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Development of Decontamination Technologies for Critical Infrastructure

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M.D. Tucker, R.G. Betty, T.A. Alam, C. Mowry, L. Serna, R. Bernstein, J.A. Hubbard
Sandia National Laboratories, Albuquerque, New Mexico

Background: The objectives of this project are to develop decontamination chemistries and methods for neutralization of highly toxic agents (HTAs) that have been released in critical infrastructure. These new technologies and deployment methods must be effective on multiple interior and exterior surfaces and spaces.

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Methods: The project consists of interdependent, complementary tasks: The development of rapid and effective HTA decontaminants; compatibility of metals and polymeric materials following exposure to baseline and new liquid decontaminants; reactivity and surface transport of novel compounds emulating HTA characteristics*[1]; stirred reactor kinetics and decontamination efficacy on HTA-contaminated porous and nonporous surfaces*[2]; and alternative decontaminant deployment methods for contaminated surfaces and spaces*[3].

Using GC/MS methods, the decontamination efficacy of developmental chemistries was determined in solution and on various surfaces, by monitoring the breakdown of G-agent simulants. Select chemistries were evaluated for HTA destruction via stirred reactor kinetics and surface decontamination efficacy trials, using GC/FPD, GC/MS and LC/MS.

In parallel, materials compatibility analyses were performed following treatment of metal and polymeric surfaces with developmental and baseline decontaminants (bleach and 5 wt% sodium hydroxide). Corrosion rates on four common infrastructure alloys were determined via Polarization Resistance and Electrochemical Impedance Spectroscopy. The impact to polymeric materials treated with liquid decontaminants was measured using TSC, DMA or the 3-pt bend test.

The reactivity and transport of novel compounds emulating HTA physical and structural characteristics[4] was performed, addressing a knowledge gap and informing formulation development. Micellar formation in decontaminants was characterized using Pulsed Gradient NMR. ^{31}P NMR was used to monitor reaction kinetics of the novel compounds treated with

[1] Abstract submitted by Alam and Mowry, Sandia National Laboratories
[2] Abstract submitted by Stickel, Burkle, Battelle Hazardous Materials Research Center
[3] Abstract submitted by Hubbard, Sandia National Laboratories
[4] Synthesized and procured from Johns Hopkins University Applied Physics Laboratory, K. Van Houten

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developmental decontaminants. Innovative sampling and analytical Thermal Desorption/Gas Chromatography/Mass Spectrometry techniques were used to assess the transport of decontaminants and of the novel compounds through a polymeric material

Effective methods for deployment and volumetric decontamination focused on development of effective aerosolization and surface deposition of charged decontaminant droplets.

Summary of Results: The rapid destruction of HTAs has been demonstrated; surface decontamination evaluations of recent developmental formulations are in progress.

An alternative deployment method based on the use of aerosolized charged droplets has demonstrated highly effective surface deposition of chemical decontaminants, thus minimizing required volumes, impact to waste management and remediation timelines.

Analysis and Conclusions: Through completion of interrelated project tasks, the development of decontamination technologies effective against HTAs has been expanded. Invaluable lessons learned will be shared with the threat area community.

Potential Impact to mission/warfighter: The development of effective decontamination chemistries and application methods will greatly improve logistics, response and restoration following an HTA release. The deliverables will be shared and used in a cooperative environment with other Federal agencies, State and local law enforcement, and first responders.

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