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The Breakup Mechanism and the Spray Pulsation Behavior of a Three-Stream Atomizer CHIN HEI NG, University of Washington, ANNE DORD, GE Global Research, ALBERTO ALISEDA — In many processes of industrial importance, such as gasification, the liquid to gas mass ratio injected at the atomizer exceeds the limit of conventional two-fluid coaxial atomizers. To maximize the shear rate between the atomization gas and the liquid while maintaining a large contact area, a secondary gas stream is added at the centerline of the spray, interior to the liquid flow, which is annular in this configuration. This cylindrical gas jet has low momentum and does not contribute to the breakup process, which is still dominated by the high shear between the concentric annular liquid flow and the high momentum gas stream. The presence of two independently controlled gas streams leads to the appearance of a hydrodynamic instability that manifests itself in pulsating liquid flow rates and droplet sizes. We study the dependency of the atomization process on the relative flow rates of the three streams. We measure the size distribution, droplet number density and total liquid volumetric flow rate as a function of time, for realistic Weber and Ohnesorge numbers. Analysis of the temporal evolution of these physical variables reveals the dominant frequency of the instability and its effect on the breakup and dispersion of droplets in the spray. We present flow visualization and Phase Doppler Particle Analyzer results that provide insight into the behavior of this complex coaxial shear flow.

Alberto Aliseda
University of Washington

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