# Modeling of flame lift-off length in diesel low-temperature combustion with multi-dimensional CFD based on the flame surface density and extinction concept

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Low-Temperature Combustion (LTC) is becoming a promising technology for simultaneously reducing soot and NOx emissions from diesel engines. LTC regimes are evaluated by the flame lift-off length ? the distance from the injector orifice to the location of hydroxyl luminescence closest to the injector in the flame jet. Various works have been dedicated to successful simulations of lifted flames of a diesel jet by use of various combustion modeling approaches. In this work, flame surface density and flamelet concepts were used to model the diesel lift-off length under LTC conditions. Numerical studies have been performed with the ECFM3Z model, n-Heptane and diesel fuels to determine the flame lift-off length and its correlation with soot formation under quiescent conditions. The numerical results showed good agreement with experimental data, which were obtained from an optically accessible constant volume chamber and presented at the Engine Combustion Network (ECN) of Sandia National Laboratories. It was shown that at a certain distance downstream from the injector orifice, stoichiometric scalar dissipation rate matched the extinction scalar dissipation rate. This computed extinction scalar dissipation rate correlated well with the flame lift-off length. For the range of conditions investigated, adequate quantitative agreement was obtained with the experimental measurements of lift-off length under various ambient gas O2 concentrations,ambient gas temperatures, ambient gas densities and fuel injection pressures.The results showed that the computed lift-off length values for most of the conditions lay in a reasonable range within the quasi-steady lift-off length values obtained from experiments. However, at ambient temperatures lower than 1000 K, the lift-off length values were under-predicted by the numerical analysis. This may be due to the use of the droplet evaporation model as it is believed that evaporation has a strong effect on the lift-off length.

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