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Effects of Drop Acceleration and Deceleration on Particle Capture in a Cross-flow Gravity Tower at Intermediate Drop Reynolds Numbers

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Cross-flow gravity towers are particle scrubbing devices in which water is sprayed from the top into particle-laden flow moving horizontally. Models for predicting particle capture assume drops traveling at terminal velocity and potential flow ($Re_D > 1000$) around it, however, Reynolds numbers in the intermediate range of 1 to 1000 are common in gravity towers. Drops are usually injected at velocities greater than their terminal velocities (as in nozzles) or from near rest (perforated tray) and they accelerate/ decelerate to their terminal velocity in the tower. Also, the effects of intermediate drop Reynolds number on capture efficiency have been simulated for (a) drops at their terminal velocity and (b) drops accelerating/decelerating to their terminal velocity. Tower efficiency based on potential flow about the drop is 40% - 50% greater than for 200 mm drops traveling at their terminal velocity. The corresponding values for 500 mm drops are about 10% - 20%. The drop injection velocity is important operating parameter. Increase in tower efficiency by about 40% for particles smaller than 5 mm is observed for increase in injection velocity from 0 to 20 m/s for 200 and 500 mm drops.

Key words : *Particle capture, accelerating drop, decelerating drop, cross-flow gravity tower, intermediate Reynolds number, simulation, inertial impaction.*