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High-Fidelity Simulation of a Rotary Bell Atomizer with Electrohydrodynamic Effects[1] VENKATA KRISSHNA, MARK OWKES, Montana State University, Bozeman — Rotary Bell Atomizers (RBA) are extensively used as paint applicators in the automotive industry. Atomization of paint is achieved by a bell cup rotating at speeds of 40k-60k RPM in the presence of a background electric field. Automotive paint shops amount up to 70% of the total energy costs [Galitsky et. al., 2008], 50% of the electricity demand [Leven et. al., 2001] and up to 80% of the environmental concerns [Geffen et al., 2000] in an automobile manufacturing facility. The atomization process in an RBA affects droplet size and velocity distribution which subsequently control transfer efficiency and surface finish quality. Optimal spray parameters used in industry are often obtained from expensive trial-and-error methods. In this work, three-dimensional near-cup atomization (primary and secondary breakup) are simulated computationally using a high-fidelity volume-of-fluid transport scheme that includes an electrohydrodynamic effects. The influence of fluid properties (viscosity ratio, flow rate and charge density), nozzle rotation rate and bell potential on atomization are investigated by performing a parametric study. This cost-effective method of research aims to identify the ideal spray parameters to achieve maximum transfer efficiency.

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