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MODELLING OF SPHERICAL AUTOMOTIVE DROPLET HEATING AND EVAPORATION: RECENT DEVELOPMENTS

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The most recent developments in the modelling of heating and evaporation of automotive (Diesel, gasoline, biodiesel and their mixtures) fuel droplets, the results of which were published in 2014-2017 (after the publication of the monograph [Sazhin 2014]), are reviewed. This overview is complementary to the more general review [Sazhin 2017]. The most important unsolved problems are identified. Several approaches to modelling the heating of evaporating droplets, predicting different heating and evaporation characteristics, are compared. Basic principles of the Discrete Component (DC) model and its application to biodiesel fuel droplets are described. The Multi-dimensional Quasi-discrete (MDQD) model and its application to droplets of Diesel, gasoline fuel and their mixtures with biodiesel fuel are discussed. A new kinetic model for Diesel fuel droplet heating and evaporation is described following [Sazhin et al. 2016]. New approaches to the estimation of the evaporation coefficient for Diesel fuel droplets, including those taking into account quantum-chemical effects, are presented.
The new models for biodiesel fuel droplet heating and evaporation are based on the analytical solutions to the species diffusion and heat transfer equations inside droplets with Robin boundary conditions at their surfaces which are incorporated into the numerical code (Discrete Component Model (DCM)). These solutions are presented in the forms of rapidly converging series and can be easily implemented into conventional Computational Fluid Dynamics (CFD) codes. The results of the implementation of one of these solutions, although referring to mono-component droplets, into the commercial ANSYS FLUENT CFD code are presented in [Rybdylova et al., 2016].

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