



## CHEMICAL AND TECHNOLOGICAL SYSTEMS

DOI: 10.15587/2312-8372.2017.102151

## FORMATION OF THE PACKAGE OF MATERIALS OF ADAPTIVE MULTIFUNCTIONAL CLOTHING

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The object of research is the process of designing of adaptive multifunctional clothing. The problematic issue of the object is to ensure its effectiveness through properties. The basis for improvement of designing of adaptive multifunctional clothing is the application of energy-information effects of materials on the functional state of the human body. On the basis of this, it is justified to form a package of materials for development of adaptive men's underwear for treatment and prevention of chronic prostatitis. Selected paintings have a high inertness level for the functional state of the human body 0.87...1.0. Positive energy-information impact on the functional state of the body is achieved due to the influence of silver plates located in the product, according to certain biologically active zones of the human body. For a reasonable choice of the technology of joining materials and means of energy-information impact, the thickness of the overhead seams is studied. The rationale is that by increasing the design thickness of the package of materials by 32 %, the thickness of the seam increases by 28.8 %. The effectiveness of the developed adaptive multifunctional underwear is confirmed by experimental wearing and clinical approbation. It is determined that the functional state of the male patients improved after the use of developed clothing for one month. The conducted researches ensure the provision of adaptive multi-functional clothing with expanded functional capabilities that has a positive social and economic effect.

**Keywords:** adaptive multifunctional clothing, seam thickness, energy-information impact, package of materials.

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DOI: 10.15587/2312-8372.2017.104895

### INVESTIGATION OF THE RESPONSE SURFACES DESCRIBING THE MATHEMATICAL MODEL OF THE INFLUENCE OF TEMPERATURE AND BeO CONTENT IN THE COMPOSITE MATERIALS ON THE YIELD AND ULTIMATE STRENGTH

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The object of research is the dependence of mechanical properties (yield strength and ultimate strength) on the beryllium-based DSCM on the parameters of their operation (temperature regime) and BeO content in the composition of the material. Such dependence can be established on the basis of technological audit of the process, which has the ultimate aim of constructing an analytical description based on the results of production experimental data, for example, in the form of regression equations.

Ridge analysis is chosen for the research. This method allows analyzing the received response surfaces and determining not only the tendency of the dependences of the material properties on the operation parameters and the characteristics of the material itself, but also to more accurately estimate the optimum values. The latter is particularly advantageous from the point of view of optimizing the operation parameters of structures made from these materials, and also from the point of view of the process of their subsequent disposal.

Based on the ridge analysis, the values of the input variables (temperature and BeO content) are chosen, which allow obtaining optimal values of the ultimate strength and yield strength. This makes it possible to obtain sets of values of these factors that can be used in the manufacture, operation and disposal of beryllium-based DSCM.

Thus, it is found that the optimum values of the yield strength, corresponding to a range of values from 130 to 200 MPa, are achieved at  $t = 456^\circ\text{C}$  and BeO content of 1.35 %, as well as  $t = 528^\circ\text{C}$  and BeO content of 1.08 %.

The optimum values of the ultimate strength, corresponding to a range of values from 180 to 250 MPa are achieved at  $t = 384^\circ\text{C}$  and BeO content of 1.35 %, as well as  $t = 326^\circ\text{C}$  and BeO content of 1.845 %.

The obtained results allow to select the optimal performance characteristics of the beryllium-based DSCM, which will ensure its maximum efficiency and at the same time reduce the operating costs, which is economically advantageous.

**Keywords:** ridge analysis, suboptimal values, composite material, beryllium oxide, yield strength, ultimate strength, response surface.

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DOI: 10.15587/2312-8372.2017.105473

#### THE DETERMINATION OF ELECTROLYTE STABILITY AND CONDITIONS FOR ELECTROCHROMIC WO<sub>3</sub> FILMS DEPOSITION

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The present research is devoted to finding the condition and intricacies of WO<sub>3</sub> film electrodeposition from peroxotungstic

acid-based electrolyte that can be used for real production process. For deposition of electrochromic WO<sub>3</sub> films, the galvanostatic regime with following parameters is proposed: cathodic current density –0.2 mA/cm<sup>2</sup>, deposition time 30 min. The films prepared under such deposition parameters are transparent and had good adhesion to the substrate – the glass coated with fluorine-doped tin oxide. The averaged coloration degree for film deposited from fresh electrolyte is 10 %, while for film deposited from regenerated electrolyte – 5 %. During investigation, the potential window in which WO<sub>3</sub> film could be colored and bleached, without reduction of SnO<sub>2</sub> to metallic tin is established. It is also demonstrated that electrolytes containing peroxotungstic acid are unstable and degrade over time. It is proposed to use hydrogen peroxide for regeneration of electrolyte. It is demonstrated that electrolyte can be partially regenerated with hydrogen peroxide.

**Keywords:** tungsten trioxide, electrochromic film deposition, peroxotungstic acid, potential window.

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DOI: 10.15587/2312-8372.2017.105609

**DEVELOPMENT OF A MINERAL BINDING MATERIAL WITH ELEVATED CONTENT OF RED MUD**

page 22–28

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The object of present research is the technology of production of mineral binding materials of low-temperature ( $T_{\max} = 1100\text{ }^{\circ}\text{C}$ )

roasting of the romancement type with maximal possible use of waste from alumina production – red mud as a technogenic raw material. We employed as research methods a combination of computer calculations using the new software, modern physical-chemical methods of analysis and standardized testing of the properties of raw materials and binding materials.

Based on computer calculations, applying the developed software «RomanCem», we performed analysis of dependence of the concentration of red mud in 3-component blends on the number of hydraulic module of the binder  $NM = 1.1–1.7$ . We determined compositions of blends containing red mud of 27.0–27.5 % by weight (versus 3–5 % by weight in the technology of Portland cement) for the production of a hydraulic mineral binder at a maximum temperature of roasting 1100 °C (versus 1400–1450 °C for Portland cement) with improved indicators of strength at 18–22 MPa (versus 5–10 MPa for romancement). Effectiveness of our technique is defined by a comprehensive solution to the issues of ecology (due to reducing the volumes of waste accumulation), resource saving (through a replacement with waste of part of the raw materials of natural origin), and technology of binders (due to obtaining a product of the romancement type with improved indicators of properties). We demonstrated the features of phase composition and properties of the binders based on the systems of carbonate component with polymineral clay, quartz powder and red mud.

**Keywords:** red mud, technogenic raw material for the production of binding material, phase composition.

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## MEASURING METHODS IN CHEMICAL INDUSTRY

DOI: 10.15587/2312-8372.2017.105505

### PROGRAMMING OF THE SEARCH ALGORITHM FOR POINT BELONGING TO THE POLYGON AND THE MUTUAL NON-INTERSECTION OF THE FIGURES

page 29–32

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The object of research is shoe parts of various configurations. At the enterprises of the footwear industry, there is a problem of densely stacking shoe parts in the nesting pattern. To solve this problem, the hodograph of the vector function of the dense distribution of geometric figures is applied. Ray tracing method is used for the formation of rational nesting patterns. These methods are introduced into the developed software package for computer-aided design of nesting patterns. Three main algorithms for finding the point belonging to the polygon are analyzed. There are much more algorithms that solve this problem, but these algorithms have optimal complexity parameters:  $O(2*N)$  against  $O(N^2)$  in other algorithms.

Based on the analysis of the three main algorithms, an algorithm for exclusion of the part from the nesting pattern is created. This algorithm is modified and adjusted to the requirements of the task – leaving 4–6 parts of one configuration in the nesting pattern. A characteristic feature of the algorithm is that instead of constructing a single point for the ray, the pole of the part is used.

**Keywords:** ray tracing method, Graham method, nesting pattern, adding and exclusion of the parts from the pattern.

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## FOOD PRODUCTION TECHNOLOGY

DOI: 10.15587/2312-8372.2017.103240

### EXPERIMENTAL INVESTIGATIONS OF THE PARAMETERS OF THE JET MILK HOMOGENIZER WITH SEPARATE CREAM SUPPLY

page 33–38

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The jet milk homogenizer provides the cream supply in the right amount for normalization of the mixture, grinding of the fat globules and their uniform distribution in the volume of the milk plasma. In the process of technological audit, the following drawbacks are identified: lack of devices to maintain a constant temperature, low resolution of a digital camera and a microscope. In addition, it is necessary to investigate the nature of the influence of the flow and fat content of cream on the average size of fat globules.

In order to level out the identified drawbacks, it is planned to increase the time of the experiment in order to exclude the possible influence on the results at the initial and final stages of each experiment. In addition, at the next stage of the study, it is planned to determine the nature of the relationship between cream supply, fat content and average size of fat globules after homogenization.

The experimental studies of a jet milk homogenizer with a separate cream supply shows the values of the factors at which the grinding is carried out to the level of valve homogenizers. The average size of fat globules at a level of 0.85 microns is provided with a diameter of the cream supply channel equal to 0.6 mm and the distance of the central channel at the site of the maximal narrowing of 2 mm. It is determined that the nature of the relationship between the skim milk rate is the main factor of grinding and the average size of fat globules is directly proportional.

The nature of the relationship between decrease in the size of fat globules is determined as increase in skim milk rate, the nature of which can be explained by an increase in Weber's criterion. Its growth leads to an increase in the magnitude of the tangential stress, the extracted droplet in the ribbon-like body, which subsequently collapses into a large number of small elements. This confirms the hypothesis of destruction when creating the maximum phase rate difference realized in the design of a jet milk homogenizer with a separate cream supply.

**Keywords:** jet homogenizer, separate cream supply, cream supply channel, diameter of fat globules.

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DOI: 10.15587/2312-8372.2017.105501

#### MICROSTRUCTURAL STUDIES OF IMPROVED MEAT CHOPPED SEMI-FINISHED PRODUCTS

page 39–44

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In many countries of the world, including in Ukraine, there is insufficient provision of the population with protein foods. So, the deficit of protein in the diet of the population of Ukraine is at least 25 %. Dishes made from chopped meat cutlets for energy value is necessary for human nutrition. However, at present,

close attention is paid to the principles of healthy nutrition based on a balanced food composition, the presence in it of all the substances and elements necessary for maintaining the health and vitality of the body. Therefore, it is proposed to introduce into the meat cut semi-finished products the powder of the elecampane root and the white lupine flour. Essential oil of a complex composition (lactones, alantol and proazulen) contains in the rhizomes and roots of elecampane. In addition to essential oil, inulin is found (up to 44%), inulinen, pseudoinulin, acetic and benzoic acids. And also elecampane stimulates the reproduction of the population of the necessary bifidobacteria in the large intestine. Lupine flour is rich in proteins and dietary fiber.

Improved ground beef with replace 5%, 10%, 15% of the meat portion of lupine flour and the addition of 0.5% of elecampane root powder and a control sample of ground beef are considered. For microscopic examination, the material of the minced meat is labeled and fixed in a 10% neutral formalin solution. On the sledge microtome, sections 0.5–1 cm thick are made dyed with hematoxylin and eosin – periodic acid Schiff reaction.

Histological studies have shown for the periodic acid Schiff reaction the content of meat and vegetable parts in the developed semi-finished product. By hematoxylin and eosin, the percentage composition of the minced meat is determined. So, thanks to the development of functional meat chopped products, it is possible to achieve health-rational nutrition. The introduction of the elecampane root helps restore the strength and health of people, and lupine flour allows the product to be enriched with proteins.

**Keywords:** meat chopped semi-finished products, elecampane root powder, white lupine flour.

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DOI: 10.15587/2312-8372.2017.105630

#### SUBSTANTIATION OF THE CHOICE OF OPTIMAL CONCENTRATIONS OF ACTIVE INGREDIENTS OF THE ANTIOXIDANT COMPOSITION FOR FRUIT TREATMENT BEFORE STORAGE

page 44–49

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The object of this research is the technological process of refrigerated storage of fruit products. In order to reduce the level of losses during normal refrigeration, a technological audit is carried out to solve this problem by applying antioxidant compositions for post-harvest treatment of fruits. The aim of research is development of a new antioxidant composition and optimization of its composition. The use of this composition for post-harvest treatment of fruits contributes to the extension of their shelf life and the reduction of the level of daily loss. The treatment with antioxidant compositions (AOC) was performed in storage facilities by immersing them in pre-prepared working solutions. Exposure – 10 seconds. The fruit was dried by ventilation. Options for treatment: K – control, option 1 – DL – a mixture of dimethyl sulfoxide, ionol and lecithin. The following concentrations of

active substances were studied: distinol 0–0.048 %, lecithin 0–6 %. The effectiveness of exposure to various concentrations of active substances is determined by the average level of daily loss of fruit during storage, consisting of the sum of mass losses and losses caused by microbiological diseases and functional disorders, referred to the number of days of storage. The following concentrations of active substances in the developed antioxidant composition are established by optimization: apple and pear fruits storage – distinol concentration is 0.041...0.042 %, the lecithin concentration is 2.9 %. Plum fruits storage, respectively: distinol – 0.022 %, lecithin – 3.4 %.

**Keywords:** treatment of fruits with antioxidant composition, prolongation of shelf life, daily loss during storage.

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DOI: 10.15587/2312-8372.2017.105631

### DETERMINING QUALITY PARAMETERS OF ALCOHOL-FREE FUNCTIONAL BEVERAGE BY THE PROCEDURE THAT EMPLOYS AFFINE TRANSFORMATIONS

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The subject of present research is to determine AFB quality indicators according to a procedure that uses affine transformations, which could be applied at any ideal value. The application of this procedure provides FFP with the most accurate quality indicators according to the results of the sample.

We found numerical characteristics of the given set – mathematical expectation, variance, mean root square deviation, third order central moment, fourth order central moment, asymmetry factor, coefficient of excess.

We determined estimates of quality indicators:

- 1) mass fraction of dry substances – 92.36 %;
- 2) mass fraction of sediment – 82.65 %;
- 3) mass fraction of pulp – 91.07 %;
- 4) mass fraction of titrated acids – 82.93 %;
- 5) viscosity (dynamic) – 94.20 %;
- 6) pH – 82.97 %.

It was established that the coefficient of variation  $v$  of random magnitudes  $X_1, X_2, X_3, X_4$  and  $X_6$  is less than 0.1. This suggests a slight dispersion of these values. The results obtained allow us to solve a number of practical tasks and are used in the method of control over indicators of quality and safety of alcohol-free beverages with functional purpose.

Implementation of the procedure for quality evaluation using affine transformations provides FFP with the most accurate quality indicators according to the results of the sample. An analysis of this model and comparison with the previous quality assessment could be applied at any ideal value.



**Keywords:** functional food products, quality and safety control, mean root square deviation.

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