

## THREAT AGENT DEFEAT MODELING AND TESTING USING WMD SIMULANTS

# Aerosol Generation And Aerosol Particle Correlations On Trials Conducted With Sono-Tek Ultrasonic Nozzle In Joint Ambient Breeze Tunnel

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To combat chemical and biological weapons developed by rogue nations and terrorist organizations, the U.S. Army has tested various aerosols of biological agents and their simulants in chambers and in the field at U.S. Army Dugway Proving Ground (DPG). Joint Ambient Breeze Tunnel (JABT) was built to test various integrated platforms: System-Under-Test Units (SUTs) simultaneously. The JABT is 168 meters (550 feet) in total length, 13 meters (43 feet) in width, and 18 meters (58 feet) in height, with an adjustable canopy/ceiling to adjust the height of the test space. The airflow velocity in the JABT is independent of outside wind condition and can be maintained in a range of 0 to 6 meters per second. Similar particle size distributions (multi-modes and polydisperse) and concentrations can be generated in the JABT, as at a field test grid, though much less materials are used in the JABT due to its controlled environment. To demonstrate that we can generate simulant aerosols by using Sono-Tek aerosol generator in a very controllable way with realistic concentrations and particle size distributions in JABT, trials were conducted in JABT, 10-22 May 2023.

Biological aerosols of *Bacillus thuringiensis* Kurstaki (BTK) were generated with the Sono-Tek spray nozzle system in the Joint Ambient Breeze Tunnel for the first time. The BTK is one of the most common simulants for *Bacillus anthracis* in biodefense research. Aerosol generator Sono-Tek ultrasonic atomizer® (Sono-Tek) was mostly used for aerosol generation in our chamber tests previously. A BTK slurry (6.95×10<sup>6</sup> CFU/mL, 12.5 grams of BTK powder into 1 L of distilled water) was fed into the Sono-Tek nozzle using a syringe pump. Wherever necessary, two sets of aerosol generation apparatus were used to achieve the total feed desired. The Broadband Ultrasonic Generator (BUG) generated high-frequency vibrations that disrupted the slurry flow at the nozzle tip and atomized the slurry into wet aerosol cloud carried by the airflow to the down airstream detection and collection platform with one MD8 Airscan Air Sampler® (MD8) and one Aerodynamic Particle Sizer® (APS) in JABT. Test results demonstrated that BTK aerosols could be generated by using Sono-Tek aerosol generator in a very controllable way to generate aerosol with realistic concentrations and particle size distributions. We found that aerosol mass concentration vs. BTK total feed (volume of BTK slurry atomized) has better correlation than aerosol number concentration vs. BTK total feed due to the inherent high concentration of polydisperse natural background particles in the JABT during the trials. It is more appropriate to use mass concentrations instead of number concentrations to correlate with sample concentrations [genome equivalent (GE/mL) and plaque-forming unit (PFU/mL)].

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