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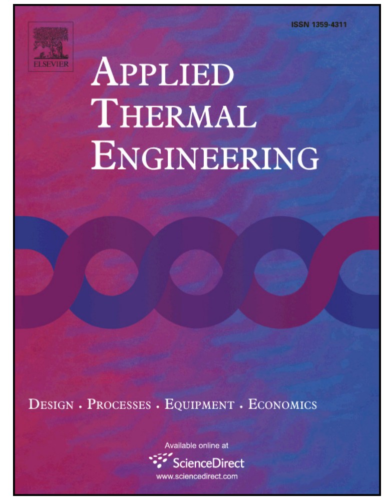


Research Paper

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# In-nozzle Flow Investigation of Flash Boiling Fuel Sprays

**Shengqi Wu[1], Min Xu[1]*, David L. S. Hung[1, 2], Hujie Pan[1]**

1. School of Mechanical Engineering, Shanghai Jiao Tong University, National Engineering Laboratory of Electronic Control Technology, Shanghai, 200240, China.

2. University of Michigan–SJTU Joint Institute, Shanghai Jiao Tong University, Shanghai, 200240, China.

*Corresponding author: mxu@sjtu.edu.cn

**Abstract**

It is widely recognized that a well atomized spray promotes the fuel evaporation in engine cylinder and contributes to higher fuel efficiency and lower exhaust emission. Specifically, higher fuel temperature enhances the fuel spray evaporation due to the superheat phenomenon even at low injection pressure. In this study, both internal flow and near nozzle fuel jet of a two-dimensional transparent nozzle were investigated using high-speed backlit imaging technique to acquire a better understanding of the primary breakup process of flash boiling sprays. The two-dimensional slit transparent nozzle was designed to facilitate the enhanced visualization of bubbles inside the nozzle by squeezing small bubbles and eliminating overlapping bubbles. The ambient pressure ranged from 40 kPa to 190 kPa, and fuel temperature varied from 41 ℃ to 71 ℃, to produce a wide range of superheated conditions. N-pentane was chosen as test fluid with an injection pressure was 0.5 MPa. Experimental results show that the bubbles occurring inside the nozzle near the nozzle exit under flash boiling conditions affect the shape and dynamic behavior of near nozzle fuel jet. It shows that higher fuel temperature and lower ambient pressure increase the inner bubble size and volume fraction, which led to narrower liquid core of near nozzle fuel jet. Inner bubbles facilitate the breakup process of fuel jet significantly. The breakup process of flash boiling spray can be elucidated with more fundamental understanding of bubble behavior inside the nozzle.

**Keywords**: Flash boiling spray, 2D transparent nozzle, internal flow, jet breakup.