Unsteadiness in Effervescent Sprays: Influence of Operational Conditions and Atomizer Design

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Abstract

Effervescent atomizers become more frequent in industrial applications as they produce fine and controllable spray even at low input pressure. However their spray is inherently unsteady; this feature is generally improper and it is necessary to minimize spray unsteadiness e.g. in case of combustion applications. In this study we focus on a single-hole effervescent atomizer spraying light heating oil with air as atomizing medium in the "outside-in" gas injection configuration. The spray is measured using Phase Doppler anemometer and the Edwards and Marx's spray unsteadiness evaluation method is applied. Variation of spray unsteadiness with droplet size, spatial location in the spray and influence of atomizer operation conditions on spray unsteadiness is evaluated on exemplary atomizer. Several atomizer internal dimensions are modified for study of influence of atomizer design on spray steadiness: size and number of aeration holes, their location and diameter of the mixing chamber. Results show that spray unsteadiness is spatially dependent; the unsteadiness is low in the spray centerline and increases with radial distance. Spray unsteadiness moderately increases with axial distance. Influence of operation conditions, air gauge pressure and gas to liquid ratio, is weak. The spray unsteadiness can be reduced by a proper dimensioning of atomizer internal geometry; short mixing chamber with high number of small aeration holes provides spray with low level of unsteadiness.

Key words: Effervescent atomizer, spray unsteadiness, atomizer internal geometry

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