

The main objective of the planned research is to develop new analytical and the numerical-analytical models for distributions of transient temperature fields and thermal stresses calculation for two tribological systems: 1) strip combined with a semi-space and heated on a free surface by a heat flux of known intensity; 2) a strip sliding on the surface of semi-space, with constant or linear speed. Solutions will consider changes of thermal properties (thermal conductivity, specific heat, thermal diffusivity coefficient) and mechanical properties (Young's modulus, Poisson's ratio, linear expansion coefficient) of the materials under the influence of temperature. Materials which will be tested divided into two types: type I are materials with a simple nonlinearity, i.e materials in which coefficients of heat conduction and specific heat depend on the temperature, and their ratio – coefficient of thermal diffusivity – is constant; the second type are materials with arbitrary nonlinearity, in which the coefficients change with temperature freely and independently of each other.

To achieve the objective the following test methods will be applied: partial or complete linearization of the problem using Kirchhoff integral transform; complementation of problem total linearization by proposing: method of linearizing coefficients for materials with a simple nonlinearity; methods of successive approximations and method of lines for materials with arbitrary nonlinearity; solving the linearized boundary-value problems of heat conduction using the Laplace integral transformation; numerical integration using the approximation properties of the section constant or section linear functions; integration of complex functions using Cauchy's theorem. In addition, to obtain a solution in the case of arbitrary slip speed Duhamel formula will be used. Whereas calculation of the thermal stresses will be based on the theory of a thermal bending of the thick plate with free ends.

Based on review of literature sources, it can be concluded, that all obtained so far solutions of nonlinear thermal problems of friction, involving a change of thermal and mechanical properties of materials have been obtained for the semi-space – semi-space system. Appropriate solutions for a tribological system in which one of the elements has a finite dimension in the direction of friction heat diffusion (strip), is not found in the literature. Therefore, the proposed project aims to clarify the influence of thermal sensitivity of materials on the distribution of undetermined temperature fields and quasi-static thermal stresses of homogeneous or sections-homogeneous elastic bodies which undergo frictional heating, with the strip-substrate system as example.