# Finite Diffusion Multi-Components Fuel Droplet Vaporization Modeling Using Continuous Thermodynamics for Fuels with Distinct Composition Distributions

C. Shen[1], W.L. Cheng[1], C. F. Lee[1,2*]

[1]Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, USA

[2]Center for Combustion Energy and State Key Laboratory of Automotive Safety and Energy, Tsinghua University, China;

caishen1@illinois.edu, waycheng@illinois.edu, and cflee@illinois.edu

**Abstract**

Commercial fuels are composed of hundreds of chemically different hydrocarbons. An accurate and efficient way to model the vaporization process is required to represent the droplet evaporation under typical engine operation condition. In this study, a finite diffusion droplet evaporation model for complex liquid mixture composed of different homogeneous groups is presented in this paper. Separate distribution functions are used to describe the composition of each homogeneous group in the mixture. Only a few parameters are required to describe the mixture. Quasi-steady assumption is applied in the determination of evaporation rates and heat flux to the droplet, and the effects of surface regression, finite diffusion and preferential vaporization of the mixture are included in the liquid phase equations using an effective properties approach. A novel approach was used to reduce the transport equations for the liquid phase to a set of ordinary differential equations. The proposed model was compared against experimental measurements for single, isolated droplets of n-decane, kerosene, heptane-decane and diesel-butanol. The proposed model predicted the temperature and droplet size variations well. The present model was applied to simulate the evaporation of isolated droplets with composition of typical diesel. Computations showed that the model captured the main distillation characteristics of commercial fuels reasonably well. The proposed model is capable in capturing the vaporization characteristics of complex liquid mixtures.

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\* Corresponding author: cflee@illinois.edu