E30 Evaluating Methods for Removing Radioactive Contamination From Traditional Forensic Evidence: Moths

Kelly Daniel, Marshall University Forensic Science Center, 1401 Forensic Science Drive, Huntington, WV 25701; Rachel Lindvall, BA, Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 94550; Lauren L. Richards-Waugh, PhD, Marshall University, 1401 Forensic Science Drive, Huntington, WV 25701; Jason Chute, MSFS, 1401 Forensic Science Drive, Huntington, WV 25701; and Michael Kristo, PhD, Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 94550*

After attending this presentation, attendees will understand some of the principles behind nuclear forensics and the need to decontaminate radioactively contaminated evidence.

This presentation will impact the forensic science community by demonstrating the potential of several solvents for removing radioactive contamination from traditional forensic evidence, specifically insects, without damaging the evidence.

Traditional forensic evidence, associated with interdicted nuclear material or an attack using a Radiological Dispersal Device (RDD or "dirty bomb"), may become contaminated by dispersible radioactive material. If so, such evidence must either be analyzed by a forensic laboratory capable of handling nuclear material or decontaminated prior to entering a traditional forensic science laboratory. There are few laboratories that are capable of handling dispersible radioactive material and, therefore, decontamination of the evidence with a method that does not destroy the evidentiary value would be preferred.

In 2009, Victoria, Australia, police found 300 grams of a uranium oxide compound in a storage property. After initial analysis by the Australian Science & Technology Organization (ANSTO), aliquots of the material were sent to Lawrence Livermore National Laboratory (LLNL) for further analysis. While aliquoting the sample for analysis, researchers at LLNL found the head and body of a moth. Analysis of the nuclear material indicated that it could not have originated within Australia. Entomological study of the moth could prove useful for understanding the history of the material from production to interdiction within Australia, a type of signature referred to as a "route attribution" signature in nuclear forensics; however, before the moth could be sent to an entomological laboratory, it would need to be decontaminated, a process that could well prove destructive.

To determine an effective and non-destructive method for decontamination of the evidence moth, exemplar moths were collected and contaminated with a uranium ore concentrate. Then, these contaminated moths were ultrasonicated in 11 solvent systems chosen for their potential decontamination properties. Mass difference was initially used to determine the efficacy of these solvents for decontamination, but Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) will be used in future work to determine residual uranium levels.

Four of the solvents (5% Radiacwash™, 5% Decon® 90, acetone, and 1% nitric acid) provided promising results. They removed a significant mass of the uranium ore concentrate without extensive damage to the moth; however, using mass difference to determine the amount of uranium ore concentrate removed from each moth by the solvation proved to be imprecise and sometimes difficult to interpret. For example, mass loss was sometimes greater than expected because of incomplete initial desiccation of the moths followed by a more complete desiccation after decontamination. In addition, the loss of wing scales during solvation seems to be unavoidable in all solvent systems. The moths decontaminated with the promising solvents were ashed and will be analyzed for remaining uranium content by ICP/MS. Future work may include DNA analysis of the moths to determine if DNA can be cleanly extracted from radioactively contaminated evidence.

Radioactive, Decontamination, Insects