INFLUENCE OF DRAWING METHODS ON FUNCTIONAL CHARACTERISTICS OF PRECISION ALUMINIUM TUBES

page 4–7

High gage interference, rigidity, strength and corrosion-resistance requirements are placed upon aluminum tubes, working in hard deformation conditions and corrosive media. Technological methods for ensuring specified requirements are quite complex and are based on a statistical description of the characteristics, implemented after each technological conversion of tube production. The possibility of using aluminum tubes in conditions of corrosive media implies their surface treatment with obtaining dense corrosion-resistant coatings.

To assess gage interference, statistical methods, which together with experimental data have allowed to determine the ways of thickness stabilization and axis line curvature, are proposed.

Fixed plug and moving-mandrel drawing reduces gage interference to an acceptable level. Conditions of reverse deformation for eliminating the axis line curvature to a given accuracy are defined.

Predicting elastic and strength properties of the aluminum tubes in conditions of the structural anisotropy formation is possible using the methods, applied for complex loading and complex stress state of systems.

Quantitative characteristic of crystallographic structures is based on the analytical estimation of crystallographic axes of crystals with respect to the laboratory axes, associated with the textured tube anisotropy.

Technology of electrochemical oxidation and ematal coating of aluminum tube surfaces is developed. Influence of protective-hardening coating on the deflection value of tubes at three-point bending on the base of 560 mm with a force of 8,8 H is experimentally found.

Keywords: drawing methods, precision aluminum tubes, functional characteristics, deformation anisotropy.

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THE DEVELOPMENT OF GRADIENT COATINGS FOR LININGS OF BRAKING DEVICES

page 7–16

The paper deals with the actual problem of developing highly efficient wear-resistant materials for manufacturing service linings of brake devices. It is proposed to use composite materials, produced based on the principle of a positive gradient of mechanical properties. Such composite materials are manufactured, and tribological testing of them is carried out. As the matrix, it is proposed to use a composite eutectic alloy, based on steel 12X18H9T taking into account thermophysical properties of reinforcing phases. A thermodynamic analysis of the interaction of all the alloy components at high temperatures is performed. Complex laser treatment of surface to improve the structure and tribological properties of the surface layer is justified. As a result of the studies, the optimal ratio of the matrix material and fillers — TiB_2, VC, and the influence of the filler ratio on the wear resistance of the composite material are determined. Parameters of complex laser treatment of friction surface are developed and proved. It is found that dual laser treatment with reflow of surface layer forms a layer with a positive gradient of mechanical properties and high wear resistance. Such treatment allows to reduce the disadvantages of plasma coatings and preserve the benefits of non-equilibrium state of the material. Using the developed materials will allow to improve the reliability and durability of braking systems, in which metallic friction materials are used.

Keywords: braking devices, eutectic alloy, steel, TiB_2, VC, thermophysical properties, laser treatment.

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TECHNICAL AUDIT OF MELT GRANULATION KNOTS IN THE PRODUCTION OF MINERAL FERTILIZERS USING TOWER METHOD

page 16–23

The paper describes the results of the research, conducted on the experimental setup on studying the effect of frequency and amplitude of the forced signal, superimposed on the liquid jet, outflowing through the hole of the perforated granulator shell, and liquid level in the volume of the device, on the homogeneity of the resulting droplets.

The study of this process is caused by the need to modernize the prilling (granulation) knots of mineral nitrogen fertilizers during their manufacture in towers in order to reduce production losses due to polydisperse fractional composition of the resulting granules.

Experimental results show that the impact of various values of the impulse on the liquid jet leads to change of its disintegration mode and diameter of the obtained droplets. This points to the need to take into account the specified frequency action when using in calculations. Otherwise, polydisperse droplets are obtained.

A combination of experimental results and theoretical studies was the basis for designing special-frequency generator, used in modernizing existing granulators in large scale production of mineral nitrogen fertilizers. The special-frequency generator allows to automatically detect and change the signal frequency when changing the level of the filled basket; improve the homogeneity of the resulting product by automatic determination of the acceptable frequency for obtaining monodisperse mode of the jet disintegration.

The studies have allowed to develop equipment that made it possible to increase the monodispersity of the resulting product (more than 98 % of the desired fraction), reduce the dust content from 0,8–1,2 % to 0,05–0,2 %, which has led to a decrease in losses during transportation and storage. In addition, dust emissions into the atmosphere have reduced from 200–250 mg/m^3 to 25–40 mg/m^3, and as a result, this has allowed to decrease specific energy consumption during production and improve the environmental situation in the production area.

Keywords: monodispersity, nitrogen fertilizers, oscillating granulator, special-frequency generator, prilling.

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SELECTION OF STRUCTURE AND PARAMETERS OF PNEUMATIC IMPACT UNIT WITH BUILT-IN TANK

page 23–28

The problems of selecting the structure of a pneumatic impact unit and its parameters are considered in the paper.

The results of the PC testing (personal computer) of the pneumatic actuator activation process with various wiring schemes of actuating mechanism are given.

The analytical dependences and diagrams for selecting the parameters of the pneumatic impact unit, allowing the improvement of the compressed air efficiency and ensuring the maximum impact velocity on the workpiece without changing the weight and size characteristics of the impact cylinder, are proposed.

Based on the PC research, it was determined that a pneumatic scheme with cylinder and air distribution operation synchronization allows achieving the most efficient pulse impact at which it is possible to avoid the cylinder head impact, as well as improving the energy characteristics of the pneumatic unit. All research results are presented in a dimensionless form. Such representation makes them universal and allows for extending it to a group of similar pneumatic units.

Keywords: pneumatic units with built-in tank, maximum impact velocity on workpiece.

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CALCULATION OF THE CONTACT ARC OF THE CAGE WITH THE LOCATOR RING OF THE BEARING

page 29–32

The methodology for analytical calculation of the size of the contact arc of the cage as an elastic ring with a rigid locator ring of cylindrical roller bearing is developed, which has allowed to make the calculation scheme of the cage more precise by replacing point contact by the arc. The influence of the size of contact arc of the cage with the locator ring depending on the cage rigidity and the gap between the cage and the locator ring is investigated. Scientific novelty of the work consists in the first proposed methodology for analytical calculation of the contact arc of the cage with the locator ring of the bearing, formed under the load from the rollers, and the practical value of the work lies in improving the accuracy of calculating stresses in the weak section of the solid structure of the cage and improving the efficiency of its designing.

Keywords: bearing, cage, calculation scheme, contact arc, bending moment, locator ring.

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STUDY OF EXPERIMENTAL-INDUSTRIAL DESIGN OF ROTARY VORTEX MACHINE

page 33–38

Comparative assessment of machines by the amount of energy consumed is presented in the paper. For comparison, machines for air purification from dust with the particle size of ~ 3–5 microns were selected. All considered scrubbing machines achieve maximum purification efficiency, but with a different amount of energy spent. A machine with guiding elements reaches maximum purification efficiency with energy consumption by 40 % less than a machine with a smooth setting. Testing of industrial design was carried out during purification of gas emissions from cement production ingredients, and purification of flue gases of boiler houses. In both cases using machines not only provided a reduction in dust emissions, but also harmful gas impurities. Dust-gas-air mixture, which has been purified in the rotary vortex machine meets the requirements of state sanitary rules and norms, and may be released into the atmosphere. Testing of the machine has shown that rotary vortex machine with guiding elements, installed on the torus surface provides the purification efficiency of up to 98 %, which indicates the usefulness of guiding elements in the rotary vortex machine design. Experiments have shown the appropriateness of using the machine in the technological scheme of gas purification since it provides an effective capture of fine particles.

Keywords: purification, rotary vortex machine, dust, gas, efficiency, energy consumption.

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MODELLING THE LIFE CYCLE OF MACHINES THAT ACCUMULATE HIDDEN DAMAGE

page 39–46

A model of damage accumulation of the node structure of a complex machine during its operation is developed.

In predicting the lifecycle of complex technical structure at its design stage, «passport» structure of analyzed option, data of bench tests of trial sample and also statistical information on external conditions and «behavior» during field testing and operation of products-analogues are used as the initial information.

Such versatility and diversity of the model allows to consider inaccessible to observation parts of the object since the state of the latter indirectly affects the processes in accessible parts.

On the example of a trailer welded frame, the problem of modeling the life cycle of complex technical system in mechanical engineering is considered. Mathematical apparatus of the automatic classification of data about the current state of the system to construct a model of damage accumulation in the frame is proposed.

Keywords: modeling machines, life cycle, hidden damage.

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IMPROVING THE RELIABILITY OF PNEUMATIC DEVICES FOR VEHICLES

page 46–53

Operation of the vehicle pneumatic system on the example of two matching devices, defining transport safety — pneumatic wheel and a device, ensuring pressure and maintaining it in automatic mode — compressor is shown in the paper. New approaches to the organization of failure-free operation of these devices are proposed. New type of pneumatic wheel of a vehicle, which during the motion can provide a desired pressure in the tire, is shown. New operation principle of pneumatic compressor, based on a linear electric motor is investigated. The necessity of such developments is caused by the fact that there is a need for improving individual units of transport equipment for further reliable and failure-free operation. During the development and theoretical calculations, it was found that this trend of technical improvement allows to increase efficiency and provide longer service life while increasing reliability. This area of technical developments is important to create a new generation of transport equipment, which will allow to operate at higher speeds and at much higher loads, as well as at minimum operating and repair costs.

Keywords: pneumatic tire, compressor, vehicle, reliability, failure-free operation, pneumatic devices.

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RESULTS OF EXPERIMENTAL RESEARCH OF THE BRAKING PROCESS OF THE WHEELED TRACTOR «FENDT 936 VARIO»

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The process of handling longitudinal and lateral accelerations, resulting from the experimental research of the braking process of tractor «Fendt 936 Vario» with hydrostatic-mechanical transmission was described. To automate the processing of data, obtained from accelerometers, Butterworth low-pass filter, in particular free «Butterworth filter» software was used. The algorithm of this program is based on the discrete Fourier transformation, which is widely used in the statistics, time series analysis. Values of braking distance and maximum deviation from the desired trajectory during service and emergency braking on roads with different coupling coefficient (dry asphalt, wet asphalt, snow) were determined. A comparative analysis of theoretical results with experimental is conducted, and it was found that error in determining the braking distance value when service braking does not exceed 9,65%, emergency — 9,95 %; error in determining the deviation of the desired trajectory when service braking does not exceed 9,91 %, emergency — 8,33 %. Increasing the change intensity of control parameters of hydrostatic-transmission hydromachines when service braking (transition from the I slowing level to the IV) leads to reducing the braking distance and increasing the deviation of the desired trajectory. During the service braking there is an insignificant increase in braking distance — up to 3,79 % and an increase in deviation from the desired trajectory — up to 25 % when changing road conditions towards a decrease in the coupling coefficient of wheel with the supporting surface as a result of artificial limitation of tractor deceleration by the control parameters of hydrostatic-transmission hydromachines and their low change intensity. The above findings allow to get a broader understanding of the braking process of

tractor «Fendt 936 Vario» and enhance the occupational safety of operators-drivers of these tractors.

Keywords: braking, hydrostatic-mechanical transmission, experimental research, braking distance.

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