ABSTRACT AND REFERENCES

APPLIED MECHANICS

INTEGRAL CHARACTERISTICS OF ABSOLUTE AND RELATIVE SILO VIBRATIONS UNDER SEISMIC INFLUENCE (p. 4-8)

Vladimir Shpachuk, Nikolay Zasyadko, Alla Garbuz, Anna Abrakitova

The results of investigating the dependence of integral quadratic values of the absolute acceleration and relative shift of a silo body on structural characteristics of the body, columns and seismic influence parameters have been presented in the article. The task of minimization of integral quadratic relative shift of silo by choosing damping coefficient has been solved. The expressions for the optimum value of damping coefficient and integral quadratic criterion as a function of maximum value of absolute acceleration have been obtained. The mathematic model and optimum value of damping coefficient allow to determine structural parameters of bearing silo structure and therefore to provide specified indices of its vibration resistance, vibration strength and durability in use. Graphic dependences of values of integral quadratic absolute acceleration and integral quadratic relative shift of a silo body at modifying the amplitude of seismic influence and the coefficient of relative damping of columns, silo mass and the value of its integral quadratic absolute acceleration have been presented. The data obtained are expected to be used in designing new and modification silo samples, high buildings and structures maintained in seismic zones as well as when developing and introducing active and passive means of damping them.

Keywords: vibration, body silage, seismic effects, displacement, acceleration, damping.

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PARAMETER OPTIMIZATION OF 3D MODELS OF CENTRIFUGAL JUICER WITH AUTO-BALANCER BY MINIMIZATION OF STEADY VIBROACCELERATION (p. 9-14)

Valery Goncharov, Gennadiy Filimonikhin

During the operation of electrical centrifugal juicers (Juicer) with cylindrical filter-sieve (sieve) a depressed weight is unevenly distributed over the sieve, which causing imbalance and vibration of the juicer.

In this paper in order to find the optimal parameters of the auto-balancer the technique, which takes into account the peculiarities of rotary machines with auto-balancer and using the theory of multivariate experiment, was proposed. It includes:

- the process of drafting the "black" box (choice of the objective function, the choice of control factors and their fields of changes in the dimensionless form);
- planning multifactorial experiment;
- research of the obtained results using programs STATISTICA_6 and MathCad (three regression models between the objective function and factors - linear, taking into account the effects of the mutual influence of the first order, quadratic, were investigated).

As a result, studies have shown that:

- auto-balancer reduces vibration acceleration on average 8.4-9.2 times;
- linear and quadratic models are effective in approximation, they give similar optimal points, but a linear function is less accurate in predicting the minimum steady acceleration.

The described technique can be considered as a standard in the optimization of parameters of auto-balancer in the rotor system.

Keywords: centrifugal juicer, acceleration, auto-balancer, multifactorial experiment, functional quality, parameter optimization.

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RATIONALE OF VIBRATION MACHINE DESIGN FOR DRYING GRANULATED AND GRANULAR MATERIALS (p. 15-19)

Igor Zozuliak

Various processing methods are used to bring grain to a steady state for storage, provide quantitative and qualitative grain characteristics, the most effective of which is grain drying. The results of experimental studies of vibration drying and industrial equipment operation experience showed the following benefits of using vibrations in drying dispersed materials: intensive mixing of material particles, intensive moisture removal due to constant renewal of moisture exchange surface, material temperature equalization in the bulk of drying apparatus, drying quality improvement, decrease in the vibro-pseudo-liquefaction startup speed, energy costs reduction, possibility of combining various manufacturing operations at continuous process running (transportation and drying, granulation and drying, shell formation and drying, fractionation and drying, etc.), creation of new highly-efficient vibration dryers with adjustable vibration settings. Having analyzed some types of vibration dryers it was decided to develop the design solution of the dryer for granulated and granular materials with high and controllable heat-mass transfer intensity. The proposed design solution allows simultaneously implement two controlled drying processes for heat-mass transfer intensification during drying bulk materials. There is intense moisture evaporation from the upper layers of granulated and granular materials due to the imposition of a temperature gradient on the controlled vibration mixing and motion (realized by bulk material displacement) along the section of U-like body in the first section of U-like vibration machine body. The moisture, remained in the central layers of granulated and granular materials in the second section of U-like vibration machine body at controlled mixing and motion of bulk material along the section of U-like body is intensively removed by convective drying method using the hollow branch pipe with gas-distributing holes.

Keywords: grain, drying, convective drying, vibration machine, vibration, imbalances, vibrodrive, vibrofluidized bed.

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RESEARCHING HYDRAULIC PROPERTIES OF A ROTOR-PULSED APPARATUS WHEN TREATING OF WATER-GRAIN MIXTURE (p. 19-22)

Alexander Obodovych, Anna Lymar

The most important feed-processing operation is the feeder grain refinement, which increases the surface area of grain material, improves the interaction between food and digestive enzymes. The equipment for carrying out this operation is still faulty because it does not allow obtaining a particle size of less than 500 microns. One of the most promising ways for improving production efficiency lies in using a rotor-pulsed apparatus based on the principle of a discrete-pulse energy input.

The results of studying hydraulic properties of the rotor-pulsed apparatus when treating a water-grain mixture are given in the paper. Optimal treatment modes of the media were chosen. The performance of the RPA in dispersing grain mixture has been studied. It has been proved that these indexes together and separately affect the head and flow characteristics of the rotor-pulsed apparatus. The obtained results allow applying when desiging industrial facilities for slop feed preparation.

Keywords: rotor-pulsation apparatus, hydraulic characteristics, water-grain mixture, slop feed.

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MATHEMATICAL MODELING OF OSCILLATIONS WHEELSET AS THE BASIS OF THE METHOD OF ACOUSTIC CONTROL (p. 22-28)

Igor Martynov, Vyacheslav Bondarenko, Dmitry Skurikhin

This publication argues the need for onboard condition monitoring of the railway car wheelsets in operation. Mathematical modeling of oscillations of the wheelset with short isolated irregularities on the surface of the rolling wheels was offered in the article. To solve the problem was developed three-dimensional finite element model of the wheelset type RU1SH-957. Mathematical modeling conducted in MSC Nastran. In determining the natural of frequencies and waveform of the railway car wheelset, the method Lanczos was applied as the most effective for most designs. We obtained results that maximum vibrodisplacement take place on the first natural frequency of oscillations of the wheelset wile motion with short isolated roughness on wheel surface. Definitely the speed of the car in which the forced vibrations of the action of periodic forces overlap, and the duration of the shock interaction between wheel and rail is not dependent on the speed of the car and the size of the roughness on the surface of the rolling wheel. The results are used for building acoustic diagnostic model and as boundary conditions in the simulation of field of wheelset noise emissions in undercar space

Keywords: wagon, wheelset, vibrodisplacement, acoustic control, diagnostic features .

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MODELING OF PARTICLE DYNAMICS IN A VERTICAL THREE – LAYER – MIXER OF BULK MATTERS (p. 29-34)

Anatoliy Mironenko, Olexiy Zavgorodnii

The mathematical model, describing scattering dynamics of grain mixture particles at the top of the three-layer vertical mixer, equipped with cantilever shafts and impeller is given in the paper. The proposed model allows considering the aerodynamics of complex vortex flows, created by rotating cantilever shafts, and grain particle interaction with the screw.

The aerodynamics model is based on the equations for ideal incompressible fluid, which are solved by the discrete vortex method. Grain particle movement is simulated within the particle dynamics model. For that, the equations of particle motion on the rotating helical surface were obtained. A simple criterion for the cantilever impeller operation efficiency in the mixing process, based on the introduced scattering coefficient was proposed.

The proposed model allows conducting a computational experiment to determine the optimal impeller design parameters and the optimal mixer operating modes.

The calculations confirmed the efficiency of installing cantilever shafts with impeller in the vertical mixer. The results of numerical calculations, performed on this model were used in the design and manufacture of vertical feed mill small-sized installation VFMSSI-04.

Keywords: bulk medium, mixing quality, feed mill installation, discrete vortex method

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STUDY OF VIBRATION IN THE PROCESS "DUMPER-TECHNOLOGY ROAD" (p. 35-44)

Yuri Rud, Ivan Radchenko, Victoria Belonozchko

Systems study of vibrations of dumpers at their motion on technology roads of complex profile is considered in the paper.

The task to investigate vertical vibrations of the mass center of the system "dumper - technology road" and its rotational vibrations around the horizontal axis, passing through the center of masses, as well as to determine natural frequencies of these vibrations using the new mathematical model is set.

To set up differential equations for vertical and rotational vibrations of dumper around the horizontal axis, passing through the center of masses, it is presented as a rigid beam, which mass is equal to the mass of the car. Rigid beam leans on the system of springs with the corresponding rigidity, determined by the car suspension rigidity, including rigidity of tires.

An analytical study of free vibrations of the system "dumper" at its motion on technology roads allows to draw the following conclusions.

Vertical displacement of the mass center of the system and the angle of mass rotation around the horizontal axis, passing through the center of masses, at motion on the rough road are represented as harmonic vibrations. For the loaded dumper, the cyclic frequency of natural vibrations decreases slightly compared with unloaded one that is caused by the increased inertness. There is always a critical speed of dumper at its motion on the rough road, at which the vibration amplitude becomes unacceptably large, as a result, the loads on components and parts unacceptably increase.

The research results can be used at the operation of dumpers at their motion on technology roads.

Keywords: system, dumper, technology road, model, vibrations, natural frequencies, amplitude.

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STRESS - STRAIN STATE OF MUSHROOM TAIL CONNECTIONS OF STEAM TURBINE BLADES (p. 44-47)

Tatiana Fursova

The distribution of strains in a two-point mushroom tail connection of a steam turbine blade is examined, and some results of the studies in this field are given in the paper. The main objective of the study lies in identifying and analyzing the VAT of a two-point mushroom tail connection by using experimental and computational methods for determining areas of the greatest risk due to the force and geometric strain concentration. The study of stress - strain state of a two-point mushroom tail connection within elastic deformations using the ANSYS software package has been carried out in the paper, and a comparison between the results of experimental and calculated data has been made. The zones, posing the greatest danger caused by the force and geometric strain concentration, have been determined. The research results can be used in turbine construction, when designing and exploiting steam turbines. It is proposed to apply the obtained results for preventing possible damages in the strain concentration zones.

Keywords: stress - strain state, strain measurement, tail connection, blade, steam turbine

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DIAGNOSTICS OF ELECTRIC TRANSPORT TRACTION ELECTRIC MACHINES (p. 48-53)

Vyacheslav Shavkun

Improving the reliability of trolley traction motors can be achieved by further improving the traction motor design and their control parameters in the manufacture, repair and

operation on the line. Technical diagnostics of traction motor parameters plays an important role in solving these problems.

Known diagnostics methods of traction motors allow to detect their faults. But there is a need to improve these methods, taking into account the capabilities of modern measuring systems and information processing tools. This will allow to improve the performance indicators of urban electric transport enterprises due to improving the operational reliability of traction motors and extending their service life. The relevance of this problem is also caused by the tendency to increase the probability of correct and accurate diagnosis at various faults in electric machines.

The operational reliability of trolley motors was comprehensively analyzed, and regularities of their parameters change during operation depending on several factors were determined in this paper. Mathematical modeling of traction motors to determine their parameters change during operation was conducted. An algorithm for diagnosing and determining the operational reliability of trolley traction motor elements using the boundary criteria was developed and the reliability calculation methods, allowing to predict failures of traction motor elements with a high adequacy degree were proposed. Practical recommendations for the rational selection of diagnostic parameters of traction motors were given.

Keywords: traction motor, operational reliability, diagnostics, failure rate, diagnostic parameter.

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THE RESEARCH OF POWER CHARACTERISTICS OF THE ROTARY WORKING BODY FOR INTER-ROW TILLAGE (p. 53-58)

Svetlana Bielovol

The analysis of power characteristics, acting on a rotary body with a vertical rotation has been carried out. It has been determined that the rotation of discs in different directions will be rational in terms of energy consumption and quality of inter-row tillage. According to the results of a kinematic analysis it has been determined that with the growth of relations between a rotary and a translational velocity of the working body its draft resistance decreases. The theoretical results are allowed justifying the technical solution of the rotary body and developing a pilot unit for inter-row tillage. Experimental studies of the dependence of the working body draft resistance of the proposed design on its parameters have been conducted. A statistical processing of experimental data has been made. The results of theoretical studies have been experimentally proved, and the optimal values of angular and translational velocity of the rotary body have been substantiated. Using the rotary bodies of the proposed design with reasonable parameters will provide a high quality inter-row tillage for rational indicators of energy consumption and process efficiency.

Keywords: rotary body, angular velocity, longitudinal velocity, draft resistance, optimization of parameters.

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HEAVY MACHINERY DYNAMIC LOAD UNDER COLLISION OF ADJACENT LINKS

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The mathematical model, describing the dynamics under collision of heavy machinery adjacent links in the presence of gaps and other elements with a dead or smoothness zone of transfer functions of kinematic chains, is given. The model is designed using a procedure of "smoothing" discontinuous functions and regarding a variable structure. The specific example of a dynamic system and its numerical calculation is considered. The pressure between the roller and a workpiece is expressed by means of the Hertz's law. The roller motion is represented as a plane-parallel motion. Four differential equations describe the process of the

roller colliding against the workpiece. By using a numerical integration of differential equations, the solution in the form of diagrams is worked out. The developed technique will allow calculating the resource of the rolling mill table more precisely when designing and thereby, improving its technical level.

Keywords: elastic-inertial system, motion equation, collision of links, kinematics, dynamic load.

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