct and balanced diet, is quite actively initiated. The key point in this regard is the authors of the formation of food security, primarily at the regional level, taking into account the development of local food resources. Since the early 70-ies of the XX century. in view of the growing number of chronic diseases and the establishment of their causes caused by the imbalance in food rations, foodstuffs have been spoken of as an effective means of maintaining health and reducing the risk of many diseases. The need to stimulate the production of healthy foods by local producers meeting modern quality and safety requirements enriched with essential nutrients is indicated in a number of regional programs in the Tyumen region. The article presents the results of scientific research in the field of technology for the production of functional foods from rabbit meat, enriched with macro- and micronutrients.*

*Keywords: Tyumen Region, rabbit meat, healthy food, public health, specialized food products, chopped semi-finished products, phospholipid-mineral complex, selenium insufficiency.*

## **ANALYSIS OF THE ADIABATIC - ISOTHERMIC PROCESS OF EXPANSION OF THE WORKING BODY IN THE GAS-AIR ROUT OF HEAT-POWER PLANTS**

Balashov A.A., Mamchur K.V., Sinitsyn V.A.

*In this article we briefly analyze the thermodynamic processes of expansion of a real working body in an open system involving diagrams in  $P$ - $V$  and  $T$ - $S$  coordinates, which show that the interaction of gas-dynamic resistances with a flow, under adiabatic conditions, leads to a special (as a special case) isothermal flow regime at a constant frozen temperature  $T^* = \text{Const}$  and the appearance of a thermal resistance in the flow. Two characteristics of the interaction of gas-dynamic resistances with a real working body in an open system are presented. The first method is characterized by the mechanical interaction of gas-dynamic resistances with the working flow body in the isothermal process at  $T^* = \text{Const}$ . The second method is characterized by the thermal interaction of gas-dynamic resistances with the working body in the adiabatic process. It is shown that in the adiabatic process of expanding the working body in an open thermodynamic system the main effect on its parameters is mechanical, which leads to the appearance of an isothermal process of expanding the working body at a constant temperature of the inhibited flow  $T^* = \text{Const}$ . It is proved that the formulation of the adiabatic expansion process of a real working body in an open thermodynamic system without performing external work should be refined and expanded.*

*Keywords: adiabatic process, isothermal process, gas-dynamic, mechanical, gas-air, heat-power, thermal.*

## **EXPERIMENTAL STUDY OF NON-STATIONARY PROCESSES DURING THE PNEUMATIC CONVEYING OF BULK MATERIALS**

K. A. Mukhopad, V. P. Tarasov

*An experimental stand for the research of non-stationary processes of pneumatic conveying of bulk materials is described. The experimental results are discussed and compared with the parameters of positive pressure pneumatic conveying system, obtained by a computer calculation based on previously developed physico-mathematical model. The equipment of the stand allows to vary a wide range of parameters influencing the process of pneumatic conveying: length and configuration of route, productivity on the transported material, air consumption, volume and resistance of the air-bringing equipment. In addition, on the stand it is possible to imitate various perturbations on productivity and register them by means of measuring instruments. This is also an opportunity to change the characteristics of air blowers and receiving-feeding devices, and use for transportation the materials with various physico-mechanical properties. The conducted experimental investigations confirm the necessity to account for non-stationary processes on calculation and design of the pneumatic conveying systems for bulk materials, because changes in the basic parameters of such systems - positive pressure and the air flow rate - in non-stationary regimes can be substantially (in several folds) different from their computed values for a stationary regime. The computer modeling results of non-stationary pneumatic conveying processes are in agreement, with the experimental data to a degree sufficient for practical applications.*

*Keywords: pneumatic transport, air, bulk materials, non-stationary processes, experimental stand, performance, positive pressure, flow rate, perturbation, experiments, model.*



## **PECULIARITIES OF THE CALCULATION OF VOLUMETRIC EFFICIENCY AND RESIDUAL GAS COEFFICIENT AT THE ANALYSIS OF THE OPERATING CYCLE OF A SCAVENGED, SUPERCHARGED DIESEL ENGINE**

A.B. Stefanovsky

*Scavenging of heavy-duty diesel engine cylinders with compressed air can improve the operating cycle output, but is not usually taken into account at simplified analysis of the cycle. Published formulae for absolute and relative volumetric efficiency, which take account of parameters of cylinder scavenging and cleaning, are analyzed. A proposed quadratic correlation of the coefficient of cleaning with the relative residual gas coefficient allows to derive the latter analytically via the volumetric efficiency taking account of scavenging and to obtain a result which coincides well with that published for a diesel engine of 4H 26/26 type. Joint influence of the compression ratio and the scavenge coefficient on the residual gas coefficient is considered.*

*Keywords: diesel engine, supercharging, scavenging, volumetric efficiency, residual gas coefficient, scavenge coefficient, exponential function.*

## **MODELING OF THE TECHNOLOGICAL PROCESS OF GRINDING HORNS OF DEER NORTHERN WITH AUGER GRINDING MECHANISM**

V.N. Teplyashin, S.K. Manasyan  
V.N. Nevzorov M.S. Churinova

*The theoretical and experimental data of the process of crushing horns (antlers) of reindeers with auger screw shredding mechanism into the final product in the form of fine powder for further sale to the food, medical and cosmetic industry market and corresponding to the developed technical specifications for "Powder from the horns of deer northern". It has been established that a special technological scheme for the step-by-step shredding of horns is necessary for obtaining fine-dispersed powder from the horns of northern reindeers, for which a patented machine was developed for cutting and milling horns of deer of the northern Evenk breed using a screw grinding mechanism. This makes it possible to obtain a powder with the required conditions and the lowest energy consumption. As a result of theoretical studies of the modeling of the technological process of chopping horns, constructive parameters of the screw grinding mechanism were determined and experimental studies were carried out to optimize the technological parameters in the grinding of the ole-northern horns.*

*Keywords: Deer, horns, antlers, technology, processing, grinding, screw, model, screw shredder.*

## **COMBINED MONITORING OF WEATHER-CLIMATE AND HYDROLOGICAL REGIME OF THE R.MAYM BASIN (MOUNTAIN ALTAY): FIRST RESULTS**

Zuev V.V., Kurakov C.A., Uymanova V.A.

*The description of the autonomous distributed complex "Maima", established in the Gorny Altai for remote monitoring of the weather-climatic and hydrological regime of the catchment basin of the river, is given. "Maima", which is located at several points along the Maima River, starting from its sources and has been operating in the Maima River basin for more than a year. Information from the whole measuring complex is collected remotely and is received in real time on the server of the Institute of Monitoring of Climatic and Ecological Systems of the Siberian Branch of the Russian Academy of Sciences (IMCES SB RAS). Each observation point has its own set of sensors. They control the basic meteorological and some hydrological parameters. There is also information on soil property to assess its absorbency. Data is recorded every hour. The choice of the location of the points was based on the territorial difference in the types of soils, soil and vegetation, as well as their homogeneity. The analysis of the first results was made using "Maima" complex in the second half of 2016 and the first half of 2017. The analysis of the first results of the monitoring of the Maima River basin showed the effectiveness of an integrated approach in the study of the level regime. All the work done is needed to create a modern information-measuring system for forecasting the hydrological behavior of the Gorny Altai rivers.*

*Keywords: the Maima River, Gorny Altai, water level, remote autonomous complex, monitoring.*

## **INFORMATION SYSTEM OF OBTAINING AND PROCESSING PARAMETERS OF THE ATMOSPHERE BY MONITORING OBSERVATIONS DATA**

Yu.Ya. Matyuschenko, V.V. Pashnev

*Recently, there has been significantly increase in interest in climate change, in particular, to the processes occurring in the Earth's atmosphere. As a consequence, in modern climatology, the construction of regional and global aerosol models of the atmosphere with the use of ground observation monitoring data became topical. Most often, meteorological stations of atmospheric networks are built on the basis of solar photometers.*

*The paper describes the features of the measurement procedures for CIMEL photometers of the global AERONET network, the disadvantages of processing observational data conducted by NASA specialists. The features of the original brightness files were analyzed, possible sources of errors that affect the correctness and accuracy of data representation are analyzed. The necessity of additional processing of information is justified, criteria for selection of cloudless situations are given. A block diagram of the algorithm for processing the data of the main program of the information system and its functional capabilities is presented.*

*Keywords: ground-based atmosphere monitoring, AERONET network, solar photometer, measuring procedures, reliability of information, solar almukantaraf, measurement error.*

## **ANALYSIS OF PERFORMANCE OF MODERN ON-STOCK AND CLIENT-SERVER DATABASES**

E.A. Shelmina, I.G. Borovskoy

*The rapid development of computer technology has affected the development of database technology. So, every day the volume of stored and processed information is steadily growing. This leads to the need to create increasingly powerful and productive databases. At the same time, companies' budgets grow slowly from year to year. As a result, after a while, most companies are faced with the fact that the available funds are no longer sufficient even for scaling existing solutions, not to mention the introduction of new systems.*

*In this paper, an overview of modern desktop and client-server databases is provided, the advantages and disadvantages of the most popular desktop and client-server databases are determined, criteria and practical recommendations are formed when choosing a database for solving various problems. In addition, we tested the performance of the DBMS in question. The most popular desktop DBMS, such as Microsoft Access, Paradox, as well as client-server DBMS: Firebird, MySQL and Oracle, are selected for this analysis. As a result, practical recommendations are offered to developers, who find it difficult to choose a DBMS for the implementation of their task.*

*Keywords: database management system, DBMS performance, transactions, triggers, stored procedures, data protection, Firebird, MySQL, Oracle, MS SQL Server.*

## **RADIATORS FOR PRODUCE HIGH-INTENSITY ULTRASOUND FIELDS IN GAS-DISPERSED SYSTEMS**

V.N. Khmelev, A.V. Shalunov, V.A. Nesterov, R.N. Golykh

*The article presents results of research aimed at the creation of disk radiators for acoustic effect on gas environment. Developed a new constructions of sources of ULTRASONIC effect, based on the use of vibrating systems with piezoelectric transducers. Longitudinal vibrations of the piezoelectric transducer is converted into the bending vibration of disks. Radiators provide exposure to various processes in gas-dispersed systems. To realize the process of high-performance sputtering of liquids from an oscillating surface, a US-disk radiator with a flat front surface is designed, providing radiation intensities of at least 140 and 144 dB, respectively, at diameters of the emitter of 250 and 320 mm. To intensify the processes of coagulation and drying, the design of a disk radiator with a phase equalizing front surface has been developed. The disk provides the formation of a plane wave with an intensity of more than 146 dB with a radiator diameter of 360 mm. To realize coagulation in the local area, contactless drying, foam destruction, contactless spraying of liquid in the focus of the radiator, an emitter with a diameter of 420 mm is designed to operate at frequencies of more than 20 kHz with an intensity of up to 170 dB.*

*Keywords: ultrasound, disk radiator, gas dispersed medium, elastic deformation, oscillations, drying, spraying, coagulation, dispersed particles, defoaming.*



## THE PROCESS OF BERYLLIUM EXTRACTION FROM PHENACITE-BERTRANDITE CONCENTRATE BY AMMONIUM HYDROGENFLUORIDE

A. N. Dyachenko, R. I. Kraydenko, L. N. Malyutin, I. V. Petlin

*At the present time one of the criteria of modern developed chemical industry and metallurgy is production of rare metals and their products. For the advanced world economies the production of beryllium containing wares is the priority direction of following development. There are no factories which process beryllium containing raw materials on the territory of Russian Federation. In the same time Russia has the upper hand in terms of beryllium resources. The most advanced Russian beryllium deposit is Ermakovskoe (the average grade of BeO is 1,00 %). Generally Russian beryllium raw materials consist of fluorite-phenacite-bertrandite metosomatites. From such ores beryllium concentrate is produced by flotation. The processing of such concentrates by exploited industrial scheme is complicated by several factors. The purpose of the research was to identify the possibility of effective processing of fluorine containing beryllium raw material by ammonium hydrogenfluoride. In the article the calculations of thermodynamic and kinetic characteristics of the beryllium concentrate hydrofluorination process are given. The results of beryllium extraction experiments by laboratory setup are described. Through the research work the value of beryllium extraction degree in condition of 180 °C,  $\text{NH}_4\text{HF}_2$  surplus amount by 10 %, during 60 minutes is about 99 %.*

*Keywords: beryllium concentrate, ammonium hydrogenfluoride, ammonium tetrafluoroberyllate, phenacite, bertrandite, hydrofluorination, exothermic effect, diffusion of leaching agent, energy of activation, rotary drum-type furnace.*

## THE PHASE TRANSITION OF BARIUM CARBONATE, CALCIUM CARBONATE AND ALUMINUM HYDROXIDE PRODUCED BY THE METHOD OF CONTINUOUS PRECIPITATION

A.O. Bezmaternykh, Yu.B. Shvalev, A.V. Kilin

*In this paper, we studied the possibility of obtaining barium carbonate, calcium carbonate and aluminum hydroxide by continuous precipitation with the help of an experimental setup. The constant value of temperature 50 °C and pH value 7.5 was maintained during experiment. Three series of samples precipitated from solutions of barium nitrate, calcium nitrate and aluminum nitrate were obtained. The method of thermal analysis has been used to study the destruction of precursors and the following main stages of decomposition have been established. Calcium carbonate decomposes to calcium oxide in one stage in the temperature range 800-850 °C. When the barium carbonate was decomposed, three endothermic effects were observed at 800 °C, 950 °C and in the temperature range 1100-1200 °C. Two endothermic effects with maxima at 800 °C and 950 °C correspond to polymorphous transformations of barium carbonate. The third endothermic effect is associated with the decomposition of barium carbonate to barium oxide. Thermal decomposition of aluminum hydroxide corresponds to the character of decomposition of the pseudoboehmite of  $\text{Al}(\text{OH})_3$ , at 20-150 °C the loss of physically bound water occurs, at 450 °C dehydration occurs, and heating to 1100 °C leads to the formation of  $\alpha\text{-Al}_2\text{O}_3$ . The phase composition of the dried and calcined substances was established by X-ray phase analysis. It was found that the samples obtained by the continuous deposition method are barium carbonate, calcium carbonate and aluminum hydroxide, which do not contain extraneous impurities. Calcination of samples at temperatures of 1100 °C, 850 °C and 1400 °C, respectively, leads to the formation of oxides.*

*Keywords: dispenser cathode, active substance, electron emission, barium carbonate, calcium carbonate, aluminium hydroxide, method of continuous precipitation, the method of thermal analysis, X-ray phase analysis, dirt.*

## NITRATION OF TERT-BUTYLUREA NITRATE

V.A. Yermoshina, D.S. Il'yasov, S.G. Il'yasov

*The study on nitration of urea derivatives has previously been reported. The targeted synthesis of urea derivatives is attractive chiefly because urea is an available domestic product and urea-based high-energy compounds are already known. The search for a synthetic route to new explosives is quite relevant. This research is concerned with nitration reactions. The study results on the reaction of tert-butylurea and tert-butylurea nitrate with mixed acids containing different content of sulfuric acids are presented herein. The study revealed that tert-butylurea in a strongly acidic medium was instable and the nitration reaction was therefore carried out with tert-butylurea nitrate (TBUN) because preliminary trials showed that the TBUN dosing into the mixed acid proceeded in a smooth manner. Microkinetic data are given on the TBUN nitration, which showed that the yield of dinitro-tert-butylurea was increasing with increasing sulfuric acid content up to 50%. The synthetic methods for the urotropic salt of dinitro-tert-butylurea and for the urea salt of dinitro-tert-butylurea are also described herein; IR spectra and melting points are reported. It is worth noting that it is the first time that the salts are obtained, and the literature lacks details on the synthesis of these products.*

*Keywords: tert-butylurea, tert-butylurea nitrate, nitration reaction, nitro-tert-butylurea, dinitro-tert-butylurea, urea salt of dinitro-tert-butylurea, urotropic salt of dinitro-tert-butylurea.*

## OPTIMUM CONDITIONS FOR THE SYNTHESIS OF COLLOXYLIN N FROM MISCANTHUS

A.A. Korchagina, Yu.A. Gismatulina, A.A. Kukhlenko

*The paper investigates the effects of the mixed acid composition, mixed acid-to-pulp mass ratio, nitration temperature and time on basic properties of cellulose nitrates synthesized from a domestic, easily renewable unconventional feedstock, Miscanthus. From a series of experiments were constructed experimental statistical models that can predict basic properties of cellulose nitrates in terms of the mixed acid composition and nitration condition parameters. The mixed acid composition and mixed acid-to-pulp mass ratio were found to have the highest impact on the resultant nitrates. Varying the temperature in the range from 30 to 40 °C and the nitration time from 30 to 90 min did not affect the quality factors of the nitrocellulose. The following optimum conditions for the synthesis of Colloxylin N from Miscanthus pulp were determined by processing experimental data: 14 % (w/w) water content in mixed acid, 1:25 mixed acid-to-pulp mass ratio, 30-40 °C temperature, and 30-60 min nitration time. Under the optimum synthesis conditions, nitrocellulose samples were obtained having basic properties equivalent to standard Colloxylin N: 12.05-12.25 % N, 9.0-15.0 mPa·s, and solubility in alcohol ester as much as 98 %. The synthesized products were confirmed by IR spectroscopy to be cellulose nitrates and to be commensurate with standard Colloxylin N. The ampule-chromatographic method revealed high chemical stability of the resultant nitrates.*

*Keywords: Miscanthus, pulp, cellulose nitrates, optimization, mathematical model, IR spectroscopy, ampule chromatographic method.*

## INVESTIGATION OF THE METHOD OF OPENING A RARE-METAL MINERAL OF BORIC ACID

O. I. Mishukova, Y. A. Zaharova, I. V. Petlin, L. N. Malutin,  
R. I. Kraidenko, A. N. D'jachenko

*The problem of the most complete chemical opening of fluorite concentrate is considered in the article. Sulfuric acid opening of the mineral raw materials is not complex because all valuable components (calcium, beryllium, lithium, rubidium and cesium) concentrate in waste production. Further extraction of them is not possible. The purpose of the work is to develop an express analytical method for the determination of calcium and rare metals in the mineral ore. Series of experiments made on the results of which the possibility of the opening fluorite ores by melting with boric acid is established. The method of analysis is developed. It is based on opening sample in microwave digestion system «MARS 6», which were further analyzed using atomic emission spectroscopy. Also the most efficient temperature conditions were picked up. They are based on the analytical review and thermodynamic calculations. The thermodynamic principles of possible chemical reactions of fluorite with boric acid are studied. The most probable reaction was chosen and kinetics of it was studied. The dependence of the degree of reaction of fluorite with boric acid on the flow time at various temperature is received in the course of the kinetic experiment. The kinetics analysis was carried out through the Ginstling-Brounstein equation, the values of the apparent activation energy and the pre-exponential factor in the Arrhenius equation were calculated, on the basis of which a conclusion was made about the limiting stage of the process and the methods for increasing it.*

*Key words: Fluorite, opening of ore, boric acid, rare metals, rare metal mineral raw materials, thermodynamic parameters, kinetics, analysis, activation energy, limiting stage.*

## INVESTIGATION OF THE REACTION TRANSIMINATION IN SYNTHESIS OF N,N'-DIBENZYL-2,3-BUTANEDIIMINE

A.V. Rybaleva, S.G. Il'yasov

*The transimination reaction is a promising research area in the synthesis of heterocyclic and linear compounds. This reaction has recently opened new synthetic routes to isowurtzitane structures. The initial object was N,N'-ditert-butyl-1,2-ethanediimine prepared using glyoxal. In advancement of this area, our study reports a reaction of 2,3-butanedione with tert-butylamine followed by its transimination with benzylamine. The reaction was carried out at 25 °C in aqueous acetonitrile over a catalytic quantity of formic acid as the catalyst. The reaction eventually afforded N,N'-dibenzyl-2,3-butanediimine. It is worth noting that the resultant compound has been obtained for the first time via transimination. A series of other diacetyl derivatives were synthesized herein (on the basis of methylamine, ethylamine, propylamine, isopropylamine, isobutylamine, furfurylamine, hexadecylamine, octylamine, and allylamine); the preparation of some diimines was reported previously in the literature. Later on, those diimines were subjected to benzylation, but in our case, the transimination reaction was not observed. The structures of the reaction products were confirmed by NMR and IR spectroscopy as well as by basic physical analytical methods.*

*Keywords: 2,3- butanedione, tert-butylamine, N,N'-dibenzyl-2,3-butanediimine, N,N'-ditert-бүтил-2,3-butanediimine, glyoxal, benzylamine, diacetyl, diimine, amine, transimination.*

## **PREPARATION ZIRCONIUM DIOXIDE BY USING AMMONIUM FLUORIDE**

A.A. Smorokov, R.I. Kraydenko

*Zirconium dioxide, which has wide implications, is commercially successful compound. Raw material for industrial applications of zirconium dioxide are baddeleyite and zircon. Baddeleyite is a rare zirconium oxide mineral, but supplies run short, for this reason it's necessary to develop a new economic zirconium dioxide technology from abundant mineral – zircon, which is nature silicate of zirconium. Research results of zirconium concentrate processing by using ammonium fluoride were presented in this paper. Starting crude, which is zirconium silicate concentrate, react with ammonium fluoride of ammonium bifluoride in process of sintering. Sintered coordination compounds directed to silicon sublimation. Further processing of silicon gave a silicon oxide as a commodity product. At the same time ammonium fluoride was regenerated, which directed to sintering of zirconium silicate concentrate. All zirconium compounds separated from fluorides impurities (iron, aluminum and so on). Zirconium dioxide is the final product of this technology, also regenerated ammonium fluoride, as in silicon oxide scheme, directed to sintering of zircon.*

*Thematic justification confirmed by need of new zirconium concentrate processing technology suitable for regeneration fluorinating agent, reduced energy cost and reduction of production cost.*

*Keywords: zircon, ammonium fluoride, ammonium hydrogen fluoride, ammonium hexafluorosilicate, zirconium tetrafluoride, zirconium dioxide.*

## **COAL PREPARATION: CURRENT STATE OF THE ART**

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*Current state of the technology processing coal presented in this paper. Technologies, which use within Russia and without, showed. Wet methods gravitation – based and flotation- based studied. Dry methods, which are use with aerosuspensions for Countries and Regions where water famine, were considered. Adduced examples of new technologies at the factory. Coal preparation review showed that development of new reagent and modernization of equipment for improvement of coal quality are need. Method of examination involved all open sources: patent database USA, RU, EU and Scopus, RSCI, Web of Science. Also, from assessment use of coal in Russia it follows that coal is more exported. This statistics is evidence that underuse of feedstocks in the domestic primary energy market. Technologies were compared, which use in a variety of climatic zones and different clean coal concentration in feed stock. High-opportunity technology «SEPAIR®» have a maximum efficiency in comparison with analogue and high essential mineral recoverability factor.*

*Keywords: Preparation, coal, dry methods, wet methods, separation, gravitational methods, flotation, coal refinery.*

## **SAFETY ASSESSMENT OF FOOD PRODUCTS FROM POLYSILOXANE POLYMERS**

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*The products of polysiloxane polymers (silicones) in recent times became widely used as a baking dish for ready culinary products. The material forms for baking were investigated by chemical, spectroscopic (infrared spectroscopy with Fourier transform and spectroscopy inductively coupled plasma), thermal (TGA and DTA) and mechanical (TMA) analyses investigated a number of products on the market of the Altai territory. According to IR spectroscopy the samples represent polydimethylsiloxane. Discovered the presence of aerosil in the samples in the amount of 12-17 wt.%. For mechanical properties the samples were characterized by the maximum deformation from 2.9 to 10.8%. The modulus of elasticity of the samples was varied in the range from 0,011 to 0.83 kg/cm<sup>2</sup>. The loss of mass during annealing samples up to a temperature of 200 °C in a nitrogen atmosphere ranges from 0 to 1.23%. Re-heating the samples reduces the amount of impurities desorbed on 50%. It is necessary preliminary heat treatment of samples before application. The study of the acid extraction by the method of spectroscopy inductively plasma showed aluminum content is 15 times in excess of MPC. Also required pre-treatment with acetic acid to remove the aluminum compounds. Recommendations are made to reduce contamination of baked products.*

*Keywords: polysiloxane polymer, composition, bake ware, thermo stability, spectroscopy, TMA, DTA, TGA, chemical compatibility, mechanical properties.*

## **PLASMACHEMICAL SYNTHESIS OF NANOPOWDERS OF YTTRIUM AND ZIRCONIUM OXIDES FROM DISPERSED WATER-SALT-ORGANIC MIXTURES**

I. Novoselov, A. Karengin, I. Shamanin, E. Alyukov

*Article represents possibility to apply low temperature plasma for plasmachemical synthesis of yttrium and zirconium oxides from water-salt-organic mixtures "yttrium nitrate-water-acetone" and "zirconyl nitrate-water-acetone" which have high mutual solubility. It was made a calculation of composition of mixtures and determined modes ensuring plasmachemical synthesis of yttrium and zirconium oxides in air plasma. Calculations were made at atmospheric pressure in wide temperature range (300-4000 K) with the use of air plasma heat carrier. In the course of experiments on laboratory plasma stand it was carried out a synthesis of powders of yttrium and zirconium oxides from water-salt-organic mixtures in air-plasma flow. Analysis results of obtained powders (scanning electron microscopy, X-ray diffraction analysis, BET analysis) confirm nanostructure of yttrium and zirconium oxides.*

*Keywords: plasma, synthesis, nanopowder, yttrium oxide, zirconium oxide, plasmatron, analysis, thermodynamic modeling, plasma stand, solution.*



## **SOLID HYDROGEN-GENERATING COMPOSITION BASED ON SODIUM BOROHYDRIDE: STUDY OF HYDROGEN GENERATION IN WATER FROM DIFFERENT SOURCES**

O.V. Netskina, N.L. Kayl, O.V. Komova, V.I. Simagina

*The process of hydrogen generation from pellets of compositions based on sodium borohydride with catalyst upon their addition to different types of natural water: from Karachi Salt Lake (Novosibirsk Region); Gulf of Finland of the Baltic Sea, Ob reservoir as well as rainwater has been investigated. Added as the catalyst was the oxide of cobalt –  $\text{Co}_3\text{O}_4$ , which in the reaction medium partially reduces under the action of the hydride to produce a catalytically active phase – the low-temperature cobalt boride ( $\text{Co}_x\text{B}$ ). Because of the slow activation of the catalyst the reactor can be closed safely without noticeable loss of hydrogen. The obtained results indicated that the presence of impurities in the water led to a decrease in the rate of hydrogen generation with the only exception when the pellets of sodium borohydride contained no catalyst and were added to the sodium sulfate- chloride-sodium water of the Karachi salt lake in which case, however, no full conversion was achieved and the hydrogen yield did not exceed 50 %. When the gas generation from the strongly mineralized water of the Gulf of Finland had completed the reactor was observed to contain transparent crystals of metal borates. With the help of a chromatographic analysis it was shown that the evolving gas consisted only of hydrogen independent on the water sources.*

*Keywords: solid hydrogen-generating composition, sodium borohydride, high-purity hydrogen production, hydride hydrolysis, water sources, autoclave reactor, pressure sensor, chromatography.*

## **RATIONAL STRUCTURES OF THE PROTECTION BARRIER OF DEEP DITCHES FOR LOESSIAL SOIL OF THE REGION**

I.V. Noskov

*Constructive solutions of a barrier of ditches from bored piles with anchor fixing in one and two levels, and also barriers from the piles executed on bit and impulse technology with anchor fixing in one and two levels are provided. Results of calculations of barriers of ditches from bored piles with anchor fixing in one and two levels, and also barriers from the piles executed on bit and impulse technology with anchor fixing in one and two levels in the loessial soil bases of the region in which are defined vertical and horizontal relocation of a barrier of a ditch at all stages of mounting of construction, the maximum moments arising in constructions, necessary reinforcement of piles. Technical and economic comparing of options of constructions of barriers of a kotlovanova is given. It is confirmed that in an arsenal of a designer there is a wide choice of constructive solutions of a barrier of deep ditches today, each of which has the merits and demerits which need to be considered in case of design in specific geological and climatic conditions. Conclusions show that the existing classical methods of calculation do not consider many factors and the uprated inventory coefficients give much that leads to rise in price of construction and that the most progressive methods of calculation in case of design of deep ditches are the finite-element method and numerical methods of the decision of contact tasks.*

*Keywords: soil, ditch, barrier, anchor, calculation, simulation, bored piles, bit and impulse technology, tier, moment, relocation, isofields of relocation, reinforcement.*