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Computational Analysis of Particle Nucleation in Dilution Tunnels: Effect of Flow Configuration and Tunnel Geometry SATBIR SINGH, PETER ADAMS, ASHWIN MISQUITTA, KYUNG LEE, Carnegie Mellon University, ERIC LIPSKY, Penn State Greater Allegheny, ALLEN ROBINSON, Carnegie Mellon University — Measurement of fine particle emission from combustion sources is important to understand their health effects, and to develop emissions regulations. Dilution sampling is the most commonly used technique to measure particle number distribution because it simulates the cooling of combustion exhaust with atmospheric air. Experiments suggest that the measured distribution is dependent on the dilution ratio used and the tunnel design. In the present work, computational analysis is performed to investigate the effect of tunnel flow and geometric parameters on H_2SO_4-H_2O binary nucleation inside dilution tunnels using a large-eddy-simulation (LES) based model. Model predictions suggest that the experimental trends are likely due to differences in the level of turbulence inside the tunnels. It is found that the interaction of dilution air and combustion exhaust in the mixing layer greatly impacts the extent of nucleation. In general, a cross-flow configuration with enhanced turbulent mixing leads to greater number of nucleation-mode particles than an axial-flow configuration.

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