ITERATIVE METHODS
PROBLEMS INCREASE IN STRENGTH OF MATERIALS

T.Kryvorot, Assistant

Thermomechanical processes linked investigated using basic equations and dynamical coupled problem of value thermomechanics. For problem solution used approximation scheme Crank-Nicholson on time combined with an iterative process, applied iterative method and finite element method.

Keywords: microstructure transformation, stress state, parameter equation, model, process.

Setting thermomechanical tasks include: value Cauchy equations of motion, heat equation, initial conditions, boundary conditions thermomechanical loading. Impulse metal is an effective method of increasing strength, wear resistance and durability of metal elements of the system power supply.

The purpose of research – a numerical definition of micro-structural transformation and stress state in the thermomechanical loading.

Materials and methods of research. The problem is nonlinear and is solved numerically by stepping in time, simulating the thermal and power factor of laser irradiation surface metal bodies.

The problem is nonlinear. It is solved numerically using temporal scheme iterative method and finite element method. Calculation of the collapse of supercooled austenite phases was performed using thermokinetic charts and ratios for specific volumes phases. The law of accumulation along the trajectory of a new phase under the law Koistinena-Marburhera approximated.

Consider converting to half-microstructure, thermomechanical acting on impulse. This takes into account the impact of volume and plastic characteristics of individual phases on the stress state of the material. The problem that is solved, models as thermal and power factor of laser irradiation surface metal bodies with their technological processing, including defamation. The interest in such problems due to the definition of rational technological parameters of strengthening surfaces of metal parts.

With thermomechanical stress on the body are both thermal and mechanical loads, accompanied by reacting partial thermomechanical processes.

Thermomechanical behavior of a material unified model describes the flow Bodner-Partoma that multyfazovoho generalized to the case of the material. The essence of generalization is to use mixtures of rules to determine model parameters responsible for border flow and tensile material.

The model includes the following relationship:

– Additivity equation deformation $\varepsilon_{ij} = \varepsilon_{ij}^{e} + \varepsilon_{ij}^{p} + \varepsilon_{ij}^{\theta ph}$, $i, j = r, z, \varphi$,,

– Hooke's law $s_{ij} = 2G\left(e_{ij} - \varepsilon_{ij}^{p}\right)$, $\sigma_{kk} = 3K_{v}\left(\varepsilon_{kk} - \varepsilon_{kk}^{\theta ph}\right)$,

– The current law Prandtl Reis

$$\dot{\varepsilon}_{ij}^{p} = D_0 \exp\left\{-\frac{1}{2}\left[\frac{\left(\bar{K}_0 + K\right)^2}{3J_2}\right]^n\right\}\frac{s_{ij}}{\sqrt{J_2}}, \quad \dot{\varepsilon}_{kk}^{p} = 0, \ \dot{\varepsilon}_{jj}^{p}(0) = 0,$$

- Evolution equation parameter isotropic strengthening

$$\dot{K} = m_1\left(\bar{K}_1 - K\right)\dot{W}^{p}, \ K(0) = 0,$$

In the surface layer in time there are significant compressive stress GPa. This is because partial thermal and mechanical stresses imposed task.

Consideration transformation changes the volume depending on the state of micro structural causes greater level of compressive radial stresses that increase the strength and durability of parts designs.

The work related to the study of thermomechanical processes used basic equations and dynamical coupled problem of value thermomechanics. The problem is nonlinear and is solved numerically by stepping in time. Used iterative method and finite element method. The equations of motion are integrated by the implicit Newmark, and the current equation - implicit Euler method. Nonlinear boundary problem is solved by simple iteration. Thermomechanics linearized problem at each iteration is solved by finite element method based on the variational formulation of Lagrange.