ABSTRACT AND REFERENCES

ENGINEERING TECHNOLOGICAL SYSTEMS

DOI: 10.15587/1729-4061.2018.142628

DEVELOPMENT OF A MODEL FOR THE ESTIMATION OF FINANCIAL PROCESSES IN LOGISTIC SYSTEMS AT INDUSTRIAL ENTERPRISES (p. 6–16)

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The model and the method for assessment of the effectiveness of management of financial processes in logistic systems of industrial enterprises were substantiated. The model takes into consideration the parameters of financial flows and their cumulative effect on overall efficiency. The method was developed based on calculation of the integral index by the criteria of liquidity, balance, intensity, and sufficiency of financial flows, taking into consideration the structure of factor features.

The groups of factors were generated based of the methods for data standardization and actualization, which determine the key criteria for the management of financial processes at industrial enterprises under conditions of logistication of economy. The economic content of correlation dependences between the latent factors and their variables was interpreted. The level of influence of the key criteria on the general state of management of financial processes in logistic systems was determined with the use of the methods of taxonomy. The formula of calculation of the integral index was proposed in order to ensure a reliable assessment of the final state of the management of financial processes (high, medium, low, rather low). The permissible limits of its fluctuations were established by the method of the Shewhart control charts.

The application of the model provides the design of objective recommendations regarding decision-making on the regulation of the corresponding indicators in the context of the selected key criteria.

The software IBM SPSS Statistics (Russia) was used for the calculations, which makes it possible to analyze the values of arrays of information and level the errors in justifying decisions.

The proposed model can be useful for economic entities in the international format. It opens up additional possibilities for evaluation, taking into consideration the life cycle of an enterprise, industrial tendencies, the stage of logistication of the world economy.

Keywords: logistication, management of processes, taxonomy method, integral indicator, model for assessment of financial processes.

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DOI: 10.15587/1729-4061.2018.142674

IMPROVING THE QUALITY OF FORGINGS BASED ON UPSETTING THE WORKPIECES WITH CONCAVE FACETS (p. 16–24)

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We propose a forging method for forgings, which implies the upsetting of workpieces with concave facets. A procedure for the theoretical research has been devised aimed at studying the mechanism of closure of artificial axial defects in workpieces. The study was performed based on a finite element method. The key examined parameter was the depth of the concave facets in a workpiece. This parameter varied in the range 0.75; 0.85; and 0.80. The angle of the concave facets was 120°. The results of the theoretical study are the following distributions: deformations, temperatures, and stresses in the body of a workpiece in the process of upsetting the workpieces with concave facets. Based on these parameters, we established an indicator of the stressed state in the axial zone of the workpiece.

In order to verify the theoretical results obtained, a procedure for experimental research has been developed. The study was performed using the lead and steel workpieces. The results of the theoretical study allowed us to establish that the effective depth of the concave facets is the ratio of diameters of protrusions and ledges equal to 0.85. At this ratio there occurs the intensive closure of an axial defect. This is due to the high level of compressive stresses when upsetting the workpieces with concave facets. We have established the effective degree of deformation at which the intensive closure of defects takes place. Also established are the distributions of deformations for the cross-section and height of the workpiece, as well as a change in the indicator of the stressed state in the process of upsetting workpieces with concave facets. The closure of axial defects has been confirmed by experimental study using lead and steel samples.

The new technique for upsetting workpieces with concave facets has been implemented. The results of ultrasonic testing have allowed us to establish that the obtained parts do not have internal defects, which exceed the requirements of the European standard SEP 1921. Our research has led to the conclusion of the high efficiency of the proposed new method for upsetting workpieces with concave facets, which implies the improvement of quality of the axial zone of large forgings when using a given technique.

Keywords: concave facets, upsetting, stressed-deformed state, axial defects in ingot, high-quality forgings.

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DOI: 10.15587/1729-4061.2018.141303

PRINCIPLES OF CONSTRUCTION AND IDENTIFICATION OF A MULTILEVEL SYSTEM FOR MONITORING PARAMETERS OF TECHNOLOGICAL CYCLE OF CASTING (p. 25–32)

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For the creation of a multi-level system of integrated control and operational management of physical-chemical and technological casting processes, deterministic causality of technological objects was determined. These objects are involved in the processes of melting, ladle and heat treatment in the production of ductile iron castings. This made it possible to develop a block diagram of selection and optimization of key technological parameters, geometry of gating systems for the lost-foam casting.

In order to ensure continuous control over a set of parameters of technological processes, equipment and environmental safety, key factors of influence of technological parameters were determined. To this end, the Ishikawa diagram was used to evaluate the effectiveness of the parameters and casting objects influence during lost-foam casting on the casting quality and environment. The expediency of using the Ishikawa diagram for the theory and practice of casting production was determined. Methods using the Ishikawa diagram were developed, which allow identifying and defining the deterministic influence of factors of the first, second, third order on technological processes and casting objects, as well as environment. They also provide an opportunity to determine the effectiveness of using the Ishikawa diagram in the production of high-quality cast products of iron-carbon alloys, including ductile iron.

Basic data on the identification of casting objects and processes as the full cycle of production of ductile iron and castings of it by lost-foam casting were obtained. This will allow constructing a multi-level system for controlling the parameters of the full technological cycle using modern computer information technologies, as well as monitoring the environmental condition of casting objects and determining their environmental impact.

Keywords: casting quality, ductile iron, deterministic causality, factors of influence, Ishikawa diagram.

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DOI: 10.15587/1729-4061.2018.142483

DEVELOPMENT OF COMPLEX-STRUCTURE ORE DEPOSITS BY MEANS OF CHAMBER SYSTEMS UNDER CONDITIONS OF THE KRYVYI RIH IRON ORE FIELD (p. 33–45)

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In order to keep their positions in the world markets, mining enterprises of the Kryvyi Rih iron ore field using the deep-mine method need to develop a resource-saving technology for the development of the fields represented by complex-structure ore deposits. Development of the resource-saving technology must be carried out at the initial stage which is directly related to ore extraction and affects content of iron in the extracted ore mass. Growth of iron content in the extracted ore mass can be achieved through the use of selective development of the extraction blocks by means of the chamber development systems.

The existing procedure of determining structural components of the chamber system of development applied at the Kryvbas mines does not take into account thickness of the overlying strata on the side of the hanging wall of the cleaning chamber when calculating the exposure strike. Therefore, it is necessary to improve the procedure for determining the structural components of the chamber system of development when working out complex ore fields, in order to obtain high extraction rates.

For the development of the extraction block, it was suggested to carry out the cleaning works sequentially from the hanging to the lying wall of the complex-structure ore field with the use of the chamber system of development with leaving the non-ore or ore-containing inclusion in the pillar. This sequence of cleaning will reduce concentration of tensile and compressive stresses in the middle part of the non-ore or ore-containing inclusion which will contribute to a 1.5–2.0-time increase in its stability.

It has been established that stability of the cleaning chamber, in addition to its dimensions and physico-mechanical properties of the ore, is influenced by horizontal thickness of the inclusion, safety factor, its life span and the sequence of cleaning in the extraction block. Thus, at the safety factor of rocks of the non-ore inclusion less than 10–12, it is expedient to use the sublevel-chamber version of the development system, otherwise, the horizonal-chamber version.

Keywords: deep mining, iron ore, stress, stability, chamber system of development.

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DOI: 10.15587/1729-4061.2018.142023

APPLICATION OF THE NEW STRUCTURAL SOLUTIONS IN THE SEEDERS FOR PRECISION SOWING AS A RESOURCE SAVING DIRECTION (p. 46–53)

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The study reported here provides a possibility to improve the reliability of conducting a technological process of dispensing the seeds, which affects the efficiency, that is, the cost of seed material, by introducing a dispenser of targeted action to the design of the sowing unit.

The pneumomechanical machine with the dispenser of targeted action has been developed to conduct our research. The suction active cells of the dispenser change their position at rotation in order to better target the dispensed seed.

Experimental research has confirmed that the dispenser with targeted action improves dispensing conditions for sowing seeds by using the active suction cells.

The result of using the new structural solution for the dispenser is a 12 % increase in the precision of implementing the technological process of forming a regular one-grain flow of seeds.

We have devised a procedure for experimental research into establishing and determining the reliability parameters when the unit performs a technological process of sowing.

We have established patterns in the emergence of gaps and double items depending on the basic technological parameters in the operation of a sowing device: motion speed of the dispensing element and degree of rarefaction in the vacuum chamber.

The research revealed that soybean seeds almost do not form double items with the probability of their occurrence close to zero.

We have determined values for the stochastic indicators of precision in the implementation of technological process of sowing, which confirmed the advantages of the unit with targeted action as compared to a standard one.

To assess the performance of sowing units' operation, it is expedient to use a comprehensive indicator for the probability of sowing precision, which includes the likelihood of gaps, the probability of the formation of double items, and the likelihood of seed deviations from the specified point of seeding under an almost missing inversion. The probability of sowing precision for the experimental unit, as a comprehensive indicator for the improved efficiency of its application, is larger than that of the standard one by 0.11.

The result of using the new structural solution for the dispenser is the improved precision of execution of technological process of forming a regular one-grain flow.

Keywords: pneumomechanical sowing unit, dispenser with targeted action, seeds, precise sowing, probability of gaps, probability of double items, likelihood of sowing precision.

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DOI: 10.15587/1729-4061.2018.143133

INFLUENCE OF ELASTIC CHARACTERISTICS OF RAW COTTON ON THE MECHANICS OF FEED ROLLERS IN THE CLEANERS FROM LARGE IMPURITIES (p. 53–60)

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The impact of harvesting time on the quality of raw cotton, as well as on the physical-mechanical properties of the fiber, is of paramount importance, as the cotton's maturity and content of impurities affect the quality of cleaning cotton from impurities. Our experimental study was carried out under actual field conditions. Research results have confirmed that harvesting time significantly affects the maturity and quality of raw cotton. It was established that more than 60 % of the raw cotton, harvested at the cotton boll opening from 50 % to 60 %, meet the requirements of the first industrial grade, that is, the fiber breaking load exceeds 4.5 cN. Given the fact that mature raw cotton deforms well, it leads to the enhanced cleaning effect.

The result of theoretical research is the established spreading efforts during deformation of a cotton layer by the cleaner's blades and the analyzed shapes of the deformed layer of cotton. We estimated the elastic characteristics of raw cotton and calculated spreading efforts. To determine the numerical values for the pressure forces at which a blade acts on the flow of raw cotton, for a coefficient *K* of the generalized properties of a material, the magnitude V for raw cotton was adopted in a range of 0.25–0.3.

Experiments have shown that a layer of raw cotton with a thickness from 170 to 380 mm and a width of 700 mm was loaded with the force of 3–10 kgf concentrated along the line. Based on our calculations, it was established that 38.89 % of the raw cotton cleaning time accounts for the operation of a single blade of the roller.

The result of our experimental and theoretical research is the data that make it possible to organize effective operation of cleaning machines in the cotton cleaning industry.

Keywords: raw cotton, breaking load, large impurities cleaner, cotton mill, maturity of raw cotton, flow of raw cotton, cotton «fly» particle.

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DOI: 10.15587/1729-4061.2018.143825

DEVELOPMENT OF METHODS TO CONTROL QUALITY OF THE STRUCTURE OF CROSS-WOUND PACKAGES (p. 61–70)

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The process of winding is one of the principal processes in the textile industry. Quality of the formed packages largely defines the quality of the finished product in the textile industry, as well as labor productivity and equipment performance. Therefore, attention to analysis of processes of package formation, construction of new promising methods and designs of winding mechanisms, has been growing for many decades. We address issues related to the analysis of control methods over the structure of the cross-wound winding used in spinning production. The structure of winding is understood in the present work as the mutual arrangement of threads when they are laid on the surface of the package. Thus, the parameters of the structure include such quantities as a turn lifting angle, a distance between the points of turn reversal, a step in turns, etc.

It is known that the mutual arrangement of turns on the winding body when packages are frictionally driven is not homogeneous. Under certain ratios between rotation speed of the bobbin and motion frequency of the thread guide, the threads are laid on the same place. In this case, the so-called braid formations are observed. If motion frequencies of the bobbin and the thread guide differ slightly from the multiple ones, turns are placed close to each other, in this case, a tape winding is formed. The braid winding is accompanied by a number of phenomena, which negatively affect quality of the formed packages. In this case, the shear and displacement parameters are determined based on empirical data. To substantiate the approach to choosing the technological parameters for such mechanisms, we performed a theoretical analysis of the process of braid structures formation in terms of the force interactions between threads. To make such a choice, it is necessary to have an instrumental procedure for quantifying the winding structure parameters, which is why we have in detail investigated methods for their registration.

Keywords: defects of winding, defects of structure, tape winding, braid winding, shear of turns, turn reversal point.

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DOI: 10.15587/1729-4061.2018.143674

STABILIZATION OF PHYSICAL-MECHANICAL CHARACTERISTICS OF HONEYCOMB FILLER BASED ON THE ADJUSTMENT OF TECHNOLOGICAL TECHNIQUES FOR ITS FABRICATION (p. 71–77)

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Objective preconditions for a more effective application of honeycomb structures in a number of industries are not only their advantages, already implemented and proven, but also resolving some

of their problems. Regardless whether the honeycomb filler is made directly at an enterprise or purchased before forming a structure, it is subjected to various technological operations. In the course of these operations, some of its geometrical parameters undergo change, which is also related to its physical-mechanical characteristics.

The paper reports a study into ensuring the physical-mechanical characteristics of honeycomb fillers in the cases when its characteristics are beyond the limits of permissible values due to certain deviations in the geometry of honeycombs, which are to be purposefully adjusted in the process of fabrication of a given material. Based on the conditions for the strength of honeycomb filler in terms of the uniform detachment during stretching a honeycomb packet into a block, we have adjusted its physical-mechanical characteristics by ensuring the regulated range of the honeycomb's cell stretching angle within the limit of the assigned region of its shape change coefficients.

We have obtained the regulated relationship between technological parameters and the honeycomb packet stretching angle and a shape change coefficient. The dependence makes it possible to determine the required range of technological parameters for implementing the physical-mechanical characteristics of honeycomb filler, required by the standard, with the predefined input geometrical parameters of its cell. We have analyzed all existing technological techniques for applying glue bands on a honeycomb filler's material based on the relation between the step of applying the bands, the cell shape change coefficient, and the dimension of its side. The results obtained make it possible to improve the standard production processes for honeycomb fabrication, which in turn will increase the stability of physical-mechanical characteristics of the honeycomb filler, as well as the structures based on it.

Keywords: honeycomb filler, adjustment of physical-mechanical characteristics, technology, cell opening angle, shape coefficient.

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