Spray Plume Characteristics at Multiple Cross-Flow Angles, Experimental and Computational Assessments

K. M. Bade*, W. Kalata, and R. J. Schick
Spray Analysis and Research Services
Spraying Systems Co.
P.O. Box 7900
Wheaton, IL 60187 USA

Abstract

The interaction of a spray plume within a confined cross-flow environment occurs often in spray applications, most notably in gas conditioning applications. Characterization and modeling of the drop size and velocity distributions, as well as spray shape, was conducted within a controlled wind tunnel environment. The primary focus of this study is the effect of various incident angle cross-flows on the characteristics of a spray nozzle.

While the spray characteristics immediately downstream of the nozzle will govern the significance of the effect of the cross-flow, this study aims to provide a reference case in order to guide and compare future work. A low flow rate, hydraulic, hollow cone spray was investigated with a nominally uniform cross-flow air speed of 15.4 m/s. These results demonstrate the trajectory change as well as the change in spray plume characteristics over a range of spray angles defined relative to a co-flow air stream.

The experimental results were acquired with an Artium Phase Doppler Interferometer (PDI). The computational model and simulations were conducted using the Ansys Fluent modeling software package in conjunction with methods developed at Spraying Systems Co. The computational model's agreement, and disagreement, with the experimentally acquired results provides insight for the appropriate considerations when constructing cross-flow models.

Key words: Cross-Flow, Phase Doppler Interferometry, PDI, Experimental Validation, Comparison, Computation Fluid Dynamics, CFD, Gas Conditioning

*Corresponding author, Kyle.Bade@Spray.com