



MECHANICAL ENGINEERING AND MACHINE BUILDING

CRITERION SELECTION FOR EVALUATING THE STRENGTH PROPERTIES OF FUNCTIONALLY GRADED STRUCTURES

page 4–8

The present state of the problem of calculating the strength parameters of functionally graded materials with the influence of non-local properties on the performance of the constructions under concentrated loads. Based on the analysis of modeling and engineering ways to describe the limit state of the material using the classic Pisarenko-Lebedev local strength criterion it is offered relationship of generalized integral-gradient criterion, which in particular cases is reduced to the classical criteria of the existing strength.

These relationships allow us to consider not only the stress-strain state at a particular point in assessing the strength of structures, but also consider the distribution of both stresses and their gradients in the vicinity of the local area that can significantly improve the accuracy of the strength assessment of the structure by taking into account fluctuations in the structure and distribution of spatial heterogeneity of property distribution.

Using the proposed criteria it is established increase (up to 4 times) the contact strength of the surface layers of steel 40X13 after ion plasma thermocyclic nitriding in the cycle $\pm 100^\circ\text{C}$ as compared with the material without process modifications.

The use of the proposed criterion relations for parts with a pronounced gradient of properties that are under concentrated loads (in particular, in a frictional engagement) can more accurately assess their strength parameters, which is quite difficult to carry out using only classical (local) strength criteria.

Keywords: functionally graded materials, non-local strength criteria, thermocyclic ion nitriding.

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FEATURES OF MECHANICAL ALLOYING PROCESS FOR OBTAINING POWDER CHARGE MATERIALS BASED ON THE Fe-Cu-C SYSTEM

page 9–12

The use of different alloying methods for the powder steel production is discussed and some results of original research in this field are given in the article. The main purpose of the study is obtaining a powder charge based on iron with the highest level of physical and technological properties. The use of modern diagnostic tools for properties of materials allows researchers to collect and analyze information received from experts around the world, with support for decision-making in the field of materials with a unique set of physical and mechanical characteristics. The prerequisites for use of mechanosynthesis for alloying powder constructional steels are discussed in the article. The complex of physical and technological properties of the powder mix on the basis of iron for production of sintered structural products alloying with copper and carbon is investigated. The presented methodology for assessing the properties of the powder mix allows receiving real information with the use of modern methods of analysis of the performance complex of structural materials based on iron. The methodology of the research is designed to select the most optimal method of alloying powder constructional steels produced by powder metallurgy. We propose to use a mechanosynthesis method for alloying powder constructional steels. The research results can be applied by experts, metallurgists and machine builders to create a new class of materials with high performance.

Keywords: mechanosynthesis, sintered steel, alloying, iron powder, copper powder, graphite, mechanical mixing.

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VIBRATIONS IN THE STRENGTHENING PROCESSING OF MACHINERY PARTS

page 13–16

In this paper we discuss the problem of the application of vibrations at hardening the surface of items such as the manufacture and restoration of details of agricultural machinery to increase their share. The aim of the study is to improve the wear resistance of parts through the use of technology developed on the basis of vibration hardening of the working surfaces. Analysis of the wear resistance of parts in conventional vibratory and recovery methods to evaluate the operational durability of these parts, and to develop more efficient technology of hardening in their manufacture and restoration. The process of wear of the cutting element disc coulters seeding machines, found the optimal parameters of the vibration treatment, offering enhanced durability of these components. Based on the data developed and implemented in the production process of hardening of cutting elements disc coulters grain drills based on the vibration deformation of the working surfaces. The results can be used in the manufacture of engineering for hardening of manufactured parts.

Developed and implemented in the production process using vibration reduction hardening can improve the durability of working bodies seeding machines.

Keywords: vibrations, deformation, wear resistance, durability, vibration hardening performance, working ability.

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DEVELOPMENT OF TECHNOLOGICAL PROCESSES OF VIBRATION MACHINE LONG CONTAINER FROM COMPOSITE MATERIALS

page 17–21

Relevance of the use of new materials for creation of vibrating machine U-shaped container established. Researches by selection of long container vibration machine design scheme made of composite materials presented in the article. Experimental researches by choice of container composite material are shown. Composite materials based on cold curing epoxy compositions and polyester resin hot curing chosen for researches. The results of composite samples tests analyzed. Based on the test results of fiberglass samples plotted breaking stress and changes in strength for epoxy and polyester fiberglass models, depending on fiber tissue percentage. Optimal materials for the creation of U-shaped long container selected. The technological process of manufacturing the vibration machine container intended for long type details treatment. Detailed description of the preparatory and basic operations of container manufacturing are shown in the article.

Keywords: container, composite, machine, vibration treatment.

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RESEARCH OF GAS RELEASE DURING CRYSTALLIZATION OF ALUMINIUM AND ITS ALLOYS

page 22–26

The problem of gas porosity formation in the manufacture of aluminum structural or cast porous alloys is discussed and some results of our research in this area are shown in the article. The main aim of the research is to investigate the influence of various technological, physical and chemical factors on the process of hydrogen gas release during crystallization of aluminum and its alloys. Using system simulation allows a scientist to investigate fully the flow of a process. In this paper to simulate the process of hydrogen gas release it was considered the simplest and, therefore, the most discussed in the literature option when the crystallization front moves in an unlimited amount of melt. The presented method allows determining what factors and how affecting the process of hydrogen gas release during production of aluminum castings and its alloys. The research results can be applied by experts in the field of metal technology, metallurgy, foundry, production of aluminum castings for mechanical engineering.

Keywords: gas release, hydrogen, gas porosity, crystallization, aluminum, casting, gas bubble.

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INVESTIGATION OF MANOEUVRING CHARACTERISTICS OF THE COMBINED HINGED AGRICULTURAL UNITS

page 26–30

This article deals with the problems of manoeuvrability of the combined hinged agricultural units, carrying out some technological operations within one pass on the field. The importance of these problems consists in the fact that the modern unit is a complex dynamic system, which must obey the accurate directions of the machine-operator or other controlling operators.

The given work investigates the manoeuvring characteristics of the combined hinged units on the example of soil cultivating and sowing unit. The influence of different manoeuvring indices on the unit operation in the whole as well as on the individual elements of its operation is revealed. Some indices describe the operating parameters of the unit in different ways. It concerns the turning and manoeuvrability parameters, that influence the size of turning stripes and the straightforwardness of sowing. The width of turning stripe at any field must be minimal from the points of view of operating width of the unit claw. Calculations have show that having overall dimensions, the unit will have large parameters of turning stripes the increasing of mass and the speed of movement will course the problems of possibility on the part of the field prepared for the sowing.

Keywords: manoeuvrability, turning ability, steadiness of movement, controllability of the unit, possibility.

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ENERGY, ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

SUBSTANTIATION OF SYSTEM FUNCTIONAL INDICATORS FOR SMALL DERIVATIVE HYDROELECTRIC POWER STATIONS

page 31–36

This article discusses substantiation of the indicators for small derivative hydroelectric power stations for electricity production through the development of hydropower of small rivers. The basis of the substantiation of these indicators is the coordination of the characteristics of the components of derivative hydroelectric power stations (hydro turbine and derivational channel) with the characteristics of the river (pressure, water flow). This coordination is done in the «river – SHPS» system bringing received systemic functional parameters characterizing the results of the hydroelectric power stations with certain characteristics in areas of the river. The optimization criteria for indicators of derivative hydroelectric power station for a particular area of the river are proved. There are incomes from energy that produced and sold to the grid. Comparing the results of different variants of hydroelectric power stations in the «river – SHPS» system, by this criterion, functional system indicators for small derivative hydroelectric power stations on small rivers are proved.

Keywords: derivational hydroelectric power stations, rivers, system, hydro turbine, power, pressure, water rate.

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DEFINITION OF RETAIL ELECTRICITY PRICES FOR INDUSTRIAL CONSUMERS

page 36–41

Based on the physics of normal electric power supply, in the article it is proposed a new, science-based approach to determine the retail price of electricity for industrial consumers and equivalent to them for which it is accounted an impact of reactive load of specific electricity consumer on the economics of the electricity transmission process.

Given that pricing in the electricity system is the basic calculation system, which determines its functioning economy, it is proposed two levels of it: the base (wholesale) and retail.

Principles for determining the retail electricity price are scientifically based in the article, which take into account the physics of the impact of voltage in the power grid on pricing for consumers, its active loss and bandwidth depending on the power reactive load of particular consumer of electricity, which is the basis of the methodology for determining the retail price of consumed electricity.

Keywords: electricity, electric power supply, active power, reactive power, full power, electricity price.

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FEATURES OF THE MIXING OF WATER AND ETHANOL UNDER ALTERNATING PRESSURE PULSES

page 42–45

Analytical studies of ways of mixing water and ethanol are conducted. Energy-saving method is proposed for the continuous mixing of water and ethanol under alternating pressure pulses. Rational thermophysical modes of the continuous process of mixing water and ethanol under alternating pressure pulses are chosen. The study of physical and chemical properties of the resulting mixtures is conducted. These results demonstrate the feasibility of using the power saving mode continuous mixing of water and ethanol in the conditions of alternating pressure pulses for food pharmaceutical and cosmetic industries. Based on experimental studies, numerical experiments and field tests proposed rational technological modes of carrying out continuous mixing of water and ethanol in the conditions of alternating pressure pulses. When using the technology of production for water-ethanol mixtures in conditions of alternating pressure pulse is intense impact stress shear, shear flow, a high-frequency oscillation, which leads to reduction of quantity of harmful impurities.

Keywords: water-ethanol mixtures, continuous process, rotary pulsation apparatus, discrete-pulsed input of energy, alternating pressure pulses.

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EFFICIENCY OF STORAGE HEATERS IN PRIVATE HOUSING ESTATES OF UKRAINE

page 46–49

This paper focuses on the economic efficiency issues of heating systems employment based on storage heaters. There have been calculated capitalized and current charges involved in establishing and employment of heating systems based on storage heaters. There have been determined payback period upon their employment.

As a result of the research conducted by the author, he has reached a conclusion that employment of heating systems based on storage heaters appears profitable not only as compared to electric heating convectors but even as compared to the gas heating. There has been determined that employment of such systems is cost effective. Despite comparatively high initial expenses, heating systems based on storage heaters pay off in 3–8 years compared to the gas heating and in 7–13,5 years compared to electric heating convectors.

It is worth mentioning that the main deterrent restraining the economic planning and calculations of technical-and-economic indexes for different heating systems is uncertainty of fee policy in the field of housing and utilities services, coming from unstable economic situation in the country and also political speculations in this area.

Keywords: heating system, storage heater, economic efficiency, payback period.

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ELECTRICAL ENGINEERING AND INDUSTRIAL ELECTRONICS

DISTRIBUTION OF INDUCED POTENTIAL IN SOLENOID COIL

page 50–54

Induced magnetic field dependence of the potential for solenoid with uniform turns is considered.

It is shown that the distribution of induced potential in the solenoid is nonlinear.

Formulas for calculating induced potential using elliptic integrals I and type II are derived. Examples for the calculation of various length relations of solenoid to its radius (0,1 to 100) are given.

The basic laws related to the distribution of induced potential in the solenoid are shown.

The conditions necessary to achieve high stability characteristics of the coil in a wide frequency range are defined.

In the future, similar researches are possible for multilayer coils.

Keywords: solenoid, induced potential, high-frequency line trap, interference generation.

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SIMULATION OF POWER SUPPLY SYSTEMS WITH MOTOR LOAD IN THE TRANSIENT MODES

page 55–59

The method of mathematical modeling of power supply systems with motor load in the transient modes is proposed in the article. This method provides the possibility of submitting the electric network of any configuration. The model is based on equations in the phase coordinates and allows simulating as electromagnetic and electromechanical components of transient modes.

For the formation of equations of transient processes it is used nodal method, for the numerical integration of the equa-

tions of transient processes it is applied implicit methods, the formation of the system model is implemented on the basis of discrete models of electric machines.

The mathematical model provides a complete picture of the electrical network, allows simulating all kinds of managing and disturbing external influences to meet the challenges of emergency management, reducing the number of accepted assumptions.

In addition, a possibility of multi-variant calculations for research and study of factors affecting the quantitative characteristics of the transient processes is opened in the case of the presence of computer model.

Keywords: transient processes, phase coordinates, mathematical model, electrical machines, motor load.

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