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The effect of confinement on the development of an axisymmetric wall-jet in confined jet impingement TIANQI GUO, MATTHEW J. RAU, PAVLOS P. VLACHOS, SURESH V. GARIMELLA, Purdue University — An experimental study of a confined developing axisymmetric wall-jet is reported. The wall-jet is formed downstream of a circular, confined, impinging jet of water. Stereo particle image velocimetry (SPIV) experiments are conducted at three different nozzle-to-plate spacings (2, 4 and 8 jet diameters) and across Reynolds numbers ranging from 1000 to 9000. Special attention is paid to the development of the wall-jet. The growth rate of the boundary layer thickness, decay rate of the local maximum velocity, and velocity profile scaling for both the inner- and outer-layer are investigated. Measurements are obtained with a maximum spatial resolution of 25 μm and a temporal resolution of 750 Hz. Both ensemble-averaged and instantaneous time-resolved three-component, two-dimensional (3C-2D) flow fields are obtained and analyzed. The upper confinement plate is found to limit the supply of ambient liquid for both the impinging-jet and wall-jet entrainment, and thus significantly influences the wall-jet development; the growth and decay rate of the wall-jet are shown to be greatest at the smallest confinement height. The influence of these confining effects on recirculation patterns and coherent-structure evolution is also reported. These flow field measurements and analyses will serve to inform a variety of practical applications that use impinging jets.

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