PROBLEM OF ADDITIVE MANUFACTURING MANAGEMENT BASED ON THE TECHNOLOGIES OF THE INDUSTRIAL INTERNET OF THINGS

S.L. Dobrynin, V.L. Burkovskiy

Abstract: we classified additive manufacturing technologies according to the basic state of the material: liquid base, solid base, powder base. We give definitions of common technologies depending on the basic state of the material. We describe the technological processes of manufacturing prototypes and final products by methods of additive manufacturing, including designing a 3D model, converting formats, slicing a 3D model into layers, forming a G-code and directly printing. We considered the technologies of the fourth industrial revolution as a tool for increasing the efficiency of control of technological processes of additive manufacturing. We present a model of modernization of the technological process of additive manufacturing based on technologies of the industrial internet of things, the hardware implementation of which is a single-board computer Raspberry Pi, the software implementation is MTConnect - an industrial standart for the exchange of data of machine tools with numerical control. Using Raspberry Pi, sensors connected to it and software OctoPrint implements control and remote management of additive manufacturing equipment (3D printer) in real time. We present the technical structure of the main subsystems of the cloud platform for additive manufacturing. The architecture of the proposed system consists of four levels: the access adapter level, the resource virtualization level, the service control level, and the user instrumentation level

Key words: additive manufacturing, fourth industrial revolution, industrial internet of things, distributed control system

EXPERT EVALUATION OF WEB-BASED SYSTEMS BASED ON THE LINGUISTIC APPROACH

M.Yu. Sergeev, T.I. Sergeeva, N.I. Grebennikova

Abstract: the article considers an approach to evaluating the results of the development of web-oriented systems in the framework of expert systems based on the use of a linguistic approach. It discusses the features of the formation of integral indicators of the quality of functioning and operation of web-oriented systems. We show the method of formalizing the requirements of experts for web-based systems. The evaluation of operational characteristics is based on the formation of linguistic scales that allow one to evaluate qualitative indicators that do not have a quantitative assessment. We give examples of linguistic terms for evaluating various performance indicators of web-oriented systems and also we give the correspondence between the clarifying quality indicators of the developed system and the linguistic terms. We considered an approach to the transition from qualitative indicators to quantitative frequency characteristics. The expert system takes into account the uncertainty in the evaluation of web projects and is based on the formalization of inaccurate and fuzzy information. The proposed approach to the formation of an expert evaluation system of the developed web-based system provides a consistent assessment of the developed system with the help of a group of integral quality indicators. The expert assessment will determine the compliance of the project implementation with the set development goals, which, in turn, will make it possible to determine how successful the financial component of the company's activities will be, which is the main indicator of efficiency

Key words: web-based system, expert evaluation, linguistic evaluation model

DECISION MAKING SUPPORT IN THE IMAGE RECOGNITION SYSTEM USING AN ARTIFICIAL NEURAL NETWORK

A.O. Kalashnikov, V.F. Barabanov, A.M. Nuzhnyy, A.V. Barabanov

Abstract: the article considers issues of creating a decision support system for the preparation of the passport of a road. One of the tasks solved in the process of passporting a motorway is to fill data on the presence and location of structures, road engineering devices, including road signs. The system is designed for automated analysis of the video flow to highlight frames containing road signs, as well as the subsequent classification of the found characters. We give an original two-stage system for extracting and classifying images containing road signs. The detection algorithm for the desired images is based on the use of Haar's wavelet transforms and the concept of an integrated image, which allows one

to get the required frames as quickly as possible. The originality of the use of Haar signs is to use only 2 rectangular filters (horizontal and vertical) on different scales: 2x2, 4x4, 8x8 and 16x16. Subsequent data processing, the purpose of which is the classification of the found images, is carried out using an artificial neural network. The relevance of the development of such a decision support system is determined by the need to process large volumes of video data. The system allows one to largely eliminate the factor of user errors, which is very important since the data obtained affect the safety of the road

Key words: image recognition, Haar features, neural networks, machine learning

CHOOSING A METHOD FOR ESTIMATING THE PARAMETERS OF LINEAR REGRESSION BASED ON IDENTIFICATION OF ANOMALOUS OBSERVATIONS

S.I. Noskov

Abstract: the article describes the properties of methods for estimating the parameters of regression models - least squares, moduli, anti-robust - as well as their application for solving specific practical problems. At the same time, the method of least modules does not respond to anomalous observations of the sample, the method of anti-robust estimation strongly deviates the regression line in their direction, the method of least squares occupies an intermediate position. I show that if the purpose of constructing a model is to carry out multivariate predictive calculations of the values of the dependent variable on its basis, then the choice of a method for the numerical identification of model parameters should be based on an analysis of the nature of emissions. If there is a reason to believe that similar situations may occur in the future, the anti-robust estimation method should be chosen, otherwise - the least modulus method. I built a regression model of the freight turnover of the Krasnoyarsk railway on the basis of the application of all three methods of parameter estimation. I carried out the analysis of the reasons for the situation of a sharp drop in the value of cargo turnover in 2010, which may well be characterized as anomalous observation in the data. I give recommendations on the choice of the parameter estimation method in this case

Key words: regression model, least squares methods, modules, anti-robust estimation, outlier, forecasting, cargo turnover

ALGORITHMIZATION OF ENERGY-SAVING CONTROL OF THYRISTOR POWER REGULATORS OF AUTOCLAVE PLANTS

V.L. Burkovskiy, Yu.V. Nefedov, An Tu Ha, V.N. Krysanov

Abstract: the article discusses the issue of the complex principle of thyristor power control of autoclave units for the production of polymer-composite material. To increase the level of energy saving in asynchronous motors of the autoclave equipment, we offer an original algorithm for switching thyristor keys of a typical power regulator based on the additional use of a pulse-phase control system that significantly reduces current overload. To evaluate the efficiency of the proposed algorithm, we determined the level of additional power losses in asynchronous motors based on a comparative analysis of the increased values of its phase currents during the transition process. The developed simulation model of the automated autoclave control system showed the capabilities of this algorithm to provide the required damping of undesirable transients in asynchronous motors caused by the parallel operation of powerful thermoelectric heaters and, as a result, reducing additional power losses. The developed control algorithm of a typical autoclave power regulator allows us to ensure an increase in the level of energy saving with constant monitoring and correction of the harmonic composition of the voltage of the electrical equipment of the plant. Based on results of simulated simulation, we determined values of reduction of average cycle additional losses of electric power in asynchronous motor of autoclave fan while maintaining required level of electromagnetic compatibility of power equipment

Key words: control, algorithm, power regulator, higher harmonics, autoclave installation, simulation

INTELLIGENCE CONTROL ARCHITECTURE OVERVIEW

BASED ON UTILITY AND BEHAVIOR TREE

A.K. Donskikh, V.F. Barabanov, N.I. Grebennikova, M.A. Belykh

Abstract: designing artificial intelligence (AI) is a necessary process in the development of practically any interactive modeling system. The FSM or Behavior Tree design systems do not cause questions but everything is more complicated with Utility AI. We propose a single means for designing both Behavior Tree and Utility-Based AI. The article

proposes a version of the system for designing both Behavior Tree AI and Utility AI. We give several ways of designing Utility AI (visual design, text description, creating a system in programming language), we considered their advantages and disadvantages. We considered a more preferred option for the developer - with visual design – Utility AI system consisting of a set of nodes: DataSource (DS), Scorer, Action. It is noted that two different systems are responsible for the design and operation of AI. The first design system is the simplest. The second, more important and more complex system is a real-time controller. We considered simplified algorithms for Behavior Tree and Utility AI controllers. The use of controllers will affect a positive way to improve the convenience and performance of an artificial intelligence designer

Key words: decision making system, Utility AI, behavior tree, visual programming

SIMULATION MODEL FOR ANALYSING PROBABILITY-TIME CHARACTERISTICS OF THE DURATION OF A SET OF TASKS

S.A. Oleynikova, I.A. Selishchev

Abstract: the article is devoted to the development of a simulation model that allows you to estimate the probabilistic-time indicators of a random variable, which is the duration of the completion of the complex of sequential-parallel works. First of all, such indicators include: the law of the distribution of a random value (with an accuracy of parameters), the probability of completing the project in some time interval, as well as a mathematical expectation and dispersion. The need for solving the task arises in the case if the duration of individual works are random values. In this case, the time characteristics of the completion of the work complex are necessary not only to assess the probabilistic-time characteristics but also for the simplest planning of the start time of each work. Currently, there are approaches to solving this task, the most common of which is PERT (Program Evaluation and Review Technique, an evaluation and project analysis technique). However, the estimates of the method are based on the central limit theorem based on assumptions that are impracticable in the real functioning of industrial or serving systems. Because of this, it is necessary to obtain a model that allows one to estimate the required characteristics in any conditions. As a result, a simulation model was obtained, which allows one to obtain the probabilistic-time characteristics of a random variable, which is the duration of a complex of sequential-parallel works and characterized by increased accuracy compared to existing analogues. For the implementation of the model, we chose AnyLogic medium

Key words: simulation model, project management, computational experiment, probabilistic-time characteristics, PERT

Radio engineering and communication

PROBLEMS OF IMPROVING THE RELIABILITY AND QUALITY OF RADIO ELECTRONIC PRODUCTS AND INSTRUMENTS WHEN USING LEAD-FREE SOLDERS

N.V. Astakhov, A.V. Bashkirov, O.Yu. Makarov, A.A. Pirogov, A.S. Demikhova

Abstract: ensuring the reliability and quality of radio-electronic equipment and devices is one of the main problems in the process of designing new devices. Due to the high quality of soldered joints, the service life of electronic products increases, as well as their reliability during operation and maintainability. It is also necessary not to forget about the environmental safety of the manufactured devices. In connection with all the above, it is most promising to conduct research and look for practical solutions to the emerging difficulties in the field of technologies that use lead-free solders, which will allow us to meet modern requirements for electronic equipment. The article briefly describes the main consequences and problems of using pure lead-free soldering, the problems of using mixed soldering technology, and the study of the effect "whiskers". Use of active fluxes that retain their properties at high temperatures helps to avoid most defects, the paste should be chosen with the condition that it should not contain rosin, which begins to actively emit as a gas when the temperature rises, and the temperature profile of soldering should also be correctly selected. Among the finishing coatings, immersion silver and nickel-gold proved to be the best. The use of metals such as bismuth and indium in solder, as lead substitutes, significantly increases the cost of solders. The article also notes that solders with a zinc content have

good indicators but zinc leads to the impossibility of long-term storage of soldering pastes, increased oxidation, the need for soldering in an environment of inert gases and with the use of active fluxes

Key words: lead-free soldering, mixed soldering, RoHS environmental safety directive, soldering defects, formation of jumpers, beads, poor wettability, voids, "tombstone" effect, formation of tin “whiskers”

SWITCHING SCANNING ANTENNA SYSTEM BASED ON A FLAT LUNEBERG LENS WITH CONCENTRIC RINGS

A.V. Ashikhmin, Yu.G. Pasternak, V.A. Pendurin, F.S. Safonov

Abstract: scanning antennas with wide-angle scanning capabilities are widely used in the areas such as modern wireless communications and military and civilian radars. Among them, lens antennas with switched beams and phased array antennas (PHAR) attracted considerable attention. In this paper, we consider a variant of the construction of switching scanning PHAR with a diagram-forming scheme in the form of a flat Luneberg lens consisting of a system of concentric dielectric rings placed on a substrate made of Rogers 5880 material. We studied the effect of the PHAR mounting bracket on the presence of its influence on the radiation pattern, the radiation level, the decrease in the directional coefficient, and the level of the scanning sector in the azimuth plane. The maximum diameter of the PHAR is 160 mm, the full height of this antenna is 38 mm. The power supply is carried out using coaxial cables with a wave resistance of 50 Ohms. The diameter of the Luneberg lens itself was chosen 80 mm; the full height of the lens is H=0.939 mm. The substrate has a thickness of t=0.127 mm, glued with a layer of glue, 0.025 mm thick. The concentric rings on this substrate are 0.787 mm high. Minimum width of the concentric ring (external) d – W=0.25 mm (when cutting with a UV laser, the minimum width of the partition between the holes is 0.05 mm). Strip transformers are located on the board made of Rogers 5880 material and have a thickness of H=0.939 mm

Key words: mathematical model, Luneberg lens, TEM - horn, directivity pattern, bracket for the PHA

MPU6050 MODULE CONTROL UNIT ON THE I^2C BUS BASED ON A MICROCONTROLLER

A.B. Buslaev, N.N. Kosheleva, S.S. Belokopytov

Abstract: the paper considers the GY-521 module, which is equipped with the MPU6050 chip, which combines an accelerometer, a gyroscope and a temperature sensor in one housing. Such sensors are made on the basis of micromechanical systems (MEMS), the main advantages of which are small size, low power consumption and low cost. The simultaneous use of an accelerometer and a gyroscope allows you to determine the change in the movement of a body in three-dimensional space. We considered the main characteristics of the module used. The control of the chip is carried out using the architecture of the I^2C interface "master-slave". In operation, the MPU6050 is the host, and the master (makes a request to read or write data) is a microcontroller that has an I^2C hardware data bus. We show a possible software implementation of the algorithm for connecting multiple slave devices (six MPU6050 chips). We present a schematic diagram of the connection to a single I/O port of the microcontroller. We consider the algorithm of operation of the microcontroller with connected chips (six) MPU6050. We give an example of a program (using the assembly language) for initializing communication with the MPU6050, as well as a program for reading data for taking the latest measurements of the accelerometer, gyroscope, and temperature sensor. The use of several modules with simultaneous reading of information from them allows you to control flight control systems that have a set of several control surfaces and devices

Key words: accelerometer, gyroscope, MEMS, module GY-521, chip MPU6050

ESTIMATION OF THE CAPABILITIES OF BROADBAND RECEIVERS FOR DETECTING BROADBAND SIGNALS

V.A. Makhrov, A.V. Naydenov

Abstract: we considered the problem of detecting radar discrete composite frequency signals by broadband receivers with software detectors. This type of signal is widely used in radar due to its high noise immunity and energy secrecy. To detect them, a broadband energy detector is often used, which measures the energy of the received signal, comparing it with a threshold level, and, based on this, makes a decision on the presence or absence of a signal. The disadvantage of such devices is the fact that they are triggered for single reports, which may not be a useful signal. Due to the fact that the detection is carried out in a wide frequency band, the ability to receive such signals is impaired. To

improve the reception capabilities of composite frequency signals, software detectors are used. Due to certain decision rules, the quality of detection increases, and single reports are no longer accepted. As a result, we developed a technique that makes it possible to assess the probability of correct and false signal detection by a broadband receiver with a software detector in communication systems using wideband signals using the example of discrete composite frequency radar signals. Here we show the advantage of using software processing

Key words: broadband receiver, broadband signals, signal energy to noise power spectral density ratio, energy secrecy

PROGRAMMING METHOD OF THE MDR32F9Q2I MICROCONTROLLER IN CONTROL AND MONITORING TASKS

M.V. Khoroshaylova, A.V. Chernyshov, D.A. Ledenyev

Abstract: in this article, we developed a technique that provides a full range of organization of works on programming the MDR32F9Q2I microcontroller, which allows you to obtain control and monitoring systems for secondary power supply sources. The microcontroller based on the high-performance ARM RISC processor core was programmed in the Eclipse IDE on the Windows 10 Pro operating system. We chose the Eclipse integrated development environment as the most convenient and accessible environment, it supports all kinds of programming languages and continuous compilation. Currently, 16- and 32-bit microcontrollers are rapidly gaining popularity in the field of industrial tasks. Their use is due to the ever-increasing complexity of tasks, stringent requirements for the performance of integrated controllers, the need to have advanced user controls in electronic devices. We present a simulation stand that uses an interface bridge between the I2C and 1-Wire buses - DS2482-100, converts protocols between the I2C microcontroller (master) and 1-Wire slaves, and also controls the voltage rise and fall rates in the line. The basis for writing the DS2482 class is the Arduino.h and OneWire.h header files, which are freely available

Key words: microcontroller, integrated development environment, processor core, operating system, format of executable and connecting files

METHOD FOR IMPROVING THE ACCURACY OF MEASURING INPUT SIGNALS IN A MICROCONTROLLER CONTROL UNIT

R.Yu. Kuz'menko, I.I. Tabolin, A.O. Tishchenko, A.D. Danilov

Abstract: the article presents the method of hardware-software compensation of thermal voltage drift in the measuring channels of resistive pressure and temperature sensors in the control unit of the charging and discharging device of a nickel-hydrogen battery. We considered the problem of increasing the accuracy and reliability of the measurement of controlled parameters for more precise control of the operating modes of the batteries in the power supply system when the ambient temperature changes. We show the functional diagram of the path for converting an analog signal into a digital form using the built-in analog-to-digital converter of the microcontroller. We present experimental data on the influence of temperature on the accuracy of signal measurement, as well as graphic illustrations of the maximum reduced error of 40 measuring channels. We investigated the spread of the characteristics of temperature sensors implemented in the crystals of several microcontrollers. Based on the obtained data, we determined the nodes and elements that make up the maximum temperature error in the measurement channels of the pressure and temperature sensors of the battery. We developed a method of hardware-software compensation of the temperature error of the sensor signal conversion. Here we describe the algorithm and conditions of practical implementation of the method of compensation of the total error of the measuring channel using the analog-to-digital converter of the microcontroller. We carried out an experimental evaluation of the applied calculation method in the telemetry generation unit of the electronics unit designed to convert analog signals of pressure and temperature sensors into a digital code

Key words: microcontroller, control unit, temperature drift, analog-to-digital conversion, measurement error

METHOD FOR NONLINEARITY MINIMIZATION OF MULTIPLYING DIGITAL-TO-ANALOG CONVERTER BY LOW RESOLUTION CALIBRATION CONVERTER

S.V. Kalinichenko, Yu.S. Balashov, D.G. Kharin, A.S. Shnaider

Abstract: in this paper, we present a method for nonlinearity minimization of precision multiplying digital-to-analog converter (DAC) by utilizing low resolution calibration DAC. In this method the calibration DAC generates distorted transfer characteristic which is added to the main DAC characteristic and provides resulting integral and differential nonlinearity reduction. The calibration coefficients are calculated following the presented algorithm and saved in nonvolatile memory and then are converted to controlling digital code of calibration DAC by arithmetical-logical unit (ALU) depending on input data. For experimental research we designed a model of calibration system based on field programmable gate array (FPGA) and a demo board with dual 16-bit segmented DAC. Then we give experimental results which show that inherent nonlinearity of calibration DAC does not significantly affect overall nonlinearity. The proposed calculation algorithm obtains effective integral and differential nonlinearity minimization of 16-bit DAC down to values of less than one least significant bit (LSB)

Key words: precision DAC, multiplying DAC, nonlinearity, calibration, FPGA

OVERVIEW OF METHODS TO INTEGRATE ANTENNAS AND SOLAR CELLS

S.M. Fyedorov, I.A. Chernoivanenko, E.A. Ishchenko

Abstract: the article considers methods for advanced integration of low-profile antennas with solar systems for short-range wireless communications. The need to move to more sustainable energy sources arises from the excessive production of harmful carbon emissions. The focus is on the ways to integrate crystalline silicon antennas and solar panels. We proposed and used a solution to minimize sensitivity to successfully isolate the microstrip transmission line from the solar array, thus demonstrating five antenna configurations. Further work on crystalline solar panels demonstrated their use in conjunction with circularly polarized antennas for aircraft and it also allowed us to show the need for their use with Meshed Patch Antennas for small satellites. A solar dipole antenna was developed for low power indoor applications. These approaches created the engineering capability to reduce device size and weight by integrating radio and solar panel technologies. The article presents the main characteristics of antennas for the cases under study, compares them, and determines the effect of conductive material on their parameters

Key words: radiation pattern, inverted F-antenna, circularly polarized antenna, dipole antenna, Meshed patch antenna

RESEARCH OF SIGNAL DETECTION ALGORITHMS IN COGNITIVE RADIO NETWORKS

E.E. Grinin, A.B. Antilikatorov, O.V. Chetkin, I.A. Novikova

Abstract: the article discusses some of the algorithms for scanning the radio spectrum and detecting signals in the cognitive radio system, as well as the cognitive radio itself. This topic is relevant since the use of broadband channels is one of the options for organizing communication. Due to a large number of users, it is necessary to more rationally use the radio frequency spectrum. We considered the main aspects of the detection of the signal in narrowband and broadband bands. We described the lack of adaptive detection algorithms based on the standard distribution laws. We give examples of both parametric and non-parametric detection algorithms. We described the algorithm based on Wilcoxon's criteria in detail. Using the Neuman-Pearson's criterion, you can compare the detectors among themselves. We made conclusions about the feasibility of application for monitoring the radiospectract of non-parametric detection algorithms. For the case of a constant positive signal against the background of Gaussian interference, comparing the values of asymptotic relative efficiency for the Wilcoxon's criterion with the value of the linear detector is about 0.955. This value suggests that both detectors are practically inferior to each other in such conditions

Key words: cognitive radio, radio transmission, signal detection algorithms, wide range transmission

Mechanical engineering and science of machines

INVESTIGATION OF THE GROWTH AND DISSOLUTION OF THE OXIDE PHASE ON TITANIUM WHEN HEATING DURING ITS HIGH-TEMPERATURE TREATMENT

I.L. Bataronov, V.V. Peshkov, V.F. Selivanov, V.V. Shurupov

Abstract: the production of strong diffusion-welded joints of surfactants is associated with the growth and dissolution of oxide films on the contact surfaces. In this case, the process of formation of oxides can proceed by various mechanisms. At high-temperature heating of titanium alloys during diffusion welding, implemented in a vacuum, there is an active interaction of the metal with the residual gases of the evacuated space. The resulting oxide films prevent physical contact and the further development of a high-quality solid connection of parts. Due to the transience of the growth and dissolution of oxides on the connected surfaces and the inability to quantify their value in dynamics, we proposed a physical and mathematical modeling of the process of growth and dissolution of oxides, which allows us to determine the time and temperature of heating surfaces at which welding pressure can be applied to the contact surfaces free of oxides. Based on the analysis of graphical dependencies, we found that the reduction in the thickness of the oxides, up to their almost final removal, depends on the heating rate. At a higher rate of temperature rise, a smaller layer of oxides is formed. The same situation is observed when increasing the degree of vacuuming in a sealed chamber. For practical tasks, the established mathematical and graphical data allow us to determine the technological schemes and conditions under which it becomes possible to bring the connected surfaces of titanium parts into contact when their surfaces are unblocked from oxides, which, in turn, determines the quality and reliability of the diffusion-welded joint

Key words: diffusion-welded joint, oxide film, heating rate, interaction, contact surfaces, mathematical model

INFLUENCE OF TOOLING SYSTEM ACCURACY ON DYNAMIC CHARACTERISTICS OF MULTI-PURPOSE MACHINE

V.V. Zhmurin, A.V. Antsev

Abstract: the article discusses the characteristic tendency of modern mechanical engineering to increase the concentration of technological operations on multi-purpose machine tools and intensify cutting modes. We give the analysis of machine parks of various metalworking enterprises, which showed the prevalence of milling and boring machines. This article analyzes the reasons for a wide range of tool systems for milling-boring machines and considers the influence of the diversity of the tool system on the dynamic characteristics of multi-purpose machines. We considered an example of a medium-sized tool system typical for milling and boring machines, which includes a collet chuck, a collet and a milling cutter. We give calculations of accuracy and stiffness for various versions of the instrumental system. In order to confirm the obtained theoretical calculations, we carried out experimental studies in real production conditions when processing a serially manufactured part on a VMC-600 multi-purpose milling machine. The results of experimental data processing showed that the accuracy of the tool system significantly affects the geometric accuracy of the machined part, vibration resistance of the tool system and its rigidity. The low accuracy of the tool system leads to a significant squeezing out of the cutting tool at the recommended cutting conditions, which can exceed the machining tolerance, which should be taken into account at the design stage of the technological process by understating the cutting conditions

Key words: tooling system, multipurpose machine, precision, dynamic characteristics, rigidity

DEVELOPMENT OF A HEAT-DRIVEN DEVICE FOR MOLDING LARGE-SIZED CONCRETE PRODUCTS

A.Yu. Botashev, A.A. Musaev, M.A. Saidov

Abstract: a device with a thermal power drive for pressing is a type of impulse devices. It allows one to significantly reduce the cost of compacted reinforced concrete products. To ensure high power of the device for pressing and to reduce its overall dimensions and metal consumption, a thermal energy drive of internal combustion is used in its design. Existing presses for molding concrete products of high power are structurally complex and expensive. Therefore, pressing is used mainly in the formation of small-sized concrete pieces. This article is devoted to the development of a new type of device

for pressing large-sized concrete products. To achieve this goal, we developed a device with a thermal power drive for pressing large-sized concrete products, which ensures the high strength of these products. The developed device has a high performance. We obtained dependences for determining the power parameters of the device, as well as the required pressure of the fuel mixture, which ensures the implementation of the pressing process. In particular, for pressing a concrete slab with an area of 1 m^2, a fuel mixture pressure of 0.9 MPa is sufficient. In this case, the pressure and the pressing force are: $P = 11,7\ MPa$, $F = 11.7 MH$. With an increase in the pressure of the fuel mixture to 2 MPa, the pressing force reaches 20 MN, which is quite enough for pressing large-sized concrete products

Key words: thermal power drive, pressing, concrete products molding

STABILIZATION OF QUALITY AND PRODUCTIVITY OF GRINDING OF EXTENDED CYLINDRICAL SURFACES OF SHAFTS WITH PETAL CIRCLES

S.G. Bishutin, I.L. Shupikov

Abstract: the article is devoted to the problem of stabilization of indices of petal grinding of extended cylindrical billets in order to exclude the effect of tool wear on the quality and productivity of this treatment. We present the results of studies of influence of abrasive tool wear on processes of metal removal and formation of roughness of treated surface during petal grinding. Circles of greater grain wear more intensively, and the resistance of instruments with grain 12... 20 (GOST 3647- 80 (ed. 1995)) is 2...3 times higher than circles with grain 40...50 and is 5...10 minutes. We give the data on resistance of blade grinding wheels taking into account the main factors of the processing process. We found that the rate of metal removal when grinding with unworn petal circles with grain size from 12 to 40 is 130...270 mm^3/min, the roughness parameter Ra can vary in the range from 0.4 to 3.0 μm, Sm – from 0.08 to 0.20 mm. The values of the roughness parameters of the treated surface due to wear of the tool increase by 2-3 times, and the rate of material removal over time continuously decreases and can become zero. We proposed to stabilize the indicators of petal grinding by continuous or periodic increase of deformation of the tool during abrasive processing, which will allow one to maintain the required number of cutting grains at the required level

Key words: grinding with petal circles, quality and efficiency of processing, tool wear