Numerical Study of Multi-Component Spray Combustion with a Discrete Multi-Component Fuel Model

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Abstract

A numerical investigation of fuel composition effects on spray combustions is presented. A new discrete multi-component (DMC) fuel model was used to represent the properties and composition of multi-component fuels. A multi-dimensional CFD code, KIVA-ERC-Chemkin, that is coupled with improved sub-models and the Chemkin library, was employed for the simulations. A large-bore, optically accessible, DI diesel engine operating in a low temperature combustion (LTC) regime was simulated with primary reference fuels for validation of the fuel models. Then, a small-bore, high-speed DI diesel engine operating in a low temperature combustion (LTC) regime was simulated with two different diesel fuels using a 6-component fuel model. The oxidation chemistry was calculated using a reduced mechanism for primary reference fuel, with the reaction rate coefficients adjusted to account for the Cetane number (CN) variation of the fuels of interest. The major property differences of the fuels include volatility, viscosity, and autoignitability. The predicted pressure and heat release rate are compared with experimental data available in the literature. The results show that the present multi-component fuel model performs reliably, and captures the effects of fuel composition differences on combustion.

Key words: multi-component, spray, evaporation, fuel composition.

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