

## Influence of Drop Spacing on Burning of an Emulsified-Drop Stream

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### Abstract

Combustion characteristics of water-in-dodecane emulsion drops with various initial spacings were studied experimentally by using a free-falling drop burning apparatus. The initial drop spacings ( $S_i$ ) were 2.5, 5, 10, 40, 75 (70), 100.  $S_i$  ( $s/d_i$ ) was defined as the ratio of the drop center-to-center distance ( $s$ ) to the initial drop diameter ( $d_i$ ). The water content ( $\beta$ ) and the oxygen concentration ( $\Omega_{O_2}$ ) were fixed at 5% and 21%, while two drop sizes 550  $\mu\text{m}$  and 450  $\mu\text{m}$  were compared. The results showed that the transition of the drop flame occurred for all cases in the experiment. For  $S_i > 10$  along the flow direction, the flame around the drops would change from a blue spherical flame to a yellow flame and a wake flame, and the drop flame extinguished later in the downstream region. Soot particles was generated and drops collision and merging occurred to form a flame tube for  $S_i = 2.5$  in both cases of  $d_i = 550 \mu\text{m}$  and 450  $\mu\text{m}$ . Besides, drop expansion was observed in both cases of  $d_i = 550 \mu\text{m}$  and  $d_i = 450 \mu\text{m}$ , while micro-explosion only occurred in the far downstream region for  $S_i = 40$ ,  $d_i = 450 \mu\text{m}$ . It was also shown that the emulsion drop evaporation rate was not a constant, and the trend of the drop evaporation rate was strongly influenced by changing the initial drop size.

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