Development of Low-Order Regression Models for Selected Flat Spray Characteristics

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Abstract

Dimensional as well as non-dimensional independent variables are used for predicting spray droplet size statistics and spray pattern distributions. The independent variables are: pressure, flow rate, spray angle, spray distance, viscosity, and surface tension. In the first approach, the dimensional values are used to develop a regression model for the general spray characteristics of interest; namely, Sauter mean diameter, spray width, and spray distribution profile shape. Secondly, a similitude approach is employed to generate dimensionless quantities from the independent variables, which are then used in formulating regression models. The similitude method allows for an assessment of the underlying balance of forces, which ultimately serve to form the spray characteristics. The final model development uses linear, or nonlinear where advantageous, regression models to fit the operational and rheological inputs to the spray characteristic outputs. The predictor models using dimensionless quantities showed a improved accuracy over the dimensional models. Additionally, the included number of dimensionless quantities is systematically reduced, revealing the most influential independent variables for each output. It is found that the Reynolds, Weber, and Froude Numbers are most influential. All models are developed for a particular nozzle, which limits the resulting models to this particular nozzle; however, the model *development process* has further reaching utility.

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