Informatics, computer engineering and control

INTELLECTUALIZATION OF THE SUPPORT PROVIDED TO THE DECISION MAKING PROCESS WITHIN THE ATMOSPHERIC COMPOSITION MONITORING SYSTEM

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The article considers the problem of decision-making on air quality management in the public health monitoring system. In the absence of complete information it is proposed to use the method of direct assessment to determine the groups of control actions and their relative effectiveness. Presenting the results of the processing algorithm of the expert survey for the purpose of management decision-making in the field of environmental improvement.

Based on the efficiency values using the method of direct evaluation (taking into account the expected decrease in the concentration of contaminants, minimize the amount of resources required to perform specific activities and implemented for the shortest possible time) carried out the formation of groups of control actions and make recommendations on air quality management.

The objective evaluation of the effectiveness of measures for air quality management is to find alternatives, ie, control actions, providing reduction in the concentration of pollutants in the atmosphere. Groups of control actions submitted to a set of measures, ranked according to effectiveness, and selected depending on the level of contamination in monitoring points (high, medium, low).

The use of new information technologies and the creation of an algorithm for decision support in the problem of air quality management will allow to achieve a qualitatively new results in the field of environmental security in large cities

Key words: expert assessments, the effectiveness of control actions, decisions

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DEVELOPING THE MODULE FOR PARAMETRIC BUILDING OF MODELS BASED

ON AUTOCAD SYSTEM

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In the article the question of development of the module parametric build solid models for the graphic editor AutoCAD 2015. In the basis of development is a universal algorithm of transforming geometric models in a parametric, based on analysis of the. DXF files. The proposed approach enables the decomposition of complex solid models and generate a parametric description of the individual graphics primitives included in the model.

The module is designed to extend the capabilities of parametric solid modeling, implemented in the graphic editor AutoCAD dynamic blocks. The main disadvantage of this tool is to support only surface models. Create parametric solid models using dynamic blocks in AutoCAD 2015 is not provided.

The program is executed using the application programming interface of the graphic editor AutoCAD and is implemented as a module of a universal automated information system. The module allows you to parameterize the finished solid models to make them easier to reuse. The application generated using the module of parametric models makes it possible to carry out analysis of various constructive schemes and to avoid fundamental design errors. The design of the system is maximally implemented the principle of modularity, which allows, as necessary, to expand its functionality without significant adjustments of previously created modules

Key words: solid model, parameterization, algorithm, AutoCAD

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NEURO-FUZZY FORECASTING OF FIRMNESS OF THE REINFORCED CONCRETE MATERIALS

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The article considers the possibility of applying modern forecasting techniques as an element of a quality management system. The object of research is a quality control system for the production of reinforced concrete products. To solve the problem, it was suggested to use the modernized E. Deming cycle with the prediction of the P & P-D-C-A state. The mathematical toolkit of artificial fuzzy neural networks with backward propagation of architectural errors of the form ANFIS and TSK is applied. The analysis of the factors influencing the strength of concrete is carried out. As input characteristics, the sand size modulus was chosen, the number of plaque and needle-shaped grains in the rubble, the bulk density of cement, the ultimate strength of the cement stone. As output parameter arithmetic mean value of the destroying influence by results of three experiments is used. The electronic database in the environment of MS Access on the basis of these registration logs of laboratory of incoming inspection of the enterprise is created. Two groups of tuples are created: for a training of an indistinct neural network and for check of the trained network on adequacy. The mathematical model showed the efficiency when testing. The average error value was 9.6 kg/cm^2 or 2%

Key words: Quality control system, fuzzy logic, neural networks, forecasting, production of reinforced concrete products

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Energetics

MODELS OF FORECASTING OF THE QUALITY OF PRODUCTS OF A POTENTIALLY HAZARDOUS PROCESS OF AUTOMOBILE TIRES VULCANIZATION

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The quality of the products is one of the most important criteria of efficiency of any enterprise. That the quality and safety of products determines the degree of survival of the enterprise in the conditions of market, growth of production efficiency and economy of all resources used in the enterprise. Increasing the technical level and product quality determines the pace of technological progress, and increasing the efficiency of production in General, has a significant impact on intensification of the economy, the competitiveness of goods.

In this article, as the investigated object is considered potentially dangerous, the curing process for tire production.

The paper presents the technological process of vulcanization of the tire, and analyzed the parameters that affect the quality and safety of products. As a way to improve the quality and safety of products offered to develop a machine to predict the quality of products which allows you to get most appropriate results compared to traditional mathematical models and control algorithms.

Due to the necessity of use of the device in relation to the curing process to predict the quality and safety of future products and reduce economic costs

Key words: forecast, dangerous production, curing

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MICROPROCESSOR CONTROL SYSTEM FOR "PUMA-560" MANIPULATOR

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In article questions of development and research of executive and tactical levels of a microprocessor control system by manipulator "PUMA-560" are observed. The calculated scheme of the manipulator is developed. The mathematical description of the manipulator and executive drives as object of control is determined. The algorithm and the program of simulation of executive system of the robot in system MATLAB are developed. Simulation of dynamic regimes of manipulator "PUMA-560" with direct-current drives is lead.

The executive level of a control system is developed on the basis of six modules executed on the basis of PIC-micro-controllers and providing immediate digital control by motors of the manipulator according to a principle of subordinated regulating. Control by coordinates is carried out on interface RS-485, and also with the help of discrete and analogue signals is stipulated. The speed hold of twirl of each actuating motor at the given level, and also improvement of a set trajectory of the tool with use of signals of position sensor is provided.

The tactical level of a control system is developed on the basis of a personal computer. Signals of the job of a positions, speeds and accelerations of coordinates of the manipulator on the method of cubic splines are generated. Algorithms and programs of interpolation of a path and formation of control signals are developed at consecutive and parallel moving of coordinates of the manipulator. Experimental researches of the robot in a regime of stabilization of speeds of coordinates and in a regime of improvement of a set trajectory of the tool are lead

Key words: the robot, the manipulator, dynamic model, executive system of the robot, tactical level of control

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NEURO-CONTROL SYSTEM BASED ON THE 3D NETWORK OF THE SPECIALIZED ROBOTIC TECHNICAL COMPLEX

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The article is devoted to the development of a control system for a robotic complex for complex environmental conditions. As the object of management, the RTK was considered for repair work at the nuclear power plant. The technical design of the main subsystems of the RTK is described. Due to the harsh specific working conditions, RTK must have great reliability, therefore, the principle of hybrid parallel neural control is taken as the basis of the control system architecture within the framework of the article. A typical scheme based on this architecture is considered and processed in accordance with the realities of the control object. 3D neural network of the neurocontroller was developed and described by spatial layers. The approach to the development of control systems described in the framework of the article makes it possible to achieve significant optimization and stability of the entire operation of the system, and the use of an "ordinary" controller paired with a neural controller increases the reliability and fault tolerance of the control system and the RTK as a whole

Key words: neural control, robotics, extreme conditions, neural networks, optimization

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TEMPERATURE OF FLASH AND HELMHOLTZ ENERGY FOR THE SUBSTANCES OF HOMOLOGICAL SERIES OF N-ALKYL PROPIONATES AND N-ALKYL BENZOATES

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The number of organic compounds exceeded 40 million and increases each year by 300 thousand. To ensure the fire safety and technological calculations of processes of production, for storage and transportation materials needed data rates fire and explosion hazard substances. Therefore, development of a method of forecasting fire danger indicators and thermodynamic properties of substances, based on the minimum amount of experimental data, is an important task. In this article at various temperatures were measured vapor pressure and density of the liquids in the homologous series of n-alkyl propanoates and n-alkyl butanoates. Based on experimental data and using the standard of ideal gas (taken at the temperature and volume of liquid) calculated the values internal energy, entropy, and Helmholtz energy. The analysis determined that values of thermodynamic functions are linearly dependent on the molecular weight of the substance in the homologous series. Analysis of published data established as a linear dependence of the flash point of substances of molecular weight substances in the homologous series. Considering the tendency of change these properties is established that the flash point of substances linearly dependent on the value of the energy of Helmholtz of substances homologous series. The corresponding equations were obtained

Key words: flash point; internal energy; entropy; Helmholtz energy; equation of state

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RESEARCH ON THE DISTRIBUTION OF HARMFUL SUBSTANCES CONCENTRATIONS WITHIN INDUSTRIAL SPACES OF FUEL AND ENERGY COMPLEX ENTERPRISES

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The accident rate in many industries of the Russian Federation and foreign countries is stored on to a sufficient high level that leads to large-scale pollution of the environment and loss of life. The most dangerous production objects remain the enterprises of chemical, petrochemical and refining industries.

The analysis of emergency emissions of harmful substances demonstrates the need for the development of technical and sanitary-hygienic measures, deducing the quality of the air of the working zone of the room and on the border of sanitary-protective zone on the level of regulatory indicators.

Emergency emission of harmful substances is sudden and of short duration. The emergency release-the sa chemical company is probabilistic in nature.

Existing designs of devices of the emergency ventilation involves removing air from the zones of maximal concentrations of harmful substances, which can form explosive mixtures. Not tested scheme emergency ventilation with natural and mechanical partial flow of air. Their use in a considerable me re would reduce energy costs and the purchase of ventilation equipment.

In this paper, we present the results of the research chemical fields of concentrations of harmful substances in the whole volume of the room during the operation of emergency ventilation with the set ventilation. Explosion safety of

production facilities is provided subject to the 10% lower limit of flame propagation in gas mixtures and to observe the equality of concentrations of harmful substances in the working area and in the outgoing air. The conditions for increasing the efficiency of the emergency ventilation, precluding the formation of stagnant zones and providing regulated concentration limits of flame propagation for gas-air mixtures in the room

Key words: concentration, explosion safety, stagnant zone, air-gas mix

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Radio engineering and communication

PREDICTING THE SPATIAL STRESS DISTRIBUTION OF THE E-COMPONENT OF ELECTROMAGNETIC FIELD SYSTEM OF WATER-ABSORBING INSTALLATIONS

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The paper considers the mathematical model that adequately describes the EMF created by the induction heating system, with regard to the problem of moisture absorption, and the results of an experimental test of the distribution of the electromagnetic field around a source that is an inductor. The article considers calculation of the electric field strength in a given volume of space created by an inductor consisting of several turns of a copper wire, based on the mathematical model of heating a dielectric tablet placed inside electron-beam tubes. The influence of electromagnetic fields on humans, technological processes, consisting of several sources of the same type, is considered. The calculation of the boundaries of the sanitary protection zone for three inductors at the design stage of industrial production sites is given. The construction of a mathematical model for predicting the level of distribution of the E-component of the electromagnetic field made it possible, through computer simulation, to evaluate the dependence of the form of the sanitary protection zone around the investigated object on the mutual arrangement of sources of the electromagnetic field to which the same power was supplied from the generators of high-frequency heating. The article studies the effect of the geometric and electromagnetic properties of the induction heating system on the emitted field, general laws governing the behavior of the electromagnetic field in the near-field zone and the recommendations for determining the linear dimensions of the zone where the electric field strength is less than the normalized values. Instrumental measurements and calculated values of the electromagnetic field parameters confirmed the adequacy of the proposed model

Key words: mathematical model, high-frequency heating installations, electromagnetic field, moisture absorption

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METHODOLOGY OF CONSTRUCTION OF CORRECTIVE CYCLIC CODES FOR DIGITAL SYSTEMS OF INFORMATION TRANSMISSION AND PROCESSING

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A technique is proposed for constructing non-primitive corrective cyclic codes with a length equal to a byte for digital systems for transferring and processing information, including memory devices, as well as data transmission systems using back-coupling. In such systems, the right choice of the corrective code plays an important role, providing correction or detection of errors and increasing their effectiveness. The bit capacity of the data is usually a multiple of 8 (byte), which is directly related to the corresponding multiplicity of the processor devices (16, 32, 64). At the same time, the number of information and verification code symbols must also be a multiple of a byte and can be chosen the same or different within the same multiplicity.

Most often the cyclic corrective codes are primitive, and their length does not correspond to the multiplicity of a byte. This leads to the need to select non-primitive cyclic codes, the collection of which is limited, unfortunately. In this connection, in a number of cases, there arises the need to construct a non-primitive cyclic code for solving certain problems in digital systems, which can be realized with the help of a specific method of selecting a generator polynomial.

A generator polynomial of a cyclic code must satisfy the following requirements: it must be non-zero; its weight should not be less than the code distance of the code; it should have the maximum degree of the number of check symbols in the code; all allowed code combinations of the cyclic code should have the property of divisibility on the polynomial without an excess.

To obtain a new polynomial for cyclic code, a special software procedure was developed, implemented on a computer. The sequence of actions in the procedure is as follows: the formation of a set of binary numbers with a given digit capacity; selection of binary numbers with a weight greater than or equal to the code distance of the corrective code; formation of polynomials from a set of binary numbers; constructing a generator matrix of the code by polynomials; checking the generator matrix code for the existence of a code with a given code distance; transition to a new polynomial if the condition is not fulfilled by code distance; fixation of all polynomials satisfying the requirements for the existence of a code generator matrix. Thus, the proposed method for selecting non-primitive polynomials for cyclic corrective codes with a length multiple of a byte can be realized to obtain other correction codes that have not yet been constructed for the use in digital devices of various purposes

Key words: cyclic code, code distance, information processing

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DIAGNOSTICS OF MICROCONTROLLERS ACCORDING TO THE RESULTS OF MEASUREMENT OF CRITICAL SUPPLY VOLTAGE

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In modern technology, the use of microcontrollers (MCs) as control components is ubiquitous. This is due to a number of reasons, including simplicity of development and implementation, cheapness, relatively low power consumption, small dimensions and a wide range of applications. When using microcontrollers in such areas as automotive electronics, medical equipment, etc., the question arises of ensuring the proper reliability of these devices.

To date, the leading methods of quality and reliability control of semiconductor products are destructive methods, the validity of which has been repeatedly proven. Among modern diagnostic methods, the most relevant are non-destructive methods of quality control, since they allow not to damage the crystal to determine its internal properties. In this connection, active work is being done to find alternative methods for sorting semiconductor products.

This article describes a method for diagnostic nondestructive quality control of microcontrollers, based on measuring the critical supply voltage. The article proves the dependence of the minimum working voltage on the defectiveness of the integrated circuit, which shows itself in the spread of the parameters of the initial materials and the instability of technological processes in manufacture of semiconductor products.

The method is focused on division of microcontrollers according to the reliability at the stage of both output and input control of integrated circuits in order to improve the quality of the electronic component base. The method is relevant for devices placed in circuits with increased requirements to the quality of the used control components

Key words: microcontroller, control device, critical supply voltage, quality of integrated circuits

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DIGITAL DEMODULATOR "AS A WHOLE" OF PHASE-SHIFT KEYED SIGNALS

CODED WITH WALSH FUNCTION

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The possibility of the hardware implementation and the characteristics of the digital demodulator "as a whole" of phase-shift keyed signals encoded with Walsh sequences based on erasable programmable logic device (EPLD) are considered. Signal processing "as a whole" allows to significantly increase the noise immunity of the demodulator in comparison with the element-wise reception and subsequent decoding of code combinations. However, the known technical solutions require considerable computational costs, which complicates their implementation when processing high-frequency signals. Using incoherent signal processing with phase-shift keying makes it possible to avoid phase demodulator synchronization, which greatly simplifies the equipment.

A fast digital algorithm for non-coherent demodulation of the coded phase-shift signal "as a whole" is described, which requires a minimum number of simple arithmetic operations over the period of the carrier. The RF patent was obtained for the demodulator under study. For its implementation on EPLD in VHDL, a description of the demodulation algorithm has been developed, the synthesis of HDL-code has been carried out and its implementation for fixed signal parameters. The hardware costs of various series of modern EPLD by Xilinx are estimated for various parameters of the processed signal, the operating frequency range and the power consumed by the crystal at a high clock frequency are determined. An expression is given for calculating the probability of a demodulation error. Methods of statistical simulation in the Matlab / Simulink system verify the operability of the implementation of a demodulator based on EPLD, its noise immunity at various signal parameters is investigated. The results of the research indicate the possibility of the hardware implementation of the proposed demodulator

Key words: phase-shift keying, digital demodulation, Walsh function, EPLD, VHDL, Matlab

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TECHNOLOGICAL AND ELECTROPHYSICAL MODELING OF THE FD SOI STRUCTURE VIA TCAD

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Work in the field of increasing the radiation resistance of transistors in the 70's gave development to the structures of the CNN and SOI, which have a number of advantages and high cost. Further improvement of the area led to the development of technology FD SOI - transistors with a completely depleted channel. Structures of this type have found application in microprocessor devices and until recently competed successfully with the alternative technology of creating transistors such as FinFET.

The technology of FD SOI is analyzed and compared to conventional planar technology on a bulk silicon crystal. In this paper, an algorithm for modeling a FD SOI transistor via TCAD is considered. It is described how to configure simulation parameters in Athena and Atlas modules. The geometric dimensions of the structure are given, the simulation grid is justified, and the areas of the structure are named. For numerical calculation, the physical models used and the mathematical method of calculation are indicated. As a result of the simulation, the output characteristics of the structure are constructed. The I-V characteristics analysis showed typical curves for MOS transistors, which indicates the correctness of the selection of the geometric and electrophysical parameters of the FD SOI transistor model used. The developed technological route for creating the FD SOI transistor in the Athena editor can be used to fabricate both discrete transistors and integrated circuit elements

Key words: FD SOI, completely depleted structure silicon on the insulator, Silvaco TCAD, technological process, simulation of I-V characteristic

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VERIFICATION OF FINITE ELEMENT MODEL OF THIRD LEVEL RADIO-ELECTRONIC MODULE, CREATED BY MEANS OF CREO PROGRAM COMPLEX

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The finite element method implemented in the CREO software package is the optimal tool for the design of radioelectronic facilities. To carry out the numerical modal analysis, a mathematical model of a third-level radio-electronic module has been developed based on a 3D computer model created with the help of the CREO CAD module. The numerical modal analysis is carried out by the finite element method in the CREO program complex.

In order to verify the finite element model, the created product has been tested by the swept frequency method. The dynamic test scheme has been developed in accordance with the data obtained during the modal analysis. The vertical axis of the test object has been chosen as the direction of the forced oscillations. Resonant phenomena have been observed in the range of 100-500 Hz, which corresponds to the finite element model obtained in the modal analysis.

Based on the results of the tests, the finite element model has been verified. According to the comparative analysis of the calculated resonance frequencies obtained in the CREO software package and the resonant frequencies obtained from the results of full-scale tests on the shaker, it has been concluded that the created mathematical model of the construction of the third level radio-electronic module adequately reflects the stiffness, mass and geometric parameters of the structure. The results are in good agreement with the experimental data; the discrepancy does not exceed 5%

Key words: radio-electronic modules, design, finite element model, static analysis, modal analysis

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OPTIMIZATION OF A DIPOLE MODEL VIA GENETIC ALGORITHMS

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Solving the issues of electromagnetic compatibility is now becoming an integral part of the activities of enterprises - developers and manufacturers of technical equipment, the basis of which, as a rule, are printed nodes. A typical PCB can have hundreds or even thousands of circuits. In this case, each circuit is a potential source of energy, which can eventually inadvertently affect other circuits or elements. The paper presents a printed circuit board with an array of magnetic dipoles found from optimization of genetic algorithms based on near field scanning. The main idea is to implement a balanced multi-criteria optimization taking into account both accuracy (better adapted to the field) and efficiency (less dipoles) due to the correct identification of genes and the evolution process. The number and location of the dipoles used, determined from optimization, rather than from a predetermined empirical value, provide a more efficient representation of the printed circuit board. In addition, the method works with several kinds of near field information (amplitude, amplitude and phase, any component or combination), provided that this information is sufficient for the electromagnetic characteristic

Key words: electromagnetic compatibility, printed circuit board, dipole, radiation

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Mechanical engineering and science of machines

MECHANISM AND PROCESSES OF COMBINED COATING

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The effectiveness of intensification of the process of electroerosive treatment by heating the place of discharge is shown. In a combined process, a plasma beam turned out to be an effective source of thermal energy, so it is suggested to irradiate the surface of a part before coating, giving the beam oscillating motion in the direction of supply of the tool electrode. The requirements for coatings are given: structure, etc. The main factors, influencing the course of the coating mechanism, are taken into account: the electroerosion and plasma process conditions, the fluidity of the electrode material.

The principal difference between the combined process and the previously used process of successive, separated by time coating is given. This allows to save the total thermal energy of the coating with minimal losses and to reduce the temperature gradients that cause internal stresses and cracking in the coating. Therefore, in order to obtain a high-quality coating when considering the mechanism and processes of combined treatment, the displacement of the plasma beam at the stage of application of the reinforcing layer relative to the tool electrode

should be minimal, but in all cases the last layer should be applied to the coating obtained by the electro-erosion method before its cooling due to heat transfer

Key words: heating, coating, electroerosion hardening, plasma

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ACOUSTIC CORRUGATED HONEYCOMB SANDWICH FEATURES FOR TURBOJET ENGINE HOT SECTION (TJE)

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The article considers a new type of acoustic corrugated honeycomb structures (ACHS). The peculiarity of such structure is that a corrugated insert is placed in the space between the corrugations, which provides an increase in acoustic efficiency, which is confirmed by testing the samples of a corrugated panel at the "channel with flow" stand at Central Aerohydrodynamic Institute.

The main materials used for manufacturing corrugated panels are considered, mechanical testing of sheet materials is carried out. The article presents the technological process of manufacturing a corrugated structure, also the stage of perforation of blanks, which is performed on a CNC press, is considered. The design of the stamp, allowing to carry out shaping of corrugations without thinning the material of a workpiece, is developed. A scheme of the welding process for coverings with corrugated aggregate is given. Parameters of the corrugated aggregate and insert are given.

The density of corrugated aggregate is calculated, the weight parameters of the corrugated panel with an insert for various materials are determined. The limiting values of compressive stresses for the materials under study are determined.

The finite element method was used to study the samples of the corrugated panel, the character of the loss of stability of the corrugations and the most loaded structural elements were determined as a result. The obtained data are presented in the form of a pattern of stress distribution over the surface of corrugated aggregate

Key words: corrugated honeycomb, insert, seam resistance welding

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DEVELOPMENT MATERAL DATABASE FOR CAD SYSTEMS OF FAILUREFREE TECHNOLOGY OF SHEET STAMPING

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Material database structure of modern CAD systems of technological processes of sheet stamping is stated, which allows to predict different failures of deforming type: fracture, loss of stability in a form of neck generation, structural recrystallization and Luders lines appearance. The article describes a mathematical model of material that is used at creation of technological processes CAD systems' database and numerical program control for machines at cold and hot multitransition stamping of sheets and profiled elements with intermediate heat treatment.

The ultimate strain of work-piece material, that is used to develop technological processes of bending, stretch-wrap forming, draw-forming with rubber or with puncheon, is determined with original methods of cracks' geometry measurements in different strain states. At cold plastic formation and at intermediate heat treatment, both cumulative deformation and restoration of margin of plasticity are taken into account. The parameters of the model are obtained experimentally.

The article offers the routine for accounting natural aging of work-piece material with the help of the function of deforming hardening and ageing duration of thermo-hardened alloys. It allows to correct automatically the machine control program in case of stamping delay for technical reasons. Failures-free parts production is provided because of the subdivision of the technological process onto transitions where cold deformation follows interim heat treatment

Key words: material database, mechanical technological testing

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PROCESSES OF EROSION RADIAL PLASMATIC WEARPROOF COATING

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The mechanism for applying combined erosion-radial plasmatic coatings is disclosed in the article, which made it possible to scientifically justify the physical model of the process, which is the basis of mathematical modeling.

To describe the procedure of coatings formation, a new principle is proposed for dividing the combined process into logically developing successive stages, accounting which it is possible to consider the mechanism as a single process.

A mathematical model is presented, which takes into account the initial and boundary features of the processes during application and hardening of coatings, which is the basis for designing the technological process of erosion-radial deposition of layers with the required exploitation characteristics. Experimental studies confirming the legitimacy of the combined process model are presented, which is the basis for the development of reliable methods for calculating erosion-radial coating regimes. The theoretical and experimental studies presented in the article made it possible to identify new interactions between the parameters of a combined coating, which made it possible to create new methods at the level of inventions

Key words: processing, erosion-radial treatment, coating, stages, plasmatic hardening, experiment

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ERRORS AND THEIR INFLUENCE ON FORMATION OF ELECTROCHEMICAL SHAPING ACCURACY

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Nowadays quite detailed structural models of electrochemical dimensional processing have been developed, but there are still no complete and precise classifications of errors. The article is about generalization and systematization of the grouping of operating factors and errors applied in technology of machine building according to the stages of achieving accuracy with respect to electrochemical dimensional processing. It is shown that achieving of the given formation process accuracy is affected by errors determined by characteristics of the workpieces, tools, machines, and methods of measurement. The following acting factors and the corresponding errors according to the stages of achieving accuracy are considered: when installing and fixing a workpiece; during static and dynamic adjustments of the technological system "machine-device-tool-workpiece".

Determination of the errors causes in the processing of workpieces by electrochemical machines made it possible to establish a relationship between these causes and the magnitude of the errors. Knowing the causes and magnitudes of elementary errors, differing in the mode of their effect on the technological system, it is possible to determine the resultant error in processing and to predict the achievable process accuracy, to evaluate the efficiency of combined processes involving traditional electrochemical dimensional processing.

The analysis of operating factors and elementary errors allows us to outline the ways to improve the accuracy of electrochemical dimensional processing of machine parts

Key words: errors, accuracy, electrochemical shaping

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Physics

PECULIARITIES OF THE ETCHING KINETICS OF LITHIUM NIOBATE AND TANTALATE IN A FLUORINE-CONTAINING PLASMA

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A comparative analysis of the kinetic features of the plasma-chemical etching process of single-crystal polished samples of $LiNbO_3$ and $LiTaO_3$ by fluorine-containing radicals is carried out in the article. Experiments were performed on a Corial D250 with a diode-type reaction chamber.

Data on the etching rate make it possible to quantify the process of plasma-chemical etching of the studied materials. X-ray diffractometry showed that during the etching of both niobate and lithium tantalate, a solid reaction product, lithium fluoride (LiF), is formed. Thus, one should speak of typical topochemical reactions. The formation of a solid product affects the kinetics of etching, which was revealed by analyzing the experimental data. Investigation of the time dependences of the etching rate showed an increase in the initial period of time, the presence of a maximum and a slow decline with a further increase in the etching time, which is due to the inhibitory effect of lithium fluoride on the diffusion of fluorine-containing radicals to the LiTaO3-LiF (LiNbO3-LiF) interface. The magnitude of the input power has a qualitatively similar effect for both materials. Differences are only quantitative, but often significant. In this case, nonlinear growth of the etching rate is observed with increasing input power

Key words: plasma chemistry, lithium niobate, *lithium tantalate*

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DEVELOPING TECHNOLOGY FOR THE PRODUCTION OF THE MATERIAL

FOR THE AUTOMATED LAYOUT

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In this article, technological processes of obtaining prepregs with the use of solution and melt binders are considered. Taking into account the requirements for the properties of the material used for automated computation using the MAG Viper 1200 complex as an example, initial reinforcing fillers and polymer binders of solution and melt type have been chosen. Optimum regimes for the preparation of a prepreg based on unidirectional carbon tapes using Formosa TC-35 12K yarns as well as LU/P and UOL-300R carbon tapes using the ENFB solvent binder and hot-meltepoxy T-6815 and T-107 have been worked out. In the process of working out the modes of obtaining the material, batches of prepreg have been obtained for each mode and research tests of physical and mechanical properties were carried out.

An array of data has been collected for changing the properties of the obtained batches of prepreg for each mode when the control parameters are changed. The obtained data served as the basis for creating a mathematical model for obtaining a technological material with specified properties.

As a result of the research tests, the technology of manufacturing of the technological material was developed and materials were identified that best meet the requirements for the automated calculation process using the example of the MAG Viper 1200 complex

Key words: prepreg, automated calculation, manufacturing technology, solution and melt binder, polymer composite materials, processability

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THE IMPACT OF THE CONTENT OF STRUCTURE-GENERATING COMPONENTS ON THE LOW-CARBON WHITE CAST IRON FIRMNESS

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The object of the study are complex-alloyed white cast irons for wear-resistant thin-walled castings that have the necessary strength, hardness and toughness already in the cast state, that is, without hardening heat treatment. The objective of the study is to evaluate the conditions for the formation of structures that form the composite structure of alloys that affect the mechanical properties of cast parts, in particular hardness. For the investigation, alloys were made whose composition was within the following limits,%: 1.8-2,2 C; 2,5-4 Mn; 6-7 Cr; 6,5-8 V; Up to 1 Si. Due to the fact that the degree of austenization of their structure has a very strong influence on the properties of the alloys, often overlapping the influence of other factors, all the investigated alloys were divided into several groups by the amount of austenite in their structure (or by the content of manganese as the main element of the austenitizer). The distribution of alloys by groups was carried out on the basis of an analysis of the dependences of hardness on the manganese content and the degree of austenization.

It is determined that the difference in the quantitative effect of carbides MS and M_7C_3 on the hardness of alloys with 12% austenite in the structure is small and therefore the increase in hardness depends mainly on an increase in the total amount of carbides. Carbide formation in alloys with 12-35% manganese affects the hardness weakly, and the formation of carbides M_7C_3 even leads to a slight decrease in hardness. Significantly increase the hardness in alloys containing more than 30% austenite carbides MS (about 3 times stronger than carbides M_7C_3).

It has been established that the complex alloying and modification of the investigated low-carbon white cast iron allows to significantly reduce the overall doping level (especially in vanadium) while maintaining a sufficiently high hardness (at least HRC 57) even with the predominance of the austenite matrix structure, which should provide high structural strength for these alloys and Good operational properties

Key words: white cast iron, chromium, vanadium, alloying, hardness

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DEVELOPMENT OF THE AUTOMATED LAYOUT TECHNOLOGY FOR THE POLYMER COMPOSITE MATERIAL

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The article presents the results of tests related to the development of the technology of automated laying of polymeric composite material based on the reinforcing filler of Formosa TC-35 12K yarns and the polymer epoxy binder T-107 for the high-tech complex of automated MAG Viper 1200. Have been solved some problems of prepreg material processing – the technical requirements of the used complex calculations (cutting and rewinding tapes), developed and perfected technology of plane experimental samples layouts and set the complex of physical-mechanical tests. Optimal process conditions has been selected by automated computations based on the obtained values of the strength characteristics of the material with the corresponding values of control parameter calculations (the pressure roller, the heating temperature display, the tension of the prepreg) and samples modes molding (molding temperature, molding pressure of the molding). A mathematical model of technological process of automated calculationshas been made, which allows prediction and assessment of the impact of control parameters calculations on the strength characteristics of the material

Key words: carbon unidirectional tape prepreg polymer composites, manufacturability, an automated layout technology

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