

The Electric Car Wheel Hub Motor Work Analysis with the Use of 2D FEM Electromagnetic Method and 3D CFD Thermal Simulations

Authors : Piotr Dukalski, Bartłomiej Bedkowski, Tomasz Jarek, Tomasz Wolnik

Abstract : The article is concerned with the design of an electric in wheel hub motor installed in an electric car with two-wheel drive. It presents the construction of the motor on the 3D cross-section model. Work simulation of the motor (applied to Fiat Panda car) and selected driving parameters such as driving on the road with a slope of 20%, driving at maximum speed, maximum acceleration of the car from 0 to 100 km/h are considered by the authors in the article. The demand for the drive power taking into account the resistance to movement was determined for selected driving conditions. The parameters of the motor operation and the power losses in its individual elements, calculated using the FEM 2D method, are presented for the selected car driving parameters. The calculated power losses are used in 3D models for thermal calculations using the CFD method. Detailed construction of thermal models with materials data, boundary conditions and losses calculated using the FEM 2D method are presented in the article. The article presents and describes calculated temperature distributions in individual motor components such as winding, permanent magnets, magnetic core, body, cooling system components. Generated losses in individual motor components and their impact on the limitation of its operating parameters are described by authors. Attention is paid to the losses generated in permanent magnets, which are a source of heat as the removal of which from inside the motor is difficult. Presented results of calculations show how individual motor power losses, generated in different load conditions while driving, affect its thermal state.

Keywords : electric car, electric drive, electric motor, thermal calculations, wheel hub motor

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