

Aerosol Collection Efficiency of a Graded Metal-Fiber Filter at High Airflow Velocity

George A. Klouda, Robert A. Fletcher, J. Greg Gillen, Jennifer R. Verkouteren and Scott A. Wight

Chemical Science and Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, Maryland

A graded metal-fiber filter was characterized for its collection efficiency as a function of particle size at an airflow velocity of 10 m s^{-1} . Efficiencies were determined by generating monodispersed aerosol of polystyrene Latex (PSL) spheres and oleic acid liquid particles of measured concentration with and without the presence of the filter. The filter fibers have a hexagonal cross-section of $20 \text{ }\mu\text{m}$ width, a thickness of 0.7 mm , a porosity of 87% and have no preferred orientation (tortuous path). For PSL spheres $\leq 0.7 \text{ }\mu\text{m}$, the filter efficiency follows that predicted based on theoretical calculations. For $1 \text{ }\mu\text{m}$ to $4 \text{ }\mu\text{m}$ PSL, the average collection efficiency is 45% (expanded uncertainty (U) of 8%, $n = 6$) with poor reproducibility at any single particle size. In the case of particles having very different surface characteristics, e.g., oleic acid (sticky) aerosol the collection efficiency for $> 1 \text{ }\mu\text{m}$ is nearly 100%. Tests performed on a filter coated with a synthetic oil aerosol deposit ($\approx 40 \text{ }\mu\text{g mm}^{-2}$) improved the collection efficiency for PSL $\geq 0.7 \text{ }\mu\text{m}$ to nearly 100%. Considering the poor and erratic behavior of $> 1 \text{ }\mu\text{m}$ solid (dry) particles through an uncoated filter yet high and reproducible efficiencies for a liquid aerosol or solid particles impinging on a sticky (oily) filter surface, results suggest that particle bounce is an important factor influencing the collection efficiency.