Effect of Cavitation inside Nozzle on Liquid Jet

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Abstract

The purpose of this study is to investigate how the generation and extinction of cavitation inside a nozzle affects breakup of the liquid from the nozzle. A cylindrical nozzle, whose ratio of nozzle length L to inner diameter D is L/D = 12, was used with an injection pressure P_{inj} of 0.3 to 1.0 MPa (gauge) and a fluid flow rate Q from 7.25 to 12.0 L/min in order to investigate the generation of cavitation inside the nozzle that affects liquid jet turbulence. When the injection pressure P_{inj} ranged from 0.3 to 0.5 MPa, we found that a cavitation region was formed and disappeared near the nozzle exit, large pressure fluctuations occurred, and the liquid flow inside the nozzle was disturbed. After determining the power spectrum density of pressure fluctuations inside the nozzle, we confirmed that the power spectrum density peaked in the lower frequency, which indicates fluctuations in the cavitation region. We also confirmed that liquid droplets were generated from the outer edge of the liquid jet due to large pressure fluctuations near the nozzle exit. In contrast, when the injection pressure P_{inj} was 1.0 MPa, it was confirmed that the cavitation region did not disappear completely inside the nozzle. In this case, few liquid droplets were generated even though the flow rate was larger and the air-liquid relative velocity was higher than when injection pressure is low. It is found that the large pressure fluctuations did not occur inside the nozzle due to extinction of the cavitation. The extinction of the cavitation region near the nozzle exit resulted in disturbed liquid flow inside the nozzle, and increased turbulence in the liquid jet, generation of liquid droplets from the outer edge, and spread of the liquid jet.

Key words: Cavitation, Liquid jet, liquid breakup, cylindrical nozzle

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