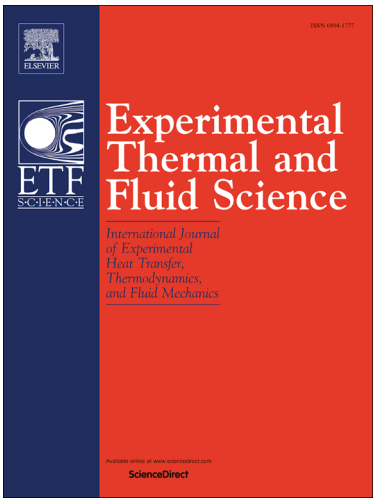

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Atomization of Impinging Opposed Water Jets Interacting With an Air Jet

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HIGHLIGHTS

- Without an air jet the size of the circular water sheet variation with water jet Reynolds number and Weber number is in agreement with previous findings.
- The average droplet diameter is confirmed to scale with Weber number and density ratio
- Sauter mean diameter (D_{32}) along the centerline of the spray, first decreases as a result of breakup and then increases, possibly due to coalesce of droplets or preferential dispersion of different droplet sizes
- Variation of D_{32}/d, where d is pipe diameter, against the air liquid momentum ratio reveals that horizontally opposed impinging jet arrangement leads to better atomization than with liquid jet impingement angle of 90°.

Abstract

The characteristics of horizontally opposed water jets in the absence and presence of an impinging air jet are investigated visually with high speed camera and quantitatively using phase Doppler anemometry (PDA). In the absence of air jet, the size of the circular water sheet variation with water jet Reynolds number and Weber number is in agreement with previous findings. The average droplet diameter is found to scale with Weber number and density ratio. Breakup phenomena are captured and described for various combinations of water and air flowrates, which indicate the significant role the air jet plays in promoting water jets atomization. Quantitative measurements using phase Doppler anemometry (PDA) reveals the effects of water flowrates on the generated droplets' size, velocity and root mean square (RMS) distributions and air mass flowrates on the droplets' size distribution along the vertical axis. At various combinations of water flowrates and air mass flowrates, the droplet Sauter mean diameter (D_{32}) along the centerline of the spray, first decreases as a result of the breakup and then increases slight possibly due to the coalesce of droplets or preferential dispersion of different droplet sizes after break was complete. Larger water flowrates result in larger D_{32}, while larger air mass flowrates lead to smaller D_{32} values. Variation of D_{32}/d, where d is the pipe diameter, against the air liquid momentum ratio reveals that the horizontally opposed impinging jet arrangement leads to better atomization than the one with liquid jet impingement angle of 90°.

Key words: Opposed impinging liquid jets; atomization; PDA; droplet size; droplet velocity