ABSTRACTS

Oleksandr Andrejkiv, Rostyslav Lesiv
Mathematical model for estimating the period of creep-fatigue crack growth in construction materials at high temperature ……

In this work we propose mathematical model of important scientific and technical problem – estimating of remaining lifetime of constructions elements subjected to high temperature fatigue. The differential equation, with initial and final conditions, for assessing the remaining lifetime of three-dimensional solid was obtained. This mathematical model is formulated, based on energetic approach. Proposed approach gave us the possibility to combine fatigue and creep loadings in the single equation. Known in scientific materials experimental data confirmed the correctness of this model.

Jan Awrejcewicz, Yuriy Pyryev
On the wear influence on a damper dynamics ……

A novel mathematical model of a dynamic vibration damper taking into account wear of contacting bodies is proposed and studied. Both analytical and numerical approaches are applied to analyze the system behavior of various parameters. In particular, influence of wear on a periodic dynamics of the system is reported.

Pavel Bogdanovich, DenisTkachuk, Dmitri Bliznets
Failure of materials at dynamic contact loading ……...…….

The paper reports data on the kinetics, failure mechanisms, and wear rate of silicate glass and sapphire in high-speed abrasive machining. Regularities of the effect of the load, the velocity of abrasive particle movement, and the duration of the cutting of sapphire and the diamond monocrystal on temperature fields in the cutting zone and adjacent areas are discussed. It is shown that at high velocities the maximal surface temperature position shifts outside the contact site and temperature stresses cause the thermal cracking of sapphire and glass in this zone. When cutting a diamond monocrystal the temperature in the cutting zone can reach values sufficient for its local graphitization to occur.

Mykolas Daunys, Romualdas Dundulis, Povilas Krasauskas
Temperature and hydrogen concentration influenceon zr-2.5nb alloy mechanical and fracture toughness characteristics ……

This paper deals with an investigation of temperature and hydrogen concentration influence on Ignalina NPP RBMK-1500 unit 2 reactor fuel channel tube material - Zr-2.5Nb zirconium alloy (TMT-2) mechanical and fracture toughness characteristics. Two types of specimens were used in this study - tensile and compact semi-natural specimens. Testing temperatures were selected from 20 to 300ºC that correspond various operating regimes of the reactor. Made-up hydrogen saturated specimens were tested at hydrogen concentration levels from 52 up to 140 ppm in order to examine hydrogen influence on mechanical and fracture toughness characteristics of the alloy. Dependence of fracture toughness to various mechanical characteristics of the alloy was analysed. Investigation has shown correlation of stress intensity factor K_C^* to modified plasticity criterion of the alloy.

Mykolas Daunys, Arturas Sabaliauskas
Damage accumulation in stress concentration zones of parts with hardened surface under low cycle tension-compression and bending .....

This paper provides experimental and analytical evaluation of durability of nonhardened and hardened by EMT specimens of grade 45 steel with stress concentrators, under low cycle tension-compression and pure bending. For both type of loading modes was carried out durability analysis, taking into account fatigue and quasi-static damage depending on loading level and number of s. Stress and strain concentration coefficients were calculated by analytical and finite element methods (FEM) under elastic plastic cyclic loading. Performed analytical investigation showed, that suggested method for quasi-static and fatigue damage summation, when accumulated plastic strain and the width of the hysteresis loop are taken into account, provides a very good agreement with the experimental results at stress concentration zones of surface-hardened parts under tension-compression and bending.

Łukasz Derpeński, Andrzej Seweryn
Numerical analysis of fracture for specimens with notches made of elasto-plastic material ……..…….

The paper presents results of numerical analysis of stress and strain fields on specimens with differences radius notches. Finite element methods was used in calculation. In simulation elastic-plastic model with isotropic hardening was load to described material. Authors pay attentions to principal stress and strain pattern and maximum non-dilatational strain on plane located at notch root. In article also presents notch's radius effect on plastic zone size under full load. Authors derive a crack criterion for specimens witch radius notches.

Krzysztof Doliński, Krzysztof P. Mróz

Fatigue cracks growth in the bimaterial - the mathematical model and numerical solution ……..……..

Recently, considerable efforts have been devoted towards developing fracture mechanics theories for bimaterials, mainly due to the need for better understanding of interfacial fractures resulting from the increasing use of adhesive and diffusive bonding or explosion-clad materials, design of microelectronic packaging and coatings intended for enhancing thermal, environmental or tribological resistance. However, the modelling of the time- or cycle-dependent failure of such bimaterials, particularly those involving the ceramic and metal layers, remains still in very preliminary phase providing no reliable prediction of the actual fatigue crack trajectory and fatigue lifetimes. Although in some papers, the experimental or numerical results are accompanied by the theoretical description of the interface crack features it does not result in developing of any effective models to predict the path and magnitude of the crack propagating in bimaterial due to the cyclic loading. It is inevitably to take into account very considerable achievements of fracture mechanics to base the fatigue models on strong theoretical foundations and to attain a significant progress in modelling of fatigue phenomena in bimaterials. The fracture mechanics concerned many complex types of cracks, including branched or forked cracks, but also other geometries have also been considered. However, some of the fracture mechanics methods are very complicated and in result of what difficult to adopting in the propagation of crack. The enough large difficulty appears in case of analysis these cracks in neighbourhood of interface, also,that is the place of connection two different materials. The paper presented method makes possible easy formation of the cracks in the bimaterial and obtainment of stress intensity factors on the tips. The problem is formulated by a system of singular integral equations by using the related Green's function (dislocation or concentrated force solution) in conjunction with the technique of superposition. In the paper the approach proposed by Erdogan et al. (1974) based on the Dunder's solution for a single dislocation in presence of a circular inclusion (Dundurs and Mura, 1964) is adopted to fatigue crack growth modelling in bimaterial taking into account the mixed-mode conditions and two stress intensity factors, K_I and K_{II}. An effective algorithm to solve the integral equations which result from accounting for the effect of dislocations distributed along a broken line is being developed. It will allow us to calculate both the stress intensity factors, K_I and K_{II}, and consequently, to use the criteria to determine the direction and increment of the branched crack due to a cycle or series of cycles of the remote loading acting on the bimaterial specimen. The integral equations with the Cauchy-type singularities is solved with the help of the numerical technique (Gauss-Chebyshev method) described by Erdogan and Gupta in (1972).

Artur Ganczarski, Marcin Cegielski

Effect of continuous damage deactivation ……..……...

The aim of present paper is a modeling of continuous deactivation of damage. The concept of continuous micro-crack closure/opening effect is formulated in case of 1D stress and next extended to the general 3D case. Two examples are demonstrated and compared with experimental data: low cycle fatigue of AISI 316L stainless steel and damage affected yield potential. Detailed quantitative and qualitative analysis of obtained results confirms the necessity and correctness of an application of continuous deactivation of damage.

Jerzy Kaleta, Przemysław Wiewiórski

Detection of defects in magnetic composite rods making use of high resolution scanner ……..…...

The paper presents original method and measurement devices for examination of magnetic and mechanical defects in rods made up from strontium ferrite. In many constructions it is necessary to carry out examinations of mechanical and magnetic properties simultaneously. Technological processes (for example cutting, magnetisation), material faults, conditions f exploitation (static and cyclic loads), errors in maintenance entail defects and the quantitative analysis of them is unavoidable. The original fast, high resolution scanner with hall probe has been constructed to measure h_x, h_y, h_z,. Advanced electronic devices have been applied for acquisition, processing and visualisation of results. The corresponding software has been also constructed. Effectiveness of a method and devices have been tested for the reference shafts as well for shafts with mechanical and magnetic defects.

Aleksander Karolczuk, Yves Nadot, Andre Dragon

Nonlocal method for fatigue limit determination of defective material ……

The paper presents a new way to reduce the non-uniform shear and normal stress distribution to the uniform ones. The reduction is performed by averaging process of shear and normal stresses over two overlapping characteristic areas. Using this concept various multiaxial critical plane fatigue failure criteria could be used to estimate fatigue life. In the present paper, the Matake multiaxial fatigue failure criterion was verified on defective material subjected to proportional loading.

Roman Kulczycki-Żyhajło, Gabriel Rogowski, Waldemar Kołodziejczyk

Two-dimensional problem of non-homogeneous elastic half-space loaded on its boundary surface ……...

The paper deals with a two-dimensional problem of an elastic non-homogeneous half-space loaded on its boundary. The body is compared of a non-homogeneous layer and a homogeneous half-space. The layer with changing material properties is described by a finite number of homogeneous layers.

Andrzej Litewka, Leszek Szojda

Experimental and theoretical study of failure of ceramic brick……

The aim of the paper is to present experimental and theoretical study of deformability and fracture of brittle rock-like materials. To this end the tests of the specimens of ceramic brick subjected to various combinations of tri-axial state of stress componentswere performed. These experiments made it possible to construct the stress-strain curves and to measure the stresses at material failure. The data obtained for uni-axial compression were used to determine the constants included in the theoretical model. All the

experimental data obtained for tri-axial loading were compared with the theoretical predictions.

Adam Mazurkiewicz, Tomasz Topoliński
Estimation of differences of values structure coefficients for osteoporosis and coxarthrosis samples of trabecular bone from human femoral head …….

In the work presented results of microtomographic investigations of samples of osteoporosis and coxarthrosis trabecular bone. Presented walue of eight coefficients structure the bone. Ascertained differences between average values and large similarity for relative standard deviations – SDW, for both examined population. Statistical analysis based on investigation of quantile graphs pointed these coefficients, which are the most essential from point of view of executing of comparative estimations.

Bohdan Monastyrskyy, Andrzej Kaczyński
The elasticity problem for a stratified semi-infinite medium containing a penny-shaped crack filled with a gas ……

This paper deals with a periodic two-layered elastic half-space weakened by an interface penny-shaped crack filled with a gas. The study is based on the approximate treatment by using the linear elasticity with microlocal parameters in the axisymmetric case. Applying the Hankel integral transforms, we obtain a system of dual integral equations. It is reduced to a set of two integral equations which are solved numerically. Some results concerning the variation of the internal gas pressure and the stress intensity factors of mode I and mode II are illustrated graphically.

Zenon Mróz, Grażyna Ziętek
Two surface model of plastic hardening for martensitic transformation cyclic deformation ……...

The present work provides the formulation of constitutive model for elasto-plastic material with account for mixed (isotropic-kinematic) hardening dependent on the martensitic transformation process induced by plastic straining. The yield surfaces, limit back stress surface and transformation surface are introduced and the back stress evolution affected by martensitic volume fraction is proposed. The model is applied to simulate uniaxial cyclic deformation and the material parameters are identified from the available experimental data. The model predictions are confronted with experimental cyclic stress-strain curve generated for the austenitic steel.

Tadeusz Niezgoda, Stanisław Ochelski, Wiesław Barnat
The experimental investigation of influence of kind fulfilment basic composite structures on energy the destruction

The opinion of applied fulfilment is on ability the aim of pracy the absorption through kompozytowy unit of thin-walled construction the energy weighted down dynamically. Energy-consuming units were executed in KMiIS. It investigations were conducted was on stamina machine engine Intron. The investigations were subjected in figure of muffs the energy-consuming units from additional foam fulfilment. Weight was realized by axial input function kinematic.

Krzysztof Nowicki, Janusz Sempruch
Problems in training process of artificial neural network used to modeling of fatigue curves ……

Prior projects realized by authors proved the rationality of using of the neural network environment to the accumulation and processing of the fatigue data. The existing literature in short supply touches practical implementation of neural network to the fatigue problems. Among others problems with the practical implementation and utilization of neural networks exists the problem of the neural network training. This one is main subject of the elaboration. In this paper authors present sequence of decisions accepted for the realization of the numeric experiment and quote illustrative examples of obtained results into the trace of these decisions.

Volodymyr Panasyuk, Viktor Sylovanyuk, Valerii Marukha
Static and cyclic strength of a cracked body which strengthened by injection technologies .....

Using the modern concepts of fracture mechanics, the injection processes of crack-shaped defects in structural elements in different service conditions are modeled. The corresponding calculations, on the bases of which the degree of hardening of the damaget structures by the injection technologies and parameters, which influence their efficiency, have been perfomed. The ways of optimization of injection technology of the damaged structural elements are established.

Dariusz M. Perkowski, Stanisław J. Matysiak
On the crack problem normal to the layering in a periodic laminated body ……

The two-dimensional problem of crack normal to the layering is considered. The nonhomogeneous body is composed of periodically repeated two constituent laminae. The homogenized model with microlocal parameters given by Woźniak (1987), Matysiak and Woźniak (1987) is applied to find an approximate solution to the problem. The problem is reduced to a well-known dual integral equations. Numerical results, which show the influence of geometrical and mechanical properties of composite constituents on SIF distributions are presented in figures.