ABSTRACT AND REFERENCES

ENGINEERING TECHNOLOGICAL SYSTEMS

DETERMINING THE EQUATION OF SURFACE OF ADDITIONAL BLADE OF A SCREW CONVEYOR (p. 4–9)

Dmitry Chasov

Analysis of directions of upgrading screw conveyors, used for the transportation of chips and sludge, was performed.

We conducted analysis of equations of determining critical rotation frequency of the screw, the values of which influences the angle of beginning of movement of material along the blade. Equations of the surface area of additional blade in a general form were analyzed. Using frontal dissection of the gutter, Authors analyzed equation of normal loop taking into account the angle of beginning of movement of material, affected by the angle of attack of the blade.

The aim of the work is to obtain equation of the line of intersection of the screw surface and the surface area of additional blades, which possesses considerable value for carrying out calculations and designing constructive parameters of screw conveyors with improved performance for the transportation of metal chips.

The formula for determining improved angle of beginning of movement of material along the surface of additional blade was obtained, which allows taking into account the impact of fluid angle. The dependency of equation of the blade surface in the polar coordinate system was described, which gave us the opportunity to develop equation of the line of intersection of the screw surface and the area surface in the parametric form.

Authors theoretically substantiated positive impact of additional blades of screw conveyor on decreasing the lifting and driving force for moving the metal chips through the reduction of forces of internal friction of transported metal chips, which is achieved by partial removal by additional blades of the layer of chips from the general stream in the gutter of a screw conveyor. Mathematical dependency for determining effective angle of beginning of metal chips motion along additional blade of the screw's spiral was obtained, and the law of its movement along the blade was established.

We designed, manufactured and tested under laboratory and industrial conditions the prototype sample of a screw conveyor with different angles of attack of additional blades, which can be used in the process of designing similar conveyors for specific workshop conditions.

Keywords: additional blade, screw conveyor, equation of screw surface, lifting and driving force, chips.

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DESIGNING THE LARSSEN TYPE SHEET PILE SHAPE WITH THE INCREASED BEARING CAPACITY (p. 10–14)

Oleg Nosenko

The paper deals with improving the Larssen sheet pile shapes on the basis of a new design concept of bending shapes.

A new theoretical concept was developed, which consists in the fact that:

– the design of shapes shall comply with the terms of rational material distribution in the cross-sectional plane of the shape;

– an increase in the specific material consumption rate shall be ensured (W/G, cm^3/kg);

– the material concentration in the shape (W/F·h) and the shape efficiency ($W/F \cdot h \cdot F_w/F_{fl}$) shall remain in the same range as those of the analogs.

As a result, two sheet pile shapes with increased bearing capacity were designed. The first one, Larssen-7 shape (W=5010 cm^3/m.sh.p.w.) was developed and adjusted for the conditions of production on the outdated rail and structural steel mill at the limit of its technical characteristics, and the second, Larssen 7H sheet pile shape (W=5200 cm^3/m.sht.w) – on the new projected universal beam mill.

Keywords: steel sheet pile, sheet pile, sheet pile wall, bearing capacity, section modulus, Larssen type sheet pile shape, U-shape.

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THE WORKING PRESSURE RESEARCH OF PISTON PUMP RN-3.8 (p. 15–20)

Sergey Kravchenko, Stanislav Popov, Sergey Gnitko

The research of working pressure of one-piston pump with a combined compensator of pressure pulsations during the operating cycle is carried out. One of the basic gas law in an isothermal process, namely the law of Boyle-Marriott is employed. The law of piston motion which is driven from the crank-connecting rod mechanism (the axis of the crank shaft is made offset downwards relative to the axis of the piston to reduce the magnitude of lateral forces) is used. The piston drive crank rotation angle, the primary pressure in the compensator are taken into account.

The research is needed to ensure a stable high-pressure feed of medium (solution) pumped by the pump, with a reduced level of pulsation.

The quantitative dependences of the solution volume in the compensator on the piston movement, the solution feed pressure relative to the crank shaft rotation angle, the minimum required amount of total given volume of combined compensator air (it is 0.02 m^3) are defined.

Practical significance of the obtained results of the research is to develop a piston pump design. It provides a stable feed pressure, moderate pulsation level of the solution, which is pumped.

Keywords: degree of pressure pulsation, combined compensator, feed pressure, crank, stroke of injection, intake stroke, compressed air, piston stroke.

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DEVELOPMENT OF THE SYSTEM ARCHITECTURE FOR DESIGN WORKS AUTOMATION (p. 20–26)

Viktoriia Zakharchenko, Viktor Nenia

The analysis of the current state of development of the systems for design works automation (CAD systems) showed the insufficient development both of the system functioning management in general, and of the management of the design procedures performance. System analysis of the design process as an automation subject is carried out. Taking into account requirements of continuous development of the system for design works automation, the separate interaction

channels with developers of CAD system components in the structure of this system are provided.

The technique of the design procedures organization is offered. The same performance of design procedures on different design stages and phases, the formation of ToR for the design and tasks for the performance of design procedures are provided. This approach provides the organization of the design process and its software and information support, the possibility of design works accounting, the monitoring of their status and management of them.

The description of components of the information system for the application automation of CAD elements is provided. The system includes databases units. They consist of contracts description, description of project structure, ToR for the design of technical objects, description of designed objects structure, description of tasks for the design of designed object components and the log-book of the performed tasks for design works with different powers to data access. Necessary information flows and the sequence of their implementation for the organization of the design process of technical objects are defined. Separate units make templates of design documents, current and completed design solutions.

The need of existence of three types of the functional software is revealed: the monitoring program of a system status, the client program of a system user and the package of applied design programs.

The charts of interaction between designers and the design system and between the system elements among themselves during the design works performance are provided.

Thus, the conceptual structure of the system for the organization of the process of the computerized technical objects design and the management of developers during the implementation of this process are offered.

Keywords: system for design works automation, information model, system architecture.

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APPLYING THE LTCC-TECHNOLOGY TO OBTAIN HEXAFERRITES FOR BASE LAYERS OF MICROSTRIP SHF DEVICES (p. 27–31)

Denis Chitanov, Vladimir Kostishyn, Lev Kozhitov, Artem Adamtsov

By the method of low-temperature co-fired ceramics (LTCC), with the addition of a small amount of reaction glasses with the composition Bi_2O_3–B_2O_3–SiO_2–ZnO (BBSZ), we obtained the samples of isotropic and anisotropic polycrystalline hexaferrites $BaFe_{12}O_{19}$ and $SrFe_{12}O_{19}$ for the base layers of the subminiature microstrip ferrite untying instruments of the short–wave part of the millimeter wavelength ranges.

The LTCC-technology makes it possible to simultaneously achieve compaction of the samples below 900 °C using the process of sintering of hexaferrites with the addition of a small amount of reaction glasses, which are based on Bi–B–Zn–Si–O (BBSZ).

It was established that the use in the LTCC-technology of operation of pressing the samples (tablets) in the magnetic field makes it possible to obtain anisotropic hexaferrites, pressing without magnetic field – isotropic hexaferrites. The application in the LTCC-technology of the method of casting a tape allows obtaining entirely isotropic samples.

Development of the technology of low-temperature co-fired ceramics, which consists of alternating ferrites and internal metal electrodes, is relevant in the production of miniature SHF-devices.

Keywords: hexagonal ferrite, LTCC-technology, microstructure, reaction glasses, density.

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ANALYSIS OF INDICES OF RELIABILITY OF CASCADE THERMOELECTRIC COOLERS IN VARIOUS CURRENT MODES (p. 32–41)

Vladimir Zaikov, Vladimir Mescheryakov, Yurii Zhuravlov

Strict requirements for the operating conditions for thermally loaded elements of radio-electronic systems contribute to essential relevance of the problem of increasing the indices of reliability of thermoelectric coolers in the implementation of their thermal modes. This leads to the need for increasing the indices of reliability not only through the use of new materials, design and technological solutions, but also optimization of the current modes of thermoelectric modules.

The aim of this work is the search for the possibility of increasing the indices of reliability of cascade thermoelectric coolers, without changing their design parameters and material of thermoelements, by the selection of current modes at varied operating conditions.

In the work we proposed a mathematical model of interrelation of the relative magnitude of the failure rate of two-stage thermoelectric device with the number of thermoelements, relative operating current, thermal load, and temperature difference in the temperature range of workability of a cooler.

We carried out comparative analysis of the main significant parameters and indices of reliability of two-stage thermoelectric coolers for different current modes of operation in a wide range of temperature differences from $\Delta T=60$ K to $\Delta T=90$ K, taking into account the thermal load. It was demonstrated that with an increase in the general temperature difference, the ratio of the number of thermoelements in the adjacent cascades increases, the total number of thermoelements increases, the refrigeratory coefficient decreases, the relative magnitude of the failure rate grows and the probability of failure-free operation decreases. We obtained expression for determining the optimum relative operating current, at which the minimum value of relative number of thermoelements in the cascades is observed.

Comparative analysis of the main parameters and indices of reliability demonstrated the possibility of selection and implementation of different current modes of operation of a cascade thermoelectric cooler for the varied operation conditions. Two extreme (characteristic) modes were proposed: the mode providing a minimum number of thermoelements, that is, minimum mass and overall dimensions of device; and the mode, providing the minimum failure rate and the maximum probability of failure-free operation. The proposed modes may be applied in the process of designing thermoelectric devices of minimum mass and increased reliability.

Keywords: thermoelectric devices, indices of reliability, operating mode, a temperature difference, thermal load

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