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PRODUCT QUALITY CONTROL. STANDARDIZATION. ORGANIZATION OF PRODUCTION

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DIGITAL PREDICTION OF OPERATIONAL PROCESSES OF POLYAMIDE FABRICS FOR PARACHUTE DOMES

The digital prediction of the operational processes of polyamide fabrics used for the manufacture of parachute canopies is considered. The specificity of these processes is their transience. Digital forecasting is carried out using computer methods based on mathematical modeling of creep and Boltzmann-Volterra integral constitutive relations.

Keywords: parachute canopies, polyamide fabrics, viscoelasticity, deformation, mathematical modeling, digital prediction

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SIMULATION OF THE PERFORMANCE PROPERTIES OF POLYAMIDE FABRICS FOR PARACHUTE DOMES

The issues of modeling and computational prediction of the operational properties of polyamide fabrics used for the manufacture of parachute domes are considered. Calculation forecasting is carried out taking into account the specifics of the transience of processes and on the basis of mathematical modeling of relaxation and creep, as well as the Boltzmann-Volterra integral constitutive relations.

Keywords: parachute canopies, polyamide fabrics, mathematical modeling, operational properties

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MATHEMATICAL MODELING OF OPERATING PROCESSES OF POLYMERIC PARACHUTE LINES

Mathematical modeling of the operational processes of polymeric parachute lines makes it possible to reveal the patterns of their dynamic behavior during the operation of parachutes, which is extremely important for conducting a qualitative analysis and evaluating the functional and operational properties of the developed and existing parachute systems. On the basis of the indicated mathematical modeling, computer prediction of the processes of stress relaxation and creep of the studied materials, which are fundamental in the theory of viscoelasticity, is also carried out.

Keywords: parachute lines, operational processes, mathematical modeling, polymeric materials

N. V. Pereborova

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INNOVATIVE METHODS OF QUALITY CONTROL AND FUNCTIONALITY OF POLYMER MATERIALS FOR TEXTILE AND LIGHT INDUSTRY

The article presents a variant of solving the problem of quality control of polymeric materials in the textile and light industry, which is based on an integral criterion for the quality of the deformation properties of the materials under study.

Keywords: product quality, production of textile materials, information technology, optimization criteria, mathematical modeling, production management, quality management.

M. B. Sukhanov

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ESTIMATION OF THE VOLUME OF POLYESTER FIBER PRODUCTION FROM WASTE USING FUZZY SET THEORY

This article discusses the environmental aspects of processing polyethylene terephthalate into polyester fiber. To quantify the total volume of production by several plants, a fuzzy model is proposed that takes into account that some of the products are exported and there is uncertainty in the initial data. In this study, the product is polyester fiber obtained from waste.

The interpretation of fuzzy numbers in the estimation of production volumes is given. Membership functions are constructed for the considered fuzzy variables. Trapezoidal ones are chosen as such functions. When organizing resource-saving and ecological production systems for building fuzzy models with membership functions, compared with MS Excel, it is more efficient to use the MATLAB computer mathematics system.

Keywords: organization of production, eco-friendly materials, light industry, chemical industry, polyester fiber, synthetic fibers, fuzzy numbers, fuzzy set theory

MACHINES, AGGREGATES AND TECHNOLOGICAL PROCESSES

N. V. Pereborova, S. V. Kiselev

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SPECTRAL SIMULATION OF DEFORMATION AND RELAXATION PROCESSES OF POLYMERIC TEXTILE MATERIALS

The article considers the methods of spectral modeling of deformation-relaxation processes of polymeric textile materials. The development of new methods for studying the deformation-relaxation processes of polymeric textile materials contributes to the most reliable prediction of their functional properties.

Keywords: polymeric textile materials, deformation-relaxation processes, spectral modeling, numerical prediction

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MATHEMATICAL MODELING OF THE ROLL UNWINDING PROCESS CONSIDERING THE TENSION FORCE OF THE MATERIAL BEING UNWOUND

The process of unwinding a fabric rolled into a roll is considered. The cross section of the roll is a convex figure, the shape of which is given by two factors that distinguish it from a circle. The elastic web can stretch in the unwinding area. There were compiled differential equations for the dynamics of the rotational movement of the roll and changes in the tension force of the web. Numerical integration of differential equations for unwinding a roll of fabric is performed using the example of sizing and sorting machines. The influence of the factors of eccentricity and ellipticity on fluctuations in the values of the angular speed of unwinding and the tension force of the web has been studied.

Keywords: roll material, roll unwinding dynamics, roll cross section, tension force, elastic web

SYSTEM ANALYSIS, CONTROL AND INFORMATION PROCESSING

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QUALITATIVE ANALYSIS OF THE PERFORMANCE PROPERTIES OF POLYMERIC PARACHUTE LINES

A qualitative analysis of the performance properties of polymer parachute lines is carried out on the basis of mathematical modeling and numerical prediction of the deformation processes of these materials. Polymeric parachute slings belong to the class of textile materials, because are ribbons and cords made of synthetic threads. A qualitative analysis of the deformation properties of polymeric parachute lines, including comprehensive studies, underlies the creation of modern parachute systems.

Keywords: parachute lines, operational properties, mathematical modeling, system analysis, qualitative analysis

S. V. Kiselev

DOI: 10.46418/2619-0729_2022_1_9

SYSTEM ANALYSIS OF DEFORMATION PROPERTIES OF HEAT-RESISTANT ARAMID MATERIALS

The methods of system analysis of deformation properties of heat-resistant aramid materials are considered. The basis for predicting the deformation processes of these materials is mathematical models of relaxation and creep. A technique for solving problems of systemic analysis of the properties of heat-resistant aramid materials, studying the relationship between properties and structure, predicting short-term and long-term mechanical effects is proposed.

Keywords: system analysis, deformation properties, aramid materials, thermoviscoelasticity

M. A. Egorova, A. A. Kozlov

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SYSTEM ANALYSIS OF THE FUNCTIONAL PROPERTIES OF MINING AND FIRE RESCUE ARAMID CORDS

The article deals with the issues of system analysis of the functional properties of textile aramid cords used in rescuing people during fires, in the mountains and in mines. These materials have both increased strength and high resistance to temperature effects. A systematic analysis of the deformation properties of aramid cords is carried out on the basis of mathematical modeling of relaxation and creep processes, as well as using computational technologies.

Keywords: aramid materials, mine rescue equipment, fire rescue equipment, functional properties, system analysis, mathematical modeling, numerical prediction

A. G. Makarov, S. V. Kiselev

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SYSTEM ANALYSIS OF DEFORMATION PROPERTIES OF POLYMERIC TEXTILE YARN

At present, numerous studies have been carried out on the deformation properties of polymeric textile materials, while a wide variety of textile materials and the amount of accumulated experiment prove the need to develop new methods for the systematic analysis of the deformation properties of textile materials of complex structure and, in particular, polymer yarn, which have received insufficient attention.

Keywords: polymeric textile materials, deformation properties, mathematical modeling, numerical prediction, yarn, system analysis

TECHNOLOGY AND PROCESSING OF SYNTHETIC AND NATURAL POLYMERS AND COMPOSITES

S. V. Aniskin, V. S. Kurov

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POLYDISPERSE MODEL OF MIXING IN THE EJECTION ZONE OF DIRECT-FLOW SPRAY APPARATUSES OF THE PULP AND PAPER INDUSTRY

The paper presents a theoretical construction of a model of the flow of a gas-liquid jet in a direct-flow spray displacement apparatus in the production of cellulose. The model, based on the similarity of the gas jet velocity distribution to the irrigation density distribution, allows us to take into account the peculiarities of the gas-liquid jet flow in four flow zones of the apparatus, including in the ejection zone with the wall circulation of the gas stream. The conditions of the occurrence of wall circulation and the occurrence of a pressure surge are considered. Experimental confirmation of the theoretical model was obtained on a laboratory bench.

Keywords: direct flow, liquid, jet, gas, droplets, model, polydispersity, speed, irrigation density, wall circulation

S. V. Aniskin, V. S. Kurov

DOI: 10.46418/2619-0729_2022_1_13

DEVELOPMENT OF HIGH-RELIABILITY DIRECT-FLOW SPRAY DEVICES COMPATIBLE WITH PULP AND PAPER PRODUCTION TECHNOLOGY

The paper presents technical solutions to the problem of improving the reliability of high-performance direct-flow spray machines in relation to the features of pulp and paper production technology. Full-scale industrial samples of high-reliability direct-flow spray devices have been developed. Industrial tests were carried out at various pulp production enterprises.

Keywords: Apparatus, jet, liquid, gas, droplets, nozzle, sprayer, insert, swirler, mud filter

M. A. Litvinov, T. I. Efremov

DOI: 10.46418/2619-0729_2022_1_14

EVALUATION OF THE STUDY EFFECTIVENESS OF THE PAPER AND CARDBOARD BY DIGITAL TECHNOLOGIES

The article presents data on the evaluation of the study effectiveness of the paper and cardboard by the digital technologies. Information is given about the approximate cost of equipment for quality control of paper and cardboard. The total costs of laboratory equipment for determining the quality parameters of paper and cardboard (forming index, porosity, roughness, thickness, tear resistance, bursting, multilayer strength, compression, morphological characteristics of fibers) are compared with the costs of preparing samples for electron microscopy and processing the images obtained by graphical and analytical programs. In addition to the economic component, the evaluation of the effectiveness of the use of digital technologies is carried out according to time costs and the number of specialists involved in the study.

Keywords: paper, cardboard, recovered paper, digital technologies, quality indicators.

I. V. Porotikova, M. B. Kirillova, D. V. Serbul

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Improving the accuracy of products made by 3D-printers

The article presents the main stages of constructing a part of a complex shape in the AutoCAD graphics program. The result of 3D-modeling is a file with the extension ".dwg", exported to the ".stl" format for further 3D-printing. The paper presents the characteristics of 3D-printing

(line thickness, extruder temperature, printing speeds, plastic infill, etc.), in accordance with which a complex-shaped part was made. The quality control of the manufactured part made it possible to establish the shrinkage parameters of the plastic for the printing conditions. The high precision of manufacturing the part was achieved by determining the shrinkage coefficient of each part size. Re-manufacturing of the part with amendments made it possible to achieve compliance with the dimensions specified in the drawing and the finished product.

Keywords: detail accuracy, 3D-design, 3D-printer, complex shape detail

N. V. Evdokimov, A. N. Keutaeva

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EVALUATION OF THE POSSIBILITY OF USING WOOD RAW MATERIAL IN ADDITIVE TECHNOLOGIES

The article is devoted to assessing the possibility of using wood waste as a raw material for various 3D printing technologies. The main types of 3D printing are analyzed, such as: laser sintering of metal powders («SLM» technology), sterolithography («SLA» technology (printing with a liquid polymer or resin)), bioprinting, polymer extrusion («FDM», «FFF» technology); layer-by-layer printing from powder («PolyJet», «Binder Jetting» technology) and et. The characteristics of materials used in additive technologies are considered in detail. Based on the critical analyses of additive technologies recommendations are given on the conditions for the preparation of wood dust for their use in 3D printing.

Keywords: Additive technology, 3D-printer, wood raw material

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COMPARATIVE EVALUATION OF PAPER MICROSTRUCTURE BY IMAGEJ AND AUTOCAD PROGRAMS

The paper presents the results of a paper study. A sample of the material obtained in the laboratory was analyzed using an electron microscope. The image of a cross-section of paper was processed using programs, ImageJ and AutoCAD. The cut-off areas of the fibrous material obtained in AutoCAD were compared with the area calculation data at various stages of image preparation to estimate the fiber cut-off area in ImageJ. As a result, the adjustment modes of shades of black and white were selected, which allow for fast and high-precision graphical processing of the microstructure of the fibrous material. As a result, the calculated areas in ImageJ and AutoCAD are compared and the error is estimated.

Keywords: paper, paper microstructure, digital processing, paper properties

TECHNOLOGY OF PRODUCTION OF TEXTILE AND LIGHT INDUSTRY PRODUCTS

N. V. Pereborova, A. A. Kozlov

DOI: 10.46418/2619-0729_2022_1_18

MATHEMATICAL MODELING AND PREDICTION OF OPERATIONAL PROCESSES OF ARAMID MATERIALS

Mathematical modeling and forecasting of the operational processes of aramid materials used as rescue equipment in case of fires makes it possible to carry out both a comparative analysis of these materials according to the criteria for operational suitability, and to select these materials that most satisfy the goal - saving people in case of fires.

Keywords: aramid materials, operational processes, mathematical modeling, numerical prediction

A. V. Demidov, A. G. Makarov, S. V. Kiselev

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PREDICTION OF DEFORMATION AND RELAXATION PROCESSES OF ARAMID MATERIALS UNDER CHANGING TEMPERATURE

The article deals with the issues of numerical prediction of deformation-relaxation processes of aramid materials under conditions of variable temperature. A generalization of methods for predicting nonlinear relaxation and nonlinear creep is proposed for the case of processes occurring under conditions of varying temperature by introducing temperature-strain-time and temperature-force-time analogies into consideration.

Keywords: aramid materials, deformation-relaxation processes, mathematical modeling, numerical prediction, variable temperature

A. A. Kozlov

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COMPREHENSIVE STUDY OF FUNCTIONAL PROPERTIES OF TEXTILE MATERIALS ON THE BASIS OF MATHEMATICAL MODELING OF OPERATIONAL PROCESSES

A comprehensive, comprehensive study and prediction of the functional properties of polymeric textile materials is possible only on the basis of mathematical modeling and system analysis of their deformation properties. This study includes: conducting a test experiment in relaxation and creep modes; construction of an adequate mathematical model of deformation properties, determination of viscoelastic parameters-characteristics of the mathematical model; modeling of deformation processes, the use of specially developed computer techniques for system analysis and qualitative assessment of the deformation properties of polymeric textile materials.

Keywords: textile materials, functional properties, mathematical modeling, system analysis, computer forecasting, operational processes

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