



MECHANICAL ENGINEERING

RESEARCH OF THE INFLUENCE OF MAIN FACTORS ON VIBRATING PROCESSING PRODUCTIVITY

page 4–8

It is obtained the partial and general empirical relations of metal removal by amplitude-frequency characteristics of the vibration treatment process and the weight of granules and samples by processing the experimental data using a least square method. These characteristics show that an increase in the magnitude of the oscillation frequency of the container, vibration amplitude A , mass of granules m and mass of samples M from the surfaces of metal removal in aluminum specimens growing. The described researches are relevant, because there are a large number of studies with conflicting results, as obtained by the authors based or not fully reflect the vibration treatment process or overwhelmed by a large number of hard-defined factors that cannot use them in engineering practice.

The analysis of the obtained dependence indicates that the greatest influence on metal removal from surface of the samples have the oscillation amplitude of the vibration of the machine container, and the smallest — the mass of the work piece. The comparisons of experimental and theoretical studies have shown their good convergence. The maximum error is 10,86 % that it is quite possible. Obtained in the course of experimental and theoretical research model is adequate and can be used in the modeling process of vibrational treatment of samples made of aluminum brand AL-9, and the resulting dependence can be recommended for use in engineering practice. The resulting calculated dependence can be used for any values of M , m , A , ω in the range adopted in research.

Keywords: metal removal, dependence, least square method.

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DETERMINATION OF WEAR PATTERN OF CUTTING ELEMENTS OF TILLAGE MACHINES

page 8–11

The problems of theoretical researches of wear surface of the working tools' cutting elements of tilling machines are shown in the article. The main aim of the research is to develop a process of hardening, providing increase their longevity and quality of soil treatment. The interaction process of working tools of tilling machines with soil abrasive environment during their movement is characterized by the interaction of abrasive soil on wedge with a flat working surface. This article describes how to influence the impact of soil on a wedge from material deformation nature, the wedge parameters, physical and mechanical properties and soil conditions. The theoretical dependence of these parameters allows to provide the wear of the cutting elements of tilling machines, which will contribute to reduction of the dynamics of their wear.

To ensure the longevity of cultivator tooth is necessary reducing the size of their wear is necessary to reduce the ability of abrasive wear out and will provide options of cultivator tooth, which will reduce the dynamics of wear. The research results will select and apply an effective technology of hardening of cutting elements of tilling machines during wear and recovery.

Keywords: cultivator tooth, deformation, technological process, abrasive wear, wear rate.

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ENERGETICS AND ENERGY SAVING

THE RESEARCH OF FLUORESCENT LAMPS' RESOURCE CHARACTERISTICS TO TEST FORCED MODE

page 12–16

The article presents the results of endurance tests of compact fluorescent lamps (CFLs) in the mode of the frequent ignitions. Using the results of examinations of compact fluorescent lamps (CFLs) in combustion mode with frequent ignitions the method of foreseeing their average durability is proposed. Experimentally was established that one ignition for CFL with previously heated cathodes is equivalent to approximately 0,53 h combustion, and for lamps without preheated cathodes – 0,65.

Using the methods different CFLs brands, presented on the market of Ukraine, were evaluated for duration of their average combustion length and compliance with EU Regulation 244/2009 concerning the number of temperate ignitions. It is shown that the majority of investigated lamps parties complies EU Regulation № 244/2009, but their foreseen durability is lower than that one which is declared by manufacturers.

This technique can be used, to a certain extent, for the prediction of the medium duration of burning, although it requires further improvement. First of all a big comparative statistics rating of the lamps durability of different constructions by traditional and accelerated methods is needed.

Keywords: compact fluorescent lamp, burning duration, resource tests.

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JUSTIFICATION OF THE DIALOG CONTROL METHOD BY ENERGY EFFICIENCY

page 16–21

This paper proposes a method for modeling the dialog control of activities to ensure the rational use of energy. Method of model forming based on the methodology of ISO 9001 and ISO 14001. It was found that the formation of the methodology of control systems on these standards based on ensuring compliance of actual values of the process implementation effectiveness with its project values in the form of balanced relationship. It is also shown that in the case of the formation of the energy management system in the form of an automated control system, it should be classified as an interactive control system, or as a decision support system controlled by model.

At the same time, it is proposed to use the activity factor model as a control model, which takes into account both process and resource factors for organizational and technological activities in this area.

The architecture of this system is allowed to form on the base of the functional system developed by Academician P. K. Anokhin.

Keywords: model, energy source, activity, energy management system.

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IMPROVING THE EFFICIENCY OF ENERGY RECOVERY IN THE ELECTRIC TRANSPORT SYSTEM WITH LIMITED TRACTION ELECTRICITY CONSUMPTION

page 21–26

In the article it is analyzed the voltage regulation on bus traction substations to extend the range of electric recovery in limited traction electricity that allow to reduce the number of failures of regenerative braking and power consumption for traction. On the basis of modeling of power distribution stationary regimes in the traction power supply with energy recovery, the dependence of the recovery zone from removing trains, their currents and voltages on the bus traction substations is determined. The regularities of formation of circulating currents in the traction power supply system with energy recovery are determined. The level of energy loss in traction network from traction substation voltage control that requires a comprehensive assessment of energy-saving recovery use is determined.

Keywords: electric transport, traction power consumption, electric braking, recovery, electric power, excess, voltage regulation.

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PERSPECTIVES OF ENERGY AND RESOURCE SAVING BASED ON INTEGRATION DEVELOPMENT MODEL OF TERRITORIAL AND INDUSTRIAL COMPLEXES

page 26–31

The technique of determining the reserves of energy and resources on the basis of the integration model of functioning of

territorial-industrial complexes is considered in the article. The main aim of the work is to develop the methods of integration of energy and material flows enterprises located in territorial and industrial zones, providing rational use of all kinds of resources, reduction of waste and anthropogenic impact on the environment. One way to achieve this aim is a methodology based on intersectoral integration energetic and technological industrial potential, which can be combined in the framework of territorial and industrial complexes. It is proposed a mathematical model for the analysis of reserves of energy and resources in the implementation of technological integration plants located within the territorial and industrial zones, as well as analysis of consumption of resources and waste generation of enterprises. The results can be applied to the fuel and energy complex, machine building enterprises, mining and metallurgical and chemical-technological profile. The proposed technique makes it possible to realize in practice low-waste energy efficiency production for the development of territorial and industrial complexes, provides a reduction in the unit cost of energy and raw materials in 2,2–3,5 times with simultaneous reduction in emissions by 2–3 times.

Keywords: energy and material secondary resources, innovations, industrial symbiosis, integration processes.

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RISK AND DAMAGES ASSESSMENT OF INDUSTRIAL OBJECTS BY STRUCTURAL AND LOGIC DECOMPOSITION OF ENTERPRISES

page 31–35

It is shown the sequence of application of systems engineering in the analysis of possible accidents in industrial plants, when a failure in one of the subsystems can serve as a «trigger» to the emergence and development of the accident in the other subsystem.

System analysis and modeling of basic processes in the technosphere are particularly relevant at the moment, when a high degree of deterioration of power and technological equipment lead to accidents with consequences that difficult to predict. The current crisis situation in matters of accident and injury due not only to poor safety culture and technological personnel indiscipline, but constructive imperfections and more deterioration of industrial equipment. Research of risk and safety are affected, primarily due to lack of a unified and coordinated methodology. Using different methods and criteria leads to sub-optimal decision-making, economic costs and imminent risk of major accidents.

As the basic scientific method with further study the risks and damages in industrial enterprises (IE) are used the systems engineering and energy and entropy concept that considers the incident as an unwanted release of energy or harmful substances that accumulate in technological objects. In this case, the IE as the «man – machine – environment» system is man-made damage as a result of an accidental release, transformation, distribution and devastating impact on the resources of IE (including and human).

Keywords: risk assessment, industrial damage, systems engineering, energy and entropy concept.

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PROCESSES AND EQUIPMENT OF FOOD AND CHEMICAL INDUSTRIES

VITAMIN D ENRICHMENT OF BAKERY PRODUCTS OF SPECIAL PURPOSE

page 36–39

Nowadays such diseases of bony tissue as osteoporosis are more often invaded. Osteoporosis is disease that occurs as a result of violations in the human body, proliferation and differentiation of osteoblasts, the synthesis of specific proteins, enzymes, bone mineral metabolism, which in turn regulates the activity of metabolites of vitamin D, which decrease bone resorption, promote the Ca mobilization in bone. Important problem is increasing the consumption of vitamin D, enriching food by them.

The comparative characteristics of vitamin D usage in Ukraine and in other countries are conducted in the article.

During research it is found that the bakery is the most appropriate product for the enrichment of vitamin D. Because of bakery products in Ukraine are the most used, it was considered the bread as an object for the enrichment of vitamin D. The use of this product will significantly increase the intake of vitamin D in the body and thus reducing the osteoporosis.

Keywords: vitamin D, bakery products, bread, functional foods, balanced diet, dairy products.

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Vitamin D and health in adults in Australia and New Zealand: a position statement. *The Medical Journal of Australia*, Vol. 196, № 11, 686–687. doi:10.5694/mja11.10301

DEFINITION OF RATIONAL MODES OF OPERATION OF BAKING OVENS

page 40–45

The flue gas temperature t_{fl} is one of the main variables that are most sensitive to changes in load in industrial ovens. This temperature in turn is associated with the loss of heat from the flue gases. The last value determines the change in fuel consumption, not directly related to the load. Therefore, the problem of determining a rational oven load is reduced mainly to establish the exact or approximate relation $t_{fl} = f(G)$.

The authors is studied the work at alternating mode of ovens with recirculation of combustion products – the most common type of baking ovens. In these furnaces load increase leads to an increase of t_{fl} , and decrease – to decrease of t_{fl} .

Increasing the temperature of the flue gas with increasing of oven productivity is explained by the fact that productivity causes a corresponding change in the heat flow to the working chamber of the oven. This change is due to increased fuel consumption and increasing the initial temperature of the heating gases. The growth in the total enthalpy heat transfer gas determines the increase of them, which leads to increase of t_{fl} .

Thus, the change in heat flow into the working chamber is caused by a change in the temperature difference Δt of the heating gases. The calculations show that the change in different modes of temperature difference, calculated as the difference between the average temperature of the heating gas and the walls of the working chamber by the law of convective heat transfer ΔQ , well reflects the change under the same conditions.

The obtained research can be applied to bakeries, at installation and after repair of baking ovens in order to obtain high-quality products with minimal cost of fuel-energy resources.

Keywords: rational mode, baking oven, fuel, temperature, heat, performance, bread.

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RESEARCH RESULTS OF WORKING BODY OF FERTILIZING MACHINE

page 45–49

The fertilizer centrifugal spreaders not provide uniformity of application of the process material. The high cost of fertilizers and crop losses provoke to address the problem of uneven application of fertilizers. This problem is important not only for Ukraine but also for the whole world. It is the fact that the technologically to do exactly same granules is expensive. Therefore, manufacturers admit a range of 1–5 mm diameter. More than 5 mm granules are fragile and the dose of mineral substances will be excessively large at its falling. Granules of less than 1 mm are greatly different in aerodynamic properties. Global manufacturers are constantly stay in search of promising solutions by centrifugal spreaders, because of the disc spreaders are most beneficial in terms of performance and quality indicators.

The program and methodology are developed and results of experimental research of the centrifugal working body for application of mineral fertilizers are obtained.

The rotary working body is proposed. The design features of this organ can improve the uniformity of dispersion of mineral fertilizers.

The original methods of determining the critical impact velocity of the metal surface with the moisture granules and influence the action of wind on the final distribution are developed. Techniques of airflow rate influence research to determine the effect, both in laminar and turbulent conditions that are not provided by known techniques.

The work will identify the optimal design parameters of centrifugal disc of fertilizer spreader.

Keywords: mineral fertilizers, fertilizer centrifugal spreader, blades, centrifugal working body, disc.

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SANITARY TREATMENT OF GAS EMISSIONS FROM AMMONIA IN THE PRODUCTION OF SODA ASH

page 49–54

The research results of the effectiveness of the spray vortex countercurrent mass transfer apparatus in the absorption of ammonia are given. The main sources of ammonia emissions in the production of soda ash and disadvantages of existing industrial units are determined. The analysis of structural mass transfer equipment, which appears in recent years, allows to identify one of the areas of mass transfer technology – the spray apparatus with high degree of turbulence. High velocity of gas (steam) also allows to atomize of liquid droplets of small size and to accelerate the process by increasing the interfacial mass transfer surface. It is developed and proposed the modernized sanitary washing apparatus for process gases. It is shown that the minimum entrainment in fluid vortex devices have a spray liquid specific design. The value of entrainment after vortex devices is much smaller than the entrainment after bubbling plates. The entrainment reducing will increase the driving force for mass transfer process, and increase the absorption of the gaseous ammonia. The operation of the upgraded unit for sanitary flushing process gases is researched and graph of the characteristics of the device is shown.

The research results of the absorber of sanitary cleaning of gaseous ammonia have shown that it operates stably in a wide range of loads on the machine phases. The effectiveness of the new device is significantly higher than the efficiency of the existing enterprise sanitary washer. The efficiency is rather high vortex apparatus and reaches more than 99 % in the entire range of each of the factors.

Keywords: vortex apparatus, mass transfer, gas velocity, mass transfer surface, e ammonia extraction from gas emissions.

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ANALYSIS OF PROBLEMS OF REGULATORY AND TECHNICAL SUPPORT OF ORGANIC PRODUCTION IN UKRAINE

page 55–59

It is analyzed a state of organic production in Ukraine in comparison with foreign experience. A sociological study of demand for organic products in the population of Western Ukraine is conducted. It is described the trends and characteristics of organic production of agricultural products in Ukraine and in Europe, prompted a number of policy measures on the formation of organic conducting of agricultural activities in Ukraine. In particular, such measures may include the need to improve the national framework of regulations relating to the industry, because domestic organic control system needs substantial reforms, which should be based on the experience of developed countries. So when will have clearly defined rules and standards of production and marketing of organic products then will be fully realized Ukrainian right on health safety. In fact, eating organic production may be significant strengths in Ukraine, the direction, moving on which we can stand tall on the world market and to enable the development of not only agriculture, but also many other related industries.

Keywords: organic production, certification of organic products, organic production control system, labeling.

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IMPROVEMENT OF LIME PRODUCTION IN SHAFT FURNACES

page 59–63

The analysis of shaft furnaces for lime production is shown. The main disadvantages of modern furnaces during the lime burning with polydisperse composition are identified. It is proposed the design of overturning furnaces with high efficiency, which enhances the productivity of the furnace by 15 %, waste disposal carbonate raw materials, reduction of heat consumption by 20–28 %. The kinetic features of burning process were established in experimental researches. The data of furnace operation with the recommended design changes is given.

The adopted in this work approach to process improvement and the design of the shaft furnace allowed developing a rational geometrical design of the shaft furnace reaction zone, and correlation of zone size from the particulate material fed to the burning, and the highest productivity, which is associated with the transverse dimension of the shaft. The relations obtained in the design of shaft lime-burning furnaces is an effective means of solving the problems of scaling of studied processes and objects, although they are semi-empirical. As shown from the table of the performance of the industrial shaft furnace and semi furnace with cone transitions given in this paper, the efficiency of lime burning in the simulated structure is evident.

Keywords: lime, lime burning, shaft furnace, calcium carbonate, furnace gases.

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MATERIALS SCIENCE

QUALITY MANAGEMENT OF SINTERED ALUMINUM POWDER (SAP) COMPOSITE ALLOY

page 64–68

This article is devoted to the research of dispersion-strengthened composite materials based on aluminum such as SAP to ensure their quality management. The orthogonal central composite design is used to analyze the composition and properties of aluminum-based DSCM. The mathematical models depending of the elongation and tensile strength of the various SAP on the temperature and the content of aluminum oxide Al_2O_3 are built.

Analysis of the mathematical models of obtained response surfaces showed that the tensile strength for SAP is most dependent on the temperature of the test sample (operating temperature) and Al_2O_3 content does not impact. As for the elongation of the samples, it is almost equally as dependent on the temperature of the test (operation), and the content of Al_2O_3 . It has been established that the increase in the Al_2O_3 content and the temperature of test samples leads to decrease of tensile strength and elongation of aluminum-based DSCM.

The results can be applied for the selection of the necessary materials in the production of equipment at a known operation temperature, as well as for compromise optimization of researched parameters for quality management of composite alloys such as SAP.

Keywords: composite material, dispersion-hardened, aluminum, strength, mathematical model, yield strength, tensile strength, elongation, composite design.

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THE CURRENT STATE OF STUDIES OF THE OPTICAL PROPERTIES OF SEMICONDUCTIVE MATERIALS

page 68–72

It is analyzed the optical properties of semiconductors due to the fact that the research of nonlinear optical effects in semiconductors is increased an interest, both in terms of basic science as well as in terms of the huge prospects for practical use of research results in the creation of new quantum electronics devices. As a result of this analysis it was found the major dependence of refraction, absorption and reflection from radiation wavelength.

The dependence between the intensity of the incident beam and the intensity of output (such reflected or passing through a semiconductor) beam with consideration of absorption (reflection) of the material is determined.

In results of absorption coefficient study of the material on free charge carriers it is appeared that it depends not only on the wavelength and refractive index, but also on factors such as the electron density and mobility of charge carriers.

Keywords: semiconductor, optical properties, photon, optical band gap, refractive index.

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RESEARCH OF HEAT CAPACITY OF MULTICOMPONENT CARBON-ALUMINIUM COMPOSITION MATERIALS

page 72–75

Despite the previously conducted specific thermal researches of one- and two-phase composite materials there are a need for integrated thermal researches for new multicomponent carbon-aluminum composites of different composition and content obtained by hot pressing. This article presents the results of experimental researches of the heat capacity of the samples of carbon-aluminum composite materials of tribotechnical purpose obtained using the comparative method of dynamic calorimeter with a heat meter and adiabatic membrane. The influence of both the component composition and content of the composites on heat capacity indicators is shown. A comparative analysis of the results with previously known heat capacity calculated indicators is conducted. It is shown that the values of maximum deviations between experimental and calculated values are less than 20 %. The research results have a scientific and practical interest

for the development of new units for dry friction engineering, aviation and space industry.

Keywords: composite materials, heat capacity, component composition, temperature, experiment.

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