MITIGATION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL HAZARD MITIGATION

Hazard Mitigation - From Science To Systems

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The purpose of hazard mitigation technologies0F0F0F is to enable unprotected personnel1F1F1F to use decontaminated assets2F2F2 without inducing negative health effects. The characterization of technology performance (efficacy) needs to account for contaminant distribution on an asset, the ability of the decontaminant to remove the contaminant, and how much of the contaminant may result in an exposure to unprotected personnel. Laboratory testing is utilized to generate representative contaminant distributions on materials, evaluate how a decontaminant removes contaminant, and determine how the residual agent may contribute to the potential exposure of personnel.

Two updates to hazard mitigation methodology have fundamentally (revolutionary rather than evolutionary) changed the ability to utilize laboratory data for operational analysis. A new shim panel (two materials separated by a variable thickness shim spacer) is introduced to quantify the effects of materials configurations that limit fluid access on contaminant retention and decontaminant performance. The contaminant entrained in the shim panel gap is much harder to decontaminate, data shows cases where efficacy was almost 2000 times less than observed on traditional flat panel testing. As a result, these features may be responsible for a disproportionate contribution of potential exposure to personnel, that was not captured in previous test methodologies.

The other new capability includes scale-up calculations that use laboratory results to represent full-scale assets. A new per drop normalization approach captures the effect of drop volume and variable contamination density and is the foundation for the scale-up of laboratory test conditions to operational context. One impact of this approach is that data analyzed on a per drop basis can be used to calculate the asset level response for any contamination density.

The normalized laboratory data provides a source term that is aggregated to represent an asset. This data use provides a shift in perspective in the objectives of laboratory RA data from strictly characterizing efficacy as defined by log reduction to also include efficacy in terms of mitigation of health effects at the asset level. The asset-level RA represents the total mass of agent that could result in an exposure to personnel. A calculation for maximum potential dose (MPD) is introduced that assumes that all agent mass associated with the asset produces vapor or contact exposures. This MPD output provides an upper bound (worst case) exposure estimate associated with the asset of interest. The use of RA data to produce an MPD output is estimated to be 20 times less resource intensive to characterize compared to acquiring the vapor emission and contact transfer data used to perform explicit exposure assessments. It is an ideal first step to build an understanding of how operational conditions and mitigation technology factors integrate to enable the mitigation of potential health effects in personnel using the decontaminated assets.

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