Advances in Aerosol Dissemination Methods for Detector Testing

Tom Hughes[1]

[1]ADT Branch, ENG Directorate, Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD

Introduction

Robust, stable and reproducible methods for liquid and solid aerosol delivery are critical for chemical detector evaluations and development. Detector testing is most commonly focused on vapor phase challenges, however low volatility compounds such as VX are not disseminated efficiently as a vapor challenge. Therefore, a method to generate and deliver a liquid aerosol challenge to detectors for algorithm development and evaluation is required. Similarly, dusty compounds (liquid compounds loaded onto a solid carrier) must be presented to a detection system as an aerosol challenge, thus requiring the implementation of solid aerosol delivery methods.

Laboratory Infrastructure

In order to generate aerosol challenges safely in a laboratory fume hood setting, custom glove boxes have been installed in ECBC laboratories. These glove boxes consist of a glove box to contain the aerosol generators, a manifold to transport the generated aerosol, a smaller containment area to house the referee and feedback particle counters, and a sample stem that allows the detector under test to access the interior manifold. The entire glove box is kept at negative pressure with a blower/filter system that provides carbon and HEPA filtration and exhausts into the chemical fume hood.

Figure 1. Hood/glove box containment for aerosol generation.

Neat Aerosol Generator (NAG) for Liquid Aerosol Generation

The Neat Aerosol Generator (NAG) is used to deliver a liquid aerosol challenge without the addition of a salt seed particle. Additionally, the NAG provides an extremely fast equilibration time, typically less than 5 minutes, extraordinary control over the concentration generated, and minimal agent consumption (5-15 mg/hr). The system consists of a commercially available sample introduction nebulizer for an inductively coupled plasma instrument and a custom needle assembly that allows operators to safely access the agent reservoir without the need to open any vials of agent. The system costs well under $3,000 for the entire assembly, and can be reused indefinitely and with different chemicals.

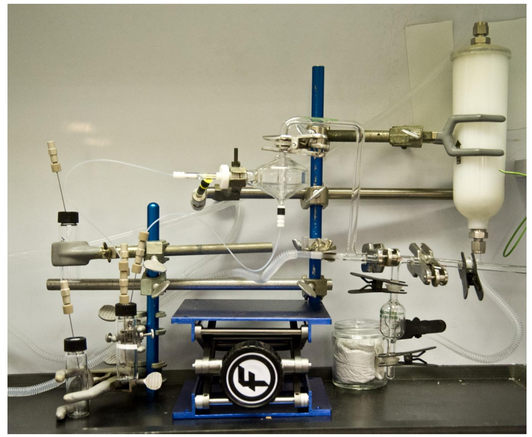

Figure 2. NAG assembly.

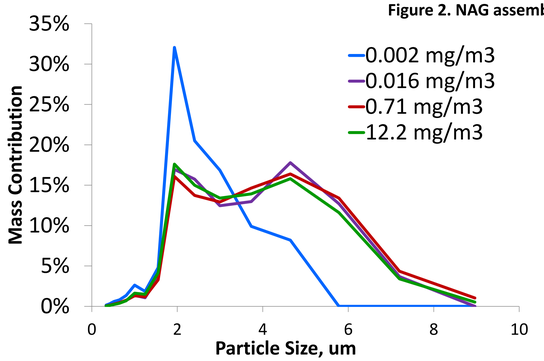

Figure 3. Particle size distributions from the NAG.

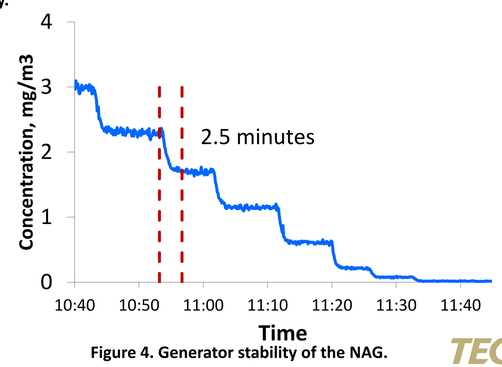

Figure 4. Generator stability of the NAG.

Acoustic Solid Aerosol Generator (ASAG) for Dusty Aerosol Generation

The Acoustic Solid Aerosol Generator is used to deliver neat dusty and solid aerosol challenges in the same aerosol test infrastructure as the NAG. The system consists of a custom built speaker enclosure with a locking mechanism to secure a cartridge above the speaker. The cartridge consists of a Lexan cylinder with butyl membranes secured on each side of the cartridge. The speaker vibrates between 10 and 80 Hz to suspend a portion of the dust loaded onto the membrane into the aerosol phase. Air is passed through the cartridge and into the test manifold. This system also incorporates a feedback mechanism from a particle counter near the detector sampling point that modifies the amplifier output as needed to maintain a constant challenge concentration. The entire system is designed to be disposable and costs less than $200 to replace the entire agent contaminated portion.

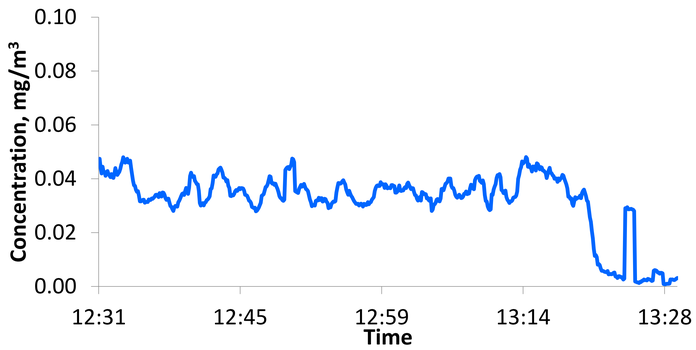

Figure 5. Generator Stability of the ASAG.

Acknowledgements

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