Portal Filter Particle Collection Efficiency Using Monodispersed Aerosol
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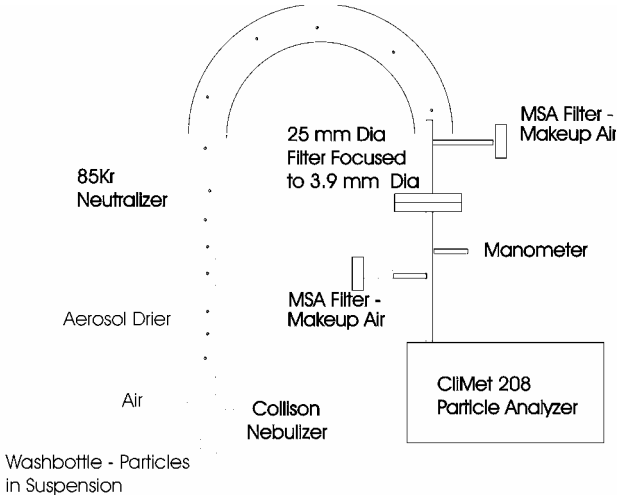
Vision:
To meet the immediate need to screen for trace explosives in a noninvasive way at airports and government facilities, two emerging portal technologies were designed to utilize air jetting and convective airflow to dislodge and transport microscopic explosive particles from clothing to filters for desorption into an ion mobility spectrometer system. However, no data exists on just how efficient these filters are at collecting particles of known size and composition. The NIST Analytical Microscopy Group, in collaboration with the NIST Office of Law Enforcement Standards, the Transportation Security Administration and the Department of Homeland Security, has characterized the collection efficiency of the metal-fiber filter material used by the manufacturers of these portal systems.

Air Jet Portal

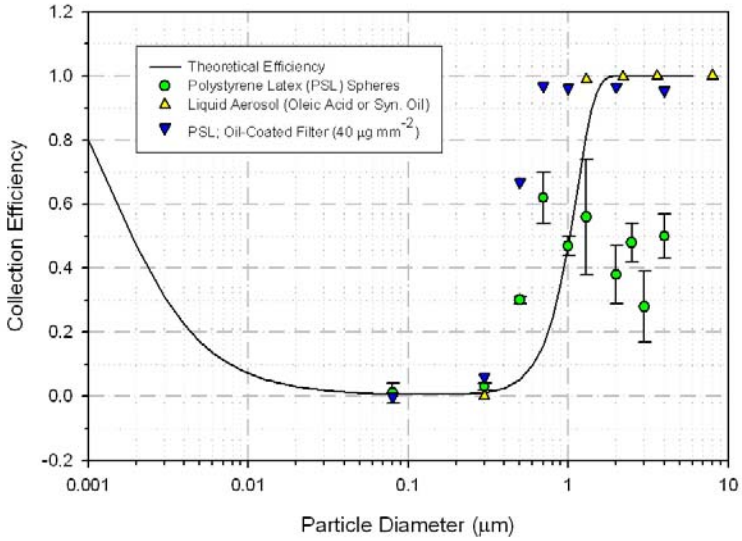


Experimental setup for measuring portal filter particle collection efficiency for particles with diameters >0.5 μm.

Purpose: To develop methods to measure aerosol particle collection efficiencies of walk through portal explosive detection systems and to use this information to develop improved technologies for more efficient particle collection.

Major Accomplishments: Clean and particle loaded filters were evaluated using airborne particles ranging in diameter from 0.08 μm to 8 μm at operational airflow velocities (10 m s^{-1}). The filter collection efficiency was measured by generating aerosol of known size using two standard methods, either a Collison Nebulizer for aerosolizing polystyrene latex (PSL) spheres or a Vibrating Orifice Aerosol Generator (VOAG) to produce sticky liquid oleic acid aerosol of known size. The dried and charge neutralized aerosol was used to challenge the filter with an optical particle analyzer used to determine the particle concentration.

The filter efficiency is calculated from difference in particle counts obtained with and without the filter in place.



Filter collection efficiency plotted vs. particle diameter for different types of aerosol. PSL variability is due to particle bounce. Collection efficiency is greater when filter fibers are coated with oil or for sticky particles, *e.g.* oleic acid.

Impact: This research contributes to a better understanding of the aerodynamic particle collection process, the interplay of particle physical properties on collection and consequently possible technological improvements that can be made to improve the sampling and collection efficiencies.

Future Plans: Future experiments will include the use of the VOAG to generate an aerosol of a high explosive and of a plastic binder, similar to a composite explosive, *e.g.* C4, for evaluating filter efficiency and for developing a standard test surface for IMS. NIST capability of testing can be applied to virtually any filtration system.