



MECHANICAL ENGINEERING AND MACHINE BUILDING

DETERMINATION OF FORCES ACTING ON THE BACK SURFACE OF TILLAGE WORKING BODIES

page 4–7

The paper discusses the results of the theoretical and operational studies to determine the forces acting on the back surface of the working bodies of the tines, plowshares, to improve their health and quality of processing. The aim of the study is to evaluate the load capacity of the working organs of tillers to select a way to improve their longevity. Analysis of the wear of the cutting elements of these working bodies revealed the main factors determining the value of underlying common loads acting on the blade of the working bodies and determine their efforts on the rear surface to develop a mechanism to reduce them. The data obtained revealed that the value of the total load on the actuator is dependent on the parameters of soil compaction and the geometric dimensions of the cutting elements and the values of the sharpening angle of the blade angle and to install it in the direction of movement.

The results can be used in mechanical engineering in the manufacture of these components with the optimal settings. These studies may be useful in determining the optimal values of the basic parameters of the working bodies of the blades as in manufacturing and in the repair to improve the quality of soil treatment and reducing the wear rate of the operation.

Keywords: operating time, the quality of treatment, occipital chamfer angle sharpening acting efforts.

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QUALIFICATION BASIS RESEARCH IN THE «PROCESSES, APPARATUS AND MACHINES OF THE INDUSTRY» FOR MECHANICAL ENGINEERS OF CHEMICAL ENGINEERING

page 7–12

The article deals with the problem of special training highly skilled Mechanical Engineers of Chemical Engineering. This problem is caused by the introduction of chemical production in the latest technology and the most modern equipment. In this connection, put forward higher requirements to the specialists of the industry. This article investigated the qualification framework in the quest for the «Process, apparatus and machines of the industry», established

especially for the training of the future mechanical engineers in «Mechanical Engineering». The result of this study to address this problem is substantiated and developed a generalized classification of learning activities on the «Process, apparatus and machines of the industry». Established generalized classification of jobs is very important for all selected groups of Mechanical Engineers of Chemical Engineering («technology», «mechanics», «designers»), as it allows not losing sight of those kinds of jobs on the «Processes, apparatus and machines of the industry», which can be useful and important to improve the efficiency of vocational training of these professionals.

Keywords: chemical engineering, process, apparatus, machines of the industry, classification, jobs, application, mechanical engineer.

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GRAVITY ATTRACTION DESIGN

page 12–17

Multi-functional entertainment complexes are popular in the leisure industry. Gravity attractions are used for children's, family and extreme entertainment. Improving reliability and safety of the attractions on the basis of gravity chutes is a complex technical problem facing the designers and staff.

Modes of movement and force acting on the slides' and attractions' users to determine safe speeds and optimal geometric dimensions during their designing were considered and analyzed. Mathematical models were proposed. There are differential equations of motion obtained by analyzing the forces acting on the sliding object. The models make it possible to perform calculations of both the individual chute elements, and its operating parameters in general. On this basis, it can be possible to determine the trajectory, velocity of the objects that different in size, shape and surface properties are guaranteed to be safe for both visitors and staff serving them.

The practical application of the obtained mathematical models will ensure the safety of staff and users with optimal positive emotional effect.

Keywords: attractions, chute calculation, gravity chutes, motion equation.

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IMPROVING OF VIBRATION RESISTANCE BY BORING ON TURNING LATHES

page 17–21

This paper discusses the possibility of improving the quality of the machined surface by boring on the turning lathes due to the use of the tool system, which allows to reduce the level of vibration in the machining process.

The methods of mathematical and three-dimensional simulation and strength analysis by finite element method are applied in the study.

The proposed technique allowed us to obtain the mathematical model of vibratory displacement of the top of the boring cutter as the

result of the action of variable forces and to develop a tool system design for reducing the vibration amplitude of the cutting tool by boring process.

The results of the research can be used in metal working when boring holes of sufficiently large diameter with large overhangs on turning lathes.

The proposed technical solution allows to reduce the level of vibration during boring process, that gives the opportunity to improve the quality of the machined surface and reduce the wear of the cutting tool.

Keywords: boring cutter, tool system, three-dimensional model, vibration resistance, amplitude.

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ENERGY, ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

RESEARCH OF RELIABILITY OF THE ELECTRIC POWER SUPPLY SYSTEM WITH THE ELECTRIC MOTOR LOAD UNDER EXTERNAL INFLUENCES

page 22–27

Research of improving the reliability of electric power supply system with electric motor load voltage of 0,4 kV by rationing of simultaneously contact breaking of switching devices and the use of electric protection devices integrated with elements of adaptability are conducted. A study of the conditions of maximum switching overvoltage considering simultaneously contact breaking of switching devices and rationing of specified time are conducted.

These studies are needed to determine the levels of asymmetry, nonsinusoidality of the voltage and switching surges in the electric power supply systems with electric motor voltage of 0,4 kV with

switching by vacuum contactors, which then affect the quality of electricity.

It is proposed a non-simultaneity standard of contact breaking of low-voltage switching devices, and method of non-simultaneity detection of contact breaking of low-voltage switching devices.

It is developed a mathematical model of «electric network – integrated device for electric motor protection – induction motor», which differs from the known by ability to complex research of electromechanical processes and modes of switching devices, devices for integrated motor protection.

Dependences of non-simultaneity impact of contact closure of low-voltage switching devices, which is guided by an asynchronous motor at switching surge, are determined. It is determined that the maximum overvoltage occurs under the following conditions: the third contact of the switching device is breaking with delay relative to the first, which are breaking simultaneously; breaking the third

contact occurs after the extinction of the currents flowing through the second and third contacts.

For this purpose, it is proposed the method of non-simultaneity detection of contact breaking of switching electric devices, which, in turn, will help determine the level of asymmetry, nonsinusoidality of the voltage and switching overvoltage in the system electric power supply system of 0,4 kV switching by vacuum contactors.

Keywords: electric power supply, reliability, load, voltage, electric motor, switching overvoltage.

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CORONA DISCHARGE INITIATION FOR TV CONTROL OF DEFECTS IN CRYSTALLINE SILICON

page 28–31

The article presents the results of experimental studies to control of defects of monocrystalline silicon wafers. Monocrystalline silicon is one of the major solar energy materials. Therefore, control of its defects is an important task that leads to saving of production resources and reduce the cost of photovoltaic solar cells put into operation. Defects in the wafer of monocrystalline silicon are observed under the excitation of negative pulsed corona discharge in the air gap over them. This method of corona discharge excitation in the planar electrode system with a dielectric insulating wafer allows adjusting the voltage and current of the discharge.

A feature of the proposed method is to produce a corona discharge at a relatively low voltage of 1–1,5 kV. Using a transparent electrode makes it possible to observe defects and measure their brightness and geometrical parameters of the corona via TV information and measuring system. In particular, the authors have observed the luminescence of the defects in the crystalline silicon wafer under the excitation of negative pulsed corona discharge in the air.

The results can be used to control the silicon wafers in the manufacture of photovoltaic solar cells.

Keywords: pulse corona discharge, gas discharge visualization, TV information and measuring system.

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ELECTRICAL ENGINEERING AND INDUSTRIAL ELECTRONICS

DETAILING OF THE TRANSFORMER EQUATION TO THE SINGLE WINDING TURNS (GROUPS OF THE WINDING TURNS)

page 32–37

Detailing of transformer equations to the level of single winding turns (groups of the winding turns) is done.

System of equations that allows to perform complex calculations of voltage drop on separate groups of the winding turns (as well as single winding turns) of transformer windings are presented.

The concept of «partial leakage inductance», «partial mutual leakage inductance», allowing detail the calculation of characteristics and parameters of transformers, are introduced.

Application of the developed method allows to determine the distribution of complex voltage drop in the windings of the transformer (up to single winding turns), which is fundamentally new.

The theory can also be used for the calculation of division coefficient (transformation ratio) of inductive associated circuits.

Testing results of the developed theory confirms the agreement of the results of the previously known data in the theory of transformers.

Keywords: transformer, inductance, leakage, partial inductance.

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OVERVIEW OF ALTERNATIVE REPLACEMENT OF INSULATING OIL IN HIGH VOLTAGE ELECTRICAL EQUIPMENT

page 42–49

We have made a review of a number of scientific publications related to questions of properties and usage of insulating liquids. We have paid special attention to results of research into solving the problem of replacing mineral insulating oil with other isolation liquids which are to be used in high voltage equipment. This article reveals main facts about liquids which have lower flammability, better dielectric characteristics, better natural recyclability (biodestruction), renewable raw resource etc. In addition to these positive characteristics of alternative liquids, we have discovered negative consequences of their usage, especially growth of mass-dimensional and cost features of equipment in case of usage of some of the liquids described in the article. None of the liquids which exist at the moment can meet all of the requirements to this specific case of usage. Characteristics are to be achieved by mixing the liquids of special quality and quantity, as well as using special additives improving some of the characteristics. We consider improving natural insulating liquids of and usage of nanotechnologies in production of those liquids to be the main areas for research and analysis of existing results of in the near future.

Keywords: insulating liquids, hydrocarbon, ethers, dielectrics of high voltage electrical equipment.

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DEVELOPMENT OF UNIT FOR RADIO FREQUENCY INTERFERENCE LIMITS TESTING OF HIGH-VOLTAGE INSULATORS

page 37–41

Requirements for structural scheme and features unit for radio frequency interference limits testing of high-voltage insulators are considered.

The basic scheme of developed unit and method for radio frequency interference limits testing of high-voltage insulators according to intergovernmental standards are described.

Minimum unit parameters $K + A = 22$ dB (mode 0,5 MHz) and $K + A = 21$ dB (mode 1 MHz), which measurement is performed not separately but as a sum immediately, providing high stability results, are achieved.

The data of measuring the level of external interference (noise of the unit) and the conditions of its use are given.

Materials of the article may be useful for the development of high voltage equipment, oriented to the requirements of international standards.

Keywords: radio frequency interference limits, insulator, air line, noise of the unit, selective microvoltmeter.

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TECHNOLOGIES OF FOOD, LIGHT AND CHEMICAL INDUSTRY

MATHEMATICAL MODEL FOR CALCULATING SEPARATORS AND COMPRESSOR OF SEPARATION UNIT FOR GAS MIXTURE DURING DISPOSAL OF WASTE

page 50–53

The problems of separation of flows of gas mixtures in the process implementation of environmentally safe waste disposal are considered. The main aim of the research is the mathematical description of the processes in the separator and the compressor – the functional elements of a complex energy-technological plant for the separation of multicomponent gas mixtures produced by the waste gasification. To determine the composition of the vapor and liquid products obtained at the outlet of the separator, it is used a set of subprograms for calculating the coefficient of thermal properties of the working bodies, which is based on the Peng-Robinson equation of state. The mathematical models of individual functional elements of a complex energy-technological plant of low-temperature separation of multicomponent gas mixtures obtained by recycling. The mathematical model of plant units, such as a separator and compressor, are presented in this part of the study. The study describes a model of the complex as a whole, and as the executive part of the system of environmental safety management of waste disposal.

Keywords: disposal, waste, environmental safety, mathematical modeling, multicomponent gas mixtures, low-temperature separation.

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SIMULATION OF NICKEL IONS EXTRACTION FROM COMBINED SOLUTIONS

page 53–57

This work is devoted to the problem of selective nickel ions extraction from dilute solutions by studying patterns ion exchange depending on the mass transfer, hydrodynamic and, in particular, concentration factors. To calculate the ion exchange process usually use cumbersome models that involve the use of parameters such as diffusion coefficients of ions in the solution and ionite, exchange capacity of the last, selectivity ratios, ionite particle size, ionite height, rate of solution. However, the actual problem is the creation of a formalized process model in a dynamic mode that minimizes the number of parameters, eliminating diffusion selectivity coefficients.

The most rational method of experimental study of dynamical laws are mathematical experiment planning. The advantage of this method is that it does not require information about the mechanism of the process and therefore available even non-specialists in the field of ion exchange.

Regression equation for accurately calculating the parameters of the ion exchange process, which is studied in the accepted range of variation factors, was obtained. Volume of solution that clears by the unit of ionite weight, duration of the filtration cycle and working volumetric ionite capacity are taken as the variables. The studied factors were concentration of the sorbed ion; concentration of other ions; pH; specific load. Regressive dependences for polymer and organic-inorganic ionite were obtained. The test model adequacy was made by comparing reproducibility and adequacy dispersion.

According to the model it was made an optimization to determine the parameters, which allow obtaining maximum value of breakthrough capacity of nickel ions. Finding the optimum values for both ionites it can be concluded that there are effective organic-inorganic ion exchangers, which allows more clear solution of metal ions about 100 ml.

Using these models we can get the value of breakthrough capacity for each ionite and choose the best of them without experiment. The models can be used to calculate the ion exchange and sorption processes aimed at extracting of some components from the combined solution.

Keywords: ion exchange, water treatment, nickel ions, calcium ions, magnesium ions, mathematical model, experiment planning.

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THEORETICAL MODELING OF THE HEAT TREATMENT PROCESS VEGETABLES DURING THEIR PEELING

page 57–65

The process of peeling onion and the corresponding equipment for this process are analyzed. It is established that a considerable part of the product is lost when the existing equipment is used. The method of peeling onion from its husk including thermal preprocessing of the onion by steam and the process of mechanical final treatment is proposed. The influence of the parameters of peeling on the percentage of raw material losses and quality of a product peeling is experimentally studied. The impact of the duration of thermal treatment of onion on the penetration depth of its surface layer is studied.

Theoretical model of boiling as a process is first received. It joins the depth of the product's boiled layer with the required duration of the process. Namely, duration of thermal treatment of potato and onion for the provision of the depth of boiled layer 2...3 mm is 50...100 s. The authors suggest mathematical model of the process of thermal treatment of vegetables during their peeling, which characterizes the dependence of the depth of the boiled layer of vegetables on the duration of the process of their thermal treatment and steam pressure. It is proved that under treatment with sharp steam the time of the achievement of maximum temperature on the product's surface does not influence general duration of boiling.

Keywords: thermal treatment, steam pressure, boiling, quality, losses, peeling.

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INVESTIGATION OF PROPERTIES OF PROTEIN-MINERAL PROPHYLACTIC SUPPLEMENTS

page 65–72

It was conducted an analysis of functional and technological properties of protein-mineral supplements, such as iodine-protein, protein-mineral and «SYVOSELEN PLUS» supplement used as a prophylactic measure for a balanced personal diet by essential nutrients. Investigations were conducted in liquids with different polarity (water, oil and water-alcohol solution) and on samples in the dry state. Differential diameter distribution curves of the samples

were obtained by dispersion analysis. Spin-spin relaxation times for different solutions of technological supplements were obtained using nuclear magnetic resonance spectrometer. Analysis and correlation of the results obtained by these methods were conducted. These physical properties of the powders are the basis of scientific justification for using protein-mineral supplements in the technology of prophylactic food.

Keywords: dispersion analysis, nuclear magnetic resonance spectroscopy, spin-spin relaxation.

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EFFECT OF HEAT TREATMENT WITH ANTIOXIDANTS ON THE CONTENT OF BIOACTIVE COMPOUNDS DURING STORAGE OF ZUCCHINI

page 72–76

The combination of heat treatment and exogenous antioxidants allows extending the storage time of zucchini. However, the effect of heat treatments with antioxidants on the complex of bioactive compounds is not considered. In this article, an influence of heat treatment with composition of antioxidants on the dynamics of ascorbic acid, phenolic compounds, chlorophylls and carotenoids during storage of zucchini is investigated.

It is established that heat treatment with composition of antioxidants inhibits the activity of ascorbate oxidase in zucchini in average of 25...27 %, allowing slow rate of decay of ascorbic acid at 25...33 % compared with control samples. After 24 days of storage amount of ascorbic acid in treated zucchini higher than in control zucchini after 12 days of storage. Amount of polyphenols grows during sto-

rage of zucchini. The applied treatment inhibited the growth rate of phenolic compounds on average 1,8 times for the Tarmino hybrid and 1,9 times for the Kavili hybrid compared with control zucchini. This inhibition is due to higher maintenance activity of polyphenol oxidase in treated zucchini. Heat treatment with antioxidants inhibits the degradation of chlorophyll and carotenoids. Treated zucchini contain for 15...17 % of chlorophylls and 19...22 % carotenoids more than control.

Thus, postharvest heat treatment with composition of antioxidant allows stabilizing the content of main bioactive compounds during storage of zucchini.

Keywords: zucchini, storage, antioxidants, heat treatment, ascorbic acid, phenolic compounds, pigments.

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THE JUSTIFICATION OF STORAGE PARAMETERS FOR SOFT CHEESES WITH PROBIOTIC PROPERTIES

page 76–81

Production of soft cheeses has a number of economic and technological advantages compared to production of hard and semi-hard cheeses. Soft cheeses with probiotic properties in Ukraine and CIS countries are not represented. Therefore, the development of domestic innovative technologies of probiotic soft cheeses and implementation of them into production is an urgent task today.

The use of symbiotic fermented compositions of bacterial concentrate of lacto- and bifidobacteria of direct application with high proteolytic, antagonistic, probiotic properties in technology of soft cheeses gives the stable high quality products with probiotic properties and extended storage time.

The results of experimental studies of physical and chemical changes, organoleptic, microbiological quality indexes of soft cheeses that obtained by fermentation of permeate enriched by fructose, fermented compositions of bacterial concentrate of lacto- and bifidobacteria of direct application with probiotic and proteolytic properties and maturation of the bunch pellet during storage. Storage parameters of probiotic soft cheeses are grounded: the temperature – 2–6 °C, duration – 60 days.

Keywords: soft cheese, storage, probiotic properties, bifidobacterium, lactobacillus, acidity, organoleptic properties.

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LIGHTFASTNESS RESEARCH OF STRUCTURALLY-COLORED ALKYD RESINS

page 82–84

Organic pigments have insufficient barrier properties, they perform a decorative function, unlike inorganic pigments. Organic pigments are often used in admixture with inorganic pigments, fillers, resulting in decreased light fastness. To increase the lightfastness can be structural coloration of polymeric materials. Practical interest is the study of the impact of structurally-colored alkyd resin coatings for lightfastness.

The lightfastness of the structurally-colored alkyd resins evaluated in the following manner. The paint obtaining from structurally-colored alkyd resins was applied on a glass plate, which after drying is placed under the radiation of the xenon lamp. Plates covered 1/3 opaque paper to ultraviolet rays. After the required time, opaque paper pushed away by another 1/2 of the total length of the plate. After it was determined color change, loss of gloss, cracking, nets and so on.

Films produced with the starting dyes in the same conditions were used as a control samples.

Experimental data have shown that lightfastness of the structurally-colored alkyd resins above the control samples, indicating the slow process of photodegradation of structurally-colored alkyd resins.

The lightfastness research data of paints confirm that colored alkyd resins have several advantages over dyes (pigments) and may be used in the preparation of paints.

Keywords: lightfastness, structurally-colored alkyd resin, pigment, coating, paints, chemical modification.

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