Doctoral Dissertation Abstract

Title: Impact of Disc Temperature on Braking Torque of Vehicle's Friction Brake

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In this dissertation the analysis of disc brake temperature impact on braking torque curve in vehicle's friction brake is presented. Scientific objective of the thesis is analysis of the braking torque versus time function induced by temperature. Temperature rise results in friction coefficient reduction, which causes a decrease of the braking process efficiency. The issues related to the design, construction, and tests of the friction brake with emphasis on the impact of temperature on the braking torque are the subject of the dissertation. In order to determine the impact of temperature on the braking torque, a number of laboratory tests was performed. Two test stands, one for friction material testing and the other for full scale brakes testing, were used. The measurements of the braking torque, rotational speed, braking force, and temperature were performed. Temperature recording was made using infrared camera, pyrometer, and thermocouples on the stand for testing friction materials and pyrometer only on the stand for testing full size brakes. As a result of the tests, the existence of the connection between temperature and the braking torque curves was confirmed. Developed test method can be used to observe phenomena occurring in the friction contact zone, difficult or even impossible to determine using other methods of measurement. At the same time the phenomenon of sudden drop in braking torque, and its re-growth to a level of equilibrium was observed and explained.

In the next part of the dissertation, numerical (FEA) and mathematical models of friction process are presented. Numerical model was created using COMSOL Multiphisics software. As the input parameters, the results from friction material laboratory test were used. The results obtained from the simulation were compared to the laboratory ones showing high level of convergence. The same laboratory results became the source of the braking torque and temperature mathematical models. They were determined using functions estimation approach.

The thesis also includes the state of the knowledge analysis in terms of friction phenomena, friction materials, full size brakes, laboratory tests, and numerical simulations.

At the end of the dissertation the conclusions are formulated connected to the described laboratory research and calculations, which confirm the thesis. Suggestions for further works on the topic are proposed.

Keywords: vechicle, braking process, multidisc friction brake, braking torque, disk brake surface temperature, friction coefficient, braking process efficiency