

Nonlinear mathematical models and experimental investigations of frictional heating of the railway braking system

The main aim of this project is to develop a complex method to estimate value of temperature and thermomechanical wear of the railway disc brake system. Proposed method will be based on the solution to the heat dynamics of friction and wear (HDFW) system of equations.

The system of equations HDFW includes the following issues: I) evolution of pressure during braking; II) thermal stability problem – dependency of the friction coefficient of the materials on the maximum temperature on the contact surface; III) problem of braking dynamics – changes of the vehicle velocity to the standstill with variations in friction coefficient and contact pressure; IV) the boundary-value problem of heat conduction to designate the mean temperature on the disc-pad contact zone; V) problem of the flash temperature estimation; VI) changes of thermomechanical wear over time. In addition, in the nonlinear variants this system should be completed by the experimental dependencies of the mechanical and thermal properties of materials on the temperature.

Innovative character of the proposed methodology is provided by the consideration of mutual influence of velocity, temperature, thermal sensitivities of friction coefficient and friction materials during braking of the railway vehicle, in the developing the equations HDFW. This allow to mathematically describe interdependent processes of heat generation in a railway disc brake system in micro- and macroscale and also friction and wear during braking depending on the parameters, such as: brake system and its frictional elements construction, heat absorption, pressure on the contact surface of the pad and disc, initial velocity of the vehicle and temperature variations of mechanical, thermal and tribological properties of friction materials.

Verification of the results, obtained by means of proposed calculation model, will be a comparison of these results with the experimental data, obtained from the experiment designed especially for this purpose. This experiment will be conducted, first on the reduced, and next on full-sized dynamometric test rigs, intended for the investigations of the railway brake disc systems.