Computational Fluid Dynamic Modeling of Electrostatic Precipitators

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Robert G. Mudry, P.E., Technical Director
Brian J. Dumont, Project Engineer
Airflow Sciences Corporation
Livonia, Michigan

The application of Computational Fluid Dynamic (CFD) modeling techniques to electrostatic precipitators (ESPs) is discussed. Modeling methodology is reviewed. A range of ESP fluid flow characteristics that can be evaluated using CFD techniques is explored. These include the analysis of velocity distribution, temperature stratification, chemical injection, particulate deposition, and pressure loss.

The accuracy of CFD models of electrostatic precipitators is examined in detail. Flow simulation results from twelve distinct precipitator CFD models are compared with actual field measurements of velocity and/or temperature. In three of these cases, data from a physical scale modeling effort for the same ESP are available and are also compared to the field measurements.

The comparisons indicate that the CFD and physical models provide velocity predictions of similar accuracy. The velocity distribution predicted by both the CFD and physical models within the ESP collection regions are accurate to within 15% of actual test data. The CFD predictions for temperature within the ESP are also reasonably accurate, matching within 18% of measured data.
Authors:

Note: Model accuracy figures stated above are based on the analysis of only a portion of available data and are considered preliminary at this time.

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