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ЕЖЕМЕСЯЧНЫЙ НАУЧНО-ТЕХНИЧЕСКИЙ ЖУРНАЛ ПО АНАЛИТИЧЕСКОЙ ХИМИИ, ФИЗИЧЕСКИМ, МАТЕМАТИЧЕСКИМ И МЕХАНИЧЕСКИМ МЕТОДАМ ИССЛЕДОВАНИЯ, А ТАКЖЕ СЕРТИФИКАЦИИ МАТЕРИАЛОВ

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Dynamic Gas Extraction in the Ionometric Analysis of Natural and Technogenic Objects

Bebeshko G. I., Nesterina E. M.

Methods of ionometric determination of the elements using gas extraction at the stage of sample preparation are reviewed. A device for continuous gas extraction of volatile component is developed and promising character of extracting components with complex composition difficult for ionometric determination (halogens, sulfur, nitrites) is demonstrated and exemplified in determination of bromide- and nitrite-ions in natural waters of complex composition and high mineralization. Results of metrological testing of the developed methods proved the correctness, high selectivity of the developed procedures and rather high reproducibility of the analysis results.

Keywords: dynamic gas extraction; device; ionometric analysis; halogen; nitrogen; sulfur; metrological characteristics; natural and technogenic objects.

UDC 543.423:519.242

Application of the Mathematical Method of Multifactorial Experiment to Optimization of Conditions of (TJP)-AES Analysis

Kuptsov A. V., Zayakina S. B., Saprykin A. I.

Conditions of atomic emission analysis are optimized using "Grand" spectrometer with two-jet arc plasmatron as a source of excitation. The impact of plasma-supporting and conveying gas on the analytical signal of noble metals is studied. Mutual influence of various factors on the intensity of spectral lines of analytes is revealed using a mathematical method of multifactorial experimental design and optimum trade-off conditions for determination of noble metals are specified. The detection limits for noble metals are calculated under specified optimized conditions.

Keywords: two-jet arc plasmatron; atomic emission spectrometry; noble metals; multifactorial experimental design.

UDC 543.544.5.068.7

Ion Chromatographic Analyzer for Ion Composition Control of Radioactive Aqueous Media

Gursky V. S., Pridantsev A. A., Kharitonova E. Yu., Tsapko Yu. V.

The results of experimental-industrial pilot use of a measuring channel, developed on the base of domestic ion chromatograph "Stayer" and designed for on-line control of radioactive technological media of nuclear power industry are presented. Structural features of the chromatograph that differ the analyzer from the analogues are described. Metrological characteristics of the measuring procedures and area of application of the developed ion chromatograph are specified.

Keywords: ion chromatography; radioactive media; on-line analysis of cationic and anionic composition.

UDC 543.632.461:661.842.532

Rapid Method for Sulfur Trioxide Determination in Portland Cement Samples using CHNS-Analyzer

Podguzkova M. V., Vorozhtsov D. L.

Rapid method is developed for determining the mass fraction of sulfur trioxide in Portland cement using a Vario El cube elemental analyzer (Elementar, Germany) intended for a CHNS analysis of organic and inorganic samples. The possibility of using sulfanilamide as a standard for samples of Portland cement is confirmed. The metrological characteristics of the suggested procedure are evaluated. The developed method is rapid and easy to use. Duration of single analysis does not exceed 15 min.

Keywords: elemental CHNS-analyzer; Portland cement; determination; total sulfur; metrological characteristics.

UDC 535.324.2

Refraction Index and Optical Absorption in Black and Green Liquors

Avramenko E. V., Lapshov S. N., Sherstobitova A. S., Yaskov A. D.

We presents the results of measuring concentration and temperature dependences of the refraction index in i) black liquors for soluble solid residue concentrations up to 70% within a temperature range of 10 – 90°C, and ii) in green liquors at a total alkali of 0 – 250 g/liter within the same temperature range. Interpolation expressions for laboratory calibration of commercial sensors are given. Absorption spectra in the solutions and their mineral carriers are obtained. The main components that determine formation of fundamental electronic absorption bands in black and green liquors are considered. Spectrophotometry of the ultraviolet wavelength range is shown to be a simple and effective

tive method of industrial monitoring of the total alkali of liquors at a stage of caustization.

Keywords: refraction index; thermo-optic constant; optical absorption; solutions of black and green liquors.

UDC 681.17

Application of Analytical Equipment Based on DRON-7 X-Ray Diffractometer in Aircraft and Space Industries

Ivanova T. I., Kurskov A. V., Tyschenko D. V., Dmitriev D. A., Kuzmin O. V., Tsvetova E. V.

The effective application of various X-ray diffraction methods to the goals of aircraft and space industries is considered. DRON-7 X-ray diffractometer ("Bourestnik" Inc., Russia) equipped with PGTM multifunctional two-axis attachment proved to be a powerful analytical instrument for rapid and reliable analysis of phase composition and structural characteristics of aviation materials including direction-dependent parameters (texture, crystal orientation, residual stress). Four independently controlled movements can be synchronized in a different way to match the requirement of the certain method or goal of the study. Specially developed software for data accumulation and processing with user-friendly interface allows visual and interactive presentation of the measured data and results of analysis.

Keywords: X-ray diffractometer; multifunctional two-axis goniometric attachment; X-ray diffraction analysis of aviation materials; phase analysis; textures; residual stress; single crystal orientation; CMMT (crystalline meter of maximal temperature) sensor.

UDC 621.002.56:621.658.562:620.179.16.05

Ultrasonic Tomography of Press-Fit Joints

Ivannikov V. P., Kabakova A. V.

A method of studying press-fit joints using ultrasonic tomography is developed. A possibility of obtaining the gray level image of the strain-stress area of the press-fit joint by means of software assets (i.e., through synthesis of 3D-image (3D-tomograms) of the joint using circular diagrams of the object "cross-sections" (2D-tomograms) drawn by multiangle supersonic sounding. An emphasis is made on the possibility of reconstructing 3D-image of the area under study directly from the results of measurement without any additional mathematical treatment. Special attention is paid to the clarity, illustrative character of the developed method, and extension of applications to automation of the quality control of the joints.

Keywords: ultrasonic tomography; multiangle supersonic sounding; region pairing connection with tension.

UDC 620.192.34+621.315.615.2+681.518.5

Experimental Study of a Parametric Signal of Acoustic Field in Liquid Dielectric with Microinclusions

Luk'yanov M. M.

Urgent problems regarding formation of microinclusions in liquid insulation (LI) of high-voltage oil-filled electrical equipment, features of current methods of testing the availability index of LI capable of detecting the insulation damage in case of current flow through the defective area. A device is developed to detect micro-bubbles and control the availability index of LI thus providing early failure detection, forecasting of failures of high-voltage oil-filled electrical equipment and ensuring personnel safety. Operation principle of the device is based on nonlinear parametric interaction of acoustic oscillations of closely spaced frequencies. Operation sequence, formation of parametric radiating aerial and procedure of detecting the acoustic signal of difference frequency wave are presented. Experimental data regarding study of the effect of nonlinear parametric interaction of acoustic oscillations in transformer fluid containing microinclusions on the technical characteristic of model unit intended for the study of cavitation phenomenon in liquid insulation are presented. Novel features and signs characterizing the defective area of LI with microinclusions are described to develop a set of new quality indexes of liquid insulation characterizing the physical and mechanical properties of the dielectric in operating high-voltage equipment.

Keywords: high-voltage oil-filled electrical equipment; liquid insulation with microinclusions; acoustic pump wave signal; nonlinear parametric interaction of acoustic waves; parametric signal of the difference frequency wave; warning unit for detecting dangerous condition of the liquid insulation of high-voltage oil-filled electrical equipment.

UDC 620/191/33:539.376

Crack Growth Kinetics in Power Plant Engineering Steels in High-Temperature Creep

Makhutov N. A., Grin' E. A., Sarkisyan V. A.

Features of crack growth kinetics in steels under creep are analyzed from the viewpoint of fracture mechanics. The rate of crack growth in creep can be ap-

proximated by an exponential dependence on the parameter C^* or on the stress intensity factor, the exponents of those dependencies being a function of the characteristics of the long-term strength and creep. To describe the rate of creep cracks we propose to use the reduced stress intensity factor with allowance for the stress distribution in the cross section and time of crack propagation. The benefits the reduced stress intensity factor as a correlation parameter describing the rate of creep crack growth are substantiated experimentally.

Keywords: steel; creep; temperature; crack growth rate; parameter C^* ; stress intensity factor (SIF); creep rupture; stress state; crack growth time; kinetic diagram of crack resistance.

UDC 620.162.3:532.135

Rheology of Round Longitudinal Fibrous, Cross Layered and Structurally Nonuniform Composite Rod in Conditions of Torsion and Torsional Oscillations

Kravchuk A. S., Kravchuk A. I., Tarasyuk I. A.

The rheological behavior of materials in torsion and torsional oscillations is studied. The following options of the rheological models are considered: hereditary creep theory, technical theory of aging, and a generalized nonlinear viscoelastic Voigt model. The equations are derived for torsion and torsional vibrations of the rods made of homogeneous materials in the case of linear and nonlinear equations of state. All the aforementioned rheological deformation models are considered in the case of torsion of composite material (the longitudinal-fibrous, radial — and transverse-layered and structurally nonuniform) of the rod in nonlinear and linear formulations. Moreover, it was found that calculation of the effective characteristics of the rod according to Voigt hypothesis corresponds to the solution of the averaging problem for fibrous (or coaxially layered) along the rod axis material. The hypothesis of Reuss corresponds to torsion of cross-layered cylindrical rod, and the approach of Hill to the simplest approximation of the effective properties of structurally nonuniform composite material of the rod.

Keywords: equation of torsional oscillations of the round rod; eigen frequencies; Voigt hypothesis; Reuss hypothesis; rheology; creep memory function; uniform aging of material; viscosity; Voigt viscoelastic model.

UDC 620.193.16:620.178.16

Estimation of Incubation Period at Cavitation Wear of Steel through Measuring Roughness

Tsvetkov Yu. N., Gorbachenko E. O.

A new procedure of assessing incubation period in cavitation wear of low-alloyed and low-carbon steels is reported. To simulate cavitation wear an ultrasonic vibratory apparatus is used. The experiments are carried out in fresh water. The weight loss and arithmetical mean deviation of the assessed profile are measured at appropriate intervals during the test. The dependence of arithmetical mean deviation of the assessed profile on cavitation attack duration turned out to be a broken line divided into three sections. The points of inflections indicate the change in mechanisms of asperities formation. The boundary point between the first and the second section of the dependence can be used to indicate the end of an incubation period.

Keywords: cavitation wear; incubation period of cavitation wear; steel; ultrasonic vibratory apparatus; surface roughness height.

UDC 519.24:621.398

Interval Model in Optimal Control Problems

Skibitskiy N. V., Sevalnev N. V.

The problem of optimal control in the presence of interval uncertainty in the initial conditions is formulated. For the proposed formulation the problem of predicting the state of the object in the presence of interval uncertainty in the initial conditions is studied and solved. The set of control actions providing the required accuracy in solving the problem is defined. Necessary and sufficient conditions for the existence of the aforementioned set are specified and implementation algorithm is developed.

Keywords: optimal control; interval uncertainty.

UDC 681.142.64

Decision Support in Selection of Structural Materials for Safe Operation of the Equipment

Berman A. F., Maltugueva G. S., Yurin A. Yu.

An approach to decision-making support for a substantiation and selection of structural materials is discussed. Proper material selection is cornerstone that ensures strength, resource and safety of designed and upgraded equipment. The algorithms based on the joint application of case-based approach and methods of multicriteria choice are presented. The implementation of the proposed approach in the form of intelligent decision-support system is discussed.

Keywords: selection of structural materials; decision support; case-based reasoning; multicriteria choice; software.