Physical Removal Options for Porous/Permeable Materials Contaminated with a Persistent Chemical Warfare Agent

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In the event of a chemical release incident involving chemical warfare agents (CWAs), porous building materials and permeable coatings may become contaminated with CWAs that absorb into the materials and coatings. Reversal of absorption may not be possible and absorbed CWA may become inaccessible to surface decontaminants that cannot penetrate into those materials or coatings. The best course of remediation may involve physical removal of contaminated materials or coatings. The ideal process would eliminate contamination while minimizing contaminated waste production and irreparable damage to the structure or surface. Following physical contamination removal, surfaces could be restored and returned to service.

Literature searches were performed to identify physical contamination removal technologies that generate minimal waste and avoid irreparable damage. A technology compendium was developed to collate and present the data. Two technologies/approaches were selected for bench-scale laboratory studies followed by subsequent experimental evaluation of physical removal efficacy using two different techniques: grinding and chemical stripping. Grinding involved application of an angle grinder to remove layers of VX-contaminated limestone and sealed concrete (porous materials) at successive 0.25-inch depths. Chemical stripper was applied to remove VX-contaminated paint (permeable coating) from low-carbon steel and hardwood. Ground aggregate and stripped paint samples were analyzed via liquid chromatography-tandem mass spectrometry (LC-MS/MS) to quantify VX. A method for dissection of porous materials to quantify VX depth penetration extent was also developed (referred to as the “core sampling approach”).

The majority of VX recovered using the core sampling approach was collected from the topmost 0.25-inch material layer. Similarly, most of the VX recovered from materials via grinding was also recovered from the topmost 0.25-inch ground layer sample. Most of the VX contamination was removed from coated steel by a pre-stripping surface wipe followed by strip-removal of the permeable coating, suggesting that remediation may be possible though repeated wipes and chemical stripper applications. Both approaches demonstrate that physical removal of VX is feasible without loss in functionality of the material and with limited amount of generated waste.