A Simple Model for the Vaporization of Droplets with Large Numbers of Components

William L.H. Hallett*
Department of Mechanical Engineering,
University of Ottawa,
Ottawa, Ontario, Canada K1N 6N5

ABSTRACT

This paper presents a simple quasi-steady droplet evaporation model for multicomponent mixtures with large numbers of components based on a “continuous thermodynamics” description of mixture properties. This gives the composition as a probability density function rather than as a series of discrete components, making it possible to simulate commercial petroleum fractions with only three distribution parameters rather than a large number of discrete components. The vapour phase solution is a simple extension of classical droplet theory. Well-mixed and diffusion-limited models are given for the liquid phase. A $d^2$ law is shown to exist for these droplets, and expressions for the vaporization rate constant are derived. Sample calculations show the capabilities of the model for describing phenomena in complex mixtures.

(Combustion and Flame 121 (2000) 334-344)