Progress with the analysis of dimethyl ether sprays with a moments spray model

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Abstract

The representation of spray characteristics in internal combustion engines using spray models has taken on greater significance with the increased need to reduce engine emission levels. Apart from work on improving existing diesel and gasoline engines, research on evaluating other fuel types, including dimethyl ether, for internal combustion engines has intensified. Thus, existing spray models, developed for diesel engine spray assessments for example, have to be applicable to the new fuel types being investigated. A diesel spray model has been developed that represents diesel sprays by means of three moments of the droplet-size distribution function calculated from transport equations and one moment obtained from a Gamma size distribution. Typically, diesel spray models use the so-called Discrete Droplet Model (DDM) method in which the diesel sprays are represented by tracking droplet size classes. To attain stochastically significant solutions with the DDM method can require tracking a large number of groups of droplets and this can be computationally expensive. As droplet size classes are not tracked in the moments spray model, the computational intensity is reduced. The applicability of the moments spray model is analysed for dimethyl ether sprays. The results are characterized by dimethyl ether spray penetration at different injection nozzle sizes and spray pressure values. These are compared with experimental data. The results indicate that the moments spray model can be applied as a predictive tool for dimethyl ether spray penetration. This is similar to observations from other scholars using the DDM method. However, there are discrepancies in the observed and predicted penetration values at early and late injection times. Thus, it might still be useful to develop fuel initial injection correlations specific to dimethyl ether spray simulations.