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N. V. Pereborova

DOI 10.46418/2619-0729_2022_3_1

METHODS OF DIGITAL PREDICTION OF DEFORMATION AND RELAXATION PROCESSES OF POLYMER TEXTILE MATERIALS

The article discusses methods of digital prediction of deformation and relaxation processes of polymer textile materials. Such forecasting is based on mathematical models of the corresponding operational processes of any degree of complexity - from the processes of simple relaxation and simple creep to complex deformation and recovery processes.

Keywords: digital forecasting, polymer textile materials, deformation processes, relaxation processes

V. I. Wagner, S. V. Kiselev, A. A. Kozlov, I. M. Egorov

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METHODS OF MATHEMATICAL MODELING OF OPERATIONAL PROCESSES OF POLYMER TEXTILE MATERIALS

The article considers a variant of mathematical modeling of the operational processes of polymer textile materials, on the basis of which it is possible to predict the specified processes of these materials of any degree of complexity - from the processes of simple relaxation and simple creep to complex deformation-recovery processes and reverse relaxation processes with alternating loading and unloading.

Keywords: mathematical modeling, forecasting, deformation modes of operation, polymer textile materials

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METHODS FOR DIGITAL PREDICTION OF ELASTIC, VISCOELASTIC AND PLASTIC DEFORMATION OF POLYMER TEXTILE MATERIALS

The article proposes a method for determining the elastic, viscoelastic and plastic deformation components of polymeric textile materials. The decomposition of the total strain into components is based on digital prediction of the process of uniform stretching of the specified materials. Knowledge of the elastic, viscoelastic and plastic deformation components of polymeric textile materials is of particular importance in the design of various kinds of products with the required functionality.

Keywords: mathematical modeling, digital prediction, polymeric textile materials, deformation properties, elasticity, viscoelasticity, plasticity

MACHINES, AGGREGATES AND TECHNOLOGICAL PROCESSES

S. V. Kiselev, A. A. Kozlov

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METHODS OF COMPUTER PREDICTION OF DEFORMATION MODES OF OPERATION OF GEOTEXTILE NONWOVEN MATERIALS

The issues of computer prediction of deformation modes of operation of geotextile nonwoven materials, including complex deformation-recovery modes, are considered. The basis of the mathematical model of deformation-operational processes of geotextile nonwoven materials is the spectral-temporal theory of viscoelasticity. The practical use of methods for reliable

prediction of deformation-operational processes of geotextile nonwoven materials is simplified by their digitalization.

Keywords: mathematical modeling, forecasting, geotextile nonwoven materials, deformation processes, recovery processes.

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DEVELOPMENT OF A 3D MODEL OF A WINDING PRODUCT

The results of computer modeling of a winding product created on the basis of a beam of flat sections passing through the packing axis and combined into a 3D model are presented. The modeling algorithm and optimization methods of the 3D model are presented.

Keywords: three-dimensional winding model, computer simulation, winding product, experimental sample.

M. V. Stepanov, A. A. J. K. Mahdi Hamdan, A. G. Usov

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SIMULATION OF A COMPLEX BENDING OF A FABRIC FLAP, CAPTURED BY THE VACUUM SUCKER

The article is devoted to the problem of manipulation with tissue flaps in the process of their movement to the working bodies of technological machines. A flap drawn into a vacuum funnel and compressed by it is considered. A method of computer study of equilibrium multi-folded forms of bending of elastic flaps observed in experiments, and a method for estimating the parameters of a vacuum pump are described.

Keywords: flexible tissue flap, vacuum funnel, complex conical flap shape, imitation of a vacuum device

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MATHEMATICAL DESCRIPTION OF AIR MOVEMENT IN A CYLINDRICAL CHAMBER OF PNEUMATIC MIXER

The article discusses a new design of the pneumatic mixer, which allows for intensive mixing of materials, which leads to an increase in the degree of uniformity and, accordingly, to an increase in the quality of the finished product. The movement of the air medium in the mixing chamber depends on the adjustable parameters of the system (input parameters), which include the speed of the outflow of compressed air; material concentration. To control the mixing process in a pneumatic mixer, the movement of the air medium in a cylindrical chamber is considered. Equations are obtained that determine the components of the air flow velocity vector depending on the geometry of the cylindrical chamber of the mixer. During the description of the mixing process in the mixer chamber, it was assumed that the quality of the individual components coming from the feeders is a constant value, which in turn is the reason for the absence of the effect of perturbing parameters. Based on the data obtained, depending on the dimensions of the chamber, it is possible to determine the rational parameters of the energy carrier flow to determine the field of air flow velocities in the cylindrical chamber of the mixer, on which the degree of uniformity of the dust-gas mixture will depend.

Keywords: pneumatic mixer, air movement, material concentration, compressed air, volumetric energy consumption, chamber dimensions, dry building mixtures.

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INFORMATION DEVICE FOR DIAGNOSING THE TECHNICAL CONDITION OF A LOOM WITH SPECTRAL ANALYSIS OF 3D ACCELERATIONS

A device for diagnosing a loom has been developed, which collects data from vibration sensors, measures vibration along the three axes X, Y, Z, processes data, archives and transfers data to an automated workplace. At the automated workplace, the vibration acceleration parameters are displayed in tabular and graphical form in real time. Also, the received signals are analyzed using graphical information and a spectral analysis of 3D accelerations is performed to determine the diagnostic parameters of the technical condition of the mechanisms.

Keywords: diagnostics, loom, controller, sensor, accelerometer, data transfer, diagnostic parameters, workstation.

A. Yu. Ataeva, G. I. Sverdlik, D. A. Kambolov, A. R. Ataev

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STUDY OF THE CAPS GUIDING CHANNELS INFLUENCE ON THE BUBBLING PROCESSES IN THE JET BUBBLER

The article is devoted to the study of the application of guide channels in the processes of sparging in a jet sparger. The design of an experimental setup is described, which is a fragment of a dust and gas trap with industrial caps size. The conclusions of the theoretical analysis of the bubble behavior during bubbling are presented. The results of the experiments on bubbling at the facility are considered. Based on the results of preliminary tests, the features of the use of guide channels for creating jets collisions were substantiated for the implementation of a new principle of operation in the designed dust collector to expand the range of trapped solid particles, including nanoparticles.

Keywords: jet bubbler, bubbles, wet dust collectors, caps, nanoparticles.

PRODUCT QUALITY CONTROL. STANDARDIZATION. ORGANIZATION OF PRODUCTION

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THE RETURN ON INVESTMENT CRITERIA IN ENERGY SAVING AT LIGHT INDUSTRY ENTERPRISES

The article presents an overview of economic efficiency criteria and return on investment in energy saving. The advantages and disadvantages of the examined criteria are discussed. Examples of energy-saving projects implementation are described along with an assessment of their economic efficiency.

Keywords: textile and light industry, industrial enterprise, consumption of energy resources, cost of production, energy intensity of industrial enterprises, energy saving, energy efficiency, investment capital, payback period, discounted payback period, accounting rate of return, net present value, profitability index, internal rate of return.

D. A. Radushinsky, A. I. Radushinskaya

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ABOUT THE QUALITY MANAGEMENT SYSTEM OF THE PROJECT OF THE MARINE CRUISE CENTER IN SAINT PETERSBURG

He article is devoted to updating the requirements for the quality management system for the implementation of the sea cruise center project in St. Petersburg, based on current features and future changes in the composition of the target audience of the project and other factors of influence. As part of the formation of the foundations of the quality management system (QMS), when analyzing the risks and opportunities of the project, such influencing factors were identified as: an increase in the number of target audiences of the project from a number of Asian countries; the need to create mechanisms for intercultural exchange between new segments of the target audience of Russian and Asian tourists against the backdrop of a decrease in the number of "traditional" target audiences; the feasibility of taking into account and applying prospective requirements for energy saving and the use of renewable energy sources; other factors. The results of the study can be used in the formation of the QMS of the sea cruise center in St. Petersburg, as well as in the implementation of projects in the tourism industry aimed at the interaction of target audiences of Russian and Asian tourists. The results of the study can be used to modernize the requirements for the QMS of the operating companies of domestic cruises on the rivers and lakes of Russia.

Keywords: Quality management, quality management system (QMS), risks and opportunities in the formation of the QMS, sea cruise center in St. Petersburg.

M. B. Sukhanov

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CLUSTER ANALYSIS OF INVESTMENT PROJECTS IN THE RUSSIAN LIGHT INDUSTRY

In this article, using cluster analysis, the largest investment projects of the Russian light industry in 2013-2022 are grouped into three groups, each of which is homogeneous in terms of such indicators as the amount, duration, and year of project start. As a result, all projects were classified by the amount of investments into large, big and medium.

Characteristic features were revealed for each of the formed groups. The results obtained should be taken into account when planning new projects for the organization of production in light industry.

Keywords: production organization, project management, data analysis, standardization, hierarchical clustering, agglomerative strategy

K. V. Kaisheva, A. I. Bogdanov

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MATHEMATICAL MODEL OF JOINT OPTIMIZATION OF QUALITY, PRICE AND MARKETING COSTS OF A NEW PRODUCT

A mathematical model of joint optimization of quality, price and marketing costs of a new product is proposed according to the criterion of maximizing profit from its sales, analytical expressions are obtained to determine the optimal quality, price and marketing costs. An example of solving the problem on the data of a light industry enterprise is given.

Keywords: optimization, profit, price, quality, marketing costs.

R. A. Gorshkov, P. P. Rymkevich

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USE OF GROUND HEAT FOR HOT WATER SUPPLY

The article presents a model of the use of renewable energy sources and secondary energy resources at textile and light industry enterprises. A diagram of a hybrid heat pump installation is shown. The method of calculating the costs of thermal energy for the needs of hot water supply in an administrative building is given. Formulas for calculating the savings of thermal energy and cash flows achieved as a result of using a heat pump unit at an industrial enterprise are given.

Keywords: textile and light industry, industrial enterprise, consumption of energy resources, cost of production, energy intensity of industrial enterprises, energy saving, energy efficiency, hot water supply, ground heat, heat pump.

L. N. Nikitina, E. A. Kraikina, P. A. Shikov, N. M. Kasumova, A. N. Salamatova, T. A. Fliagina

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EFFECTIVE USE OF ASSETS OF TEXTILE INDUSTRY ENTERPRISES AND PLANTS PRODUCING CHEMICAL FIBERS IS AN IMPORTANT DIRECTION OF IMPORT SUBSTITUTION

The main purpose of this study is to establish the influence of the balance structure of textile and chemical industry enterprises on the efficiency of their activities. In accordance with this goal, the balance sheets and financial reporting forms of the leading enterprises of the textile and chemical industry in the federal districts were analyzed.

Keywords: textile industry, chemical fibers, federal districts, current assets, non-current assets, profit, revenue, correlation.

TECHNOLOGY AND PROCESSING OF SYNTHETIC AND NATURAL POLYMERS AND COMPOSITES

N. P. Midukov, M. A. Litvinov, T. I. Efremov, V. S. Kurov

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STUDY OF PAPER AND CARDBOARD MICROSTRUCTURE BY 3D DESIGN

The article is devoted to the current state of development of the scientific direction for the development of 3D microstructure of fibrous materials. Information is about the most modern developments of well-known scientific centers in the world engaged in the study of the microstructure of paper and cardboard. According to a critical analysis of articles published on this topic, the authors come to a new solution that allows them to develop a 3D microstructure of a fibrous material. The development allows us to reliably estimate the volume and active surface of cellulose fiber, the basis for paper and cardboard. The developed method for creating a 3D fiber model will be the basis for 3D modeling of the fibrous microstructure of paper and cardboard.

Keywords: fiber material, paper, cardboard, microstructure, digital 3D design of fibers

I. V. Porotikova, M. B. Kirillova

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EVALUATION OF 3D SKAN ACCURACY OF COMPLEX SHAPE DETAIL

The article presents the main stages of building a 3D model of a complex-shaped part in a graphical program and using a 3D scanner. As an example, a 3D model was created using a 3D laser scanner, as well as in a graphics program. The 3D model previously created in the graphics program was printed by a 3D printer, while high dimensional accuracy was achieved (the largest deviation in size did not exceed 5%, for most sizes – 1%). Then a 3D

model of the printed part was created using a laser trigonal scanner. The result of the 3D scan was a “.stl” file, which was compared with the 3d-model file exported from the graphics program, also in SLT format. The paper presents the results of comparing two 3D models in the program Inventor, which determined the errors of 3D scanning with a modern laser trigonal scanner.

Keywords: 3D design, 3D scanner, complex shape detail.

TECHNOLOGY OF PRODUCTION OF TEXTILE AND LIGHT INDUSTRY PRODUCTS

D. K. Pankevich

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COMPREHENSIVE ASSESSMENT OF THE WATERPROOFING PROPERTIES OF CLOTHING MATERIALS

Criteria for complex evaluation of waterproofing properties of clothing materials have been developed. A method of using new criteria for comparative evaluation of completeness of realization of water-protective function of materials and for evaluation of material conformity to the purpose is offered. The stages of getting wet of materials have been revealed. A method and means of determining the hydrostatic pressure of soaking and the time of four stages of soaking of materials are proposed. The example of calculation of a complex criterion of waterproofing properties and the analysis of the results of the assessment of materials compliance with the intended purpose are given.

Keywords: waterproof materials, evaluation, criteria, methodology, pressure, stages of getting wet.

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MATHEMATICAL SIMULATION OF DEFORMATION MODES OF OPERATION OF POLYMERIC TEXTILE MATERIALS WITH INCREASED ACCURACY

The issues of improving the accuracy of mathematical modeling of the deformation modes of operation of polymer textile materials, which are important both from the scientific and practical side, are considered, since this makes it possible to obtain recommendations for the creation of new promising materials with desired functional properties. The article considers a method for optimizing mathematical modeling of the fundamental deformation-operational modes of polymeric textile materials.

Keywords: mathematical modeling, optimization criteria, polymeric textile materials, deformation properties, relaxation, creep.

N. V. Pereborova

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A VARIANT FOR PREDICTION OF THERMOVISCOELASTICITY OF POLYMER TEXTILE MATERIALS ON THE BASIS OF THE THERMO-DEFORMATION-TIME ANALOGY

The article discusses the prediction of deformation modes of operation of polymeric textile materials under conditions of variable temperature. The complexity of this prediction lies in the fact that for mathematical modeling of deformation modes of operation of polymeric textile materials under conditions of variable temperature, it is impossible to use traditional mathematical models for isothermal processes. When compiling a mathematical model of the deformation modes of operation of polymeric textile materials under conditions of variable temperature, it is necessary to add one more dimension to the traditional two-dimensional

mathematical model, which significantly complicates such modeling. To avoid complicating the mathematical model by adding additional variables, it is proposed to use a thermo-strain-time analogy when modeling the thermoviscoelasticity of polymeric textile materials, the validity of which is not obvious and is only verified experimentally for each material separately.

Keywords: mathematical modeling, forecasting, polymeric textile materials, deformation modes of operation, variable temperature.

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