

Evaluation of an Electrostatic Sprayer for Personnel PPE Bio Decontamination – Mannequin Testing

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Following a bioterrorism event, the impacted area would be characterized, and work zones established based on the extent of indoor/outdoor contamination. The personnel decontamination (decon) line, established in the contamination reduction zone, is essential for ensuring potentially biohazardous materials on worker personal protective equipment (PPE) do not migrate outside of this zone. During personnel decontamination, conventional backpack sprayers are often used to distribute liquid decontaminant over PPE surfaces, and this process generally produces significant volumes of liquid waste and may lead to migration of biological agents. A previous EPA study was conducted to compare the efficacy and performance of an electrostatic sprayer to a conventional backpack sprayer for PPE decontamination with 10% diluted bleach, using 14- by 14-in PPE-covered coupons inoculated with 1×10^7 spores of *Bacillus atrophaeus* var. *globigii* (*Bg*), a surrogate for *Bacillus anthracis*. Surface efficacy results for both sprayer types indicated a log reduction (LR) ≥ 7.0 for all materials, suggesting that both sprayer types provide a high level of decontamination efficacy. However, the electrostatic sprayer generated substantially less liquid runoff ($\sim 75X$), which would substantially minimize waste generation and disposal costs.

As a follow-on pilot-scale study, surface decontamination efficacy for mannequins in PPE was evaluated using the same conventional and electrostatic sprayers to simulate a personnel decon line. A decontamination test chamber was used to evaluate both sprayers used on mannequins donned with modified Level C PPE including Tychem® SL suits, nitrile gloves, chemical-resistant rubber boots, powered air purifying respirator (PAPR), and ChemTape® at suit interfaces. Mannequins were also inoculated with 1×10^7 *Bg* spores in seven distinct areas; respirator mask, ChemTape® anterior suit midline, left torso, ChemTape® left wrist, outer left-hand glove, left leg knee, and left boot. Tests were conducted using both liquid and aerosol inoculation of spores to evaluate efficacy, runoff, and reaerosolization potential. Mannequins were sprayed with either sprayer type for a prescribed time period (2 or 4 min), using 10% diluted bleach. Wipe samples were then collected to evaluate efficacy from PPE surfaces. Liquid runoff samples were also collected, immediately neutralized, and analyzed, as well as high-volume air samples to evaluate spore reaerosolization from the decon process. Decontamination efficacy was determined by comparing the average number of CFUs observed for inoculum controls to the average number of CFUs observed for decontaminated test areas of the mannequins.

Results from the aerosol inoculation indicate full decon (no detectable CFUs) was achieved with the conventional backpack sprayer and several positive “hard-to-reach” areas were observed for the electrostatic sprayer, with a 2-min spray time. Comparable results were obtained for both sprayers with greater than 5 LR when liquid inoculation was used. Reaerosolization of spores from the conventional backpack sprayer was up to three orders of magnitude higher than the electrostatic sprayer, which demonstrates the potential for spore migration during the decon process.