B49 Reliability Testing of Commercial Containers for Fire Debris Evidence Storage

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The goal of this presentation is to present results from a study on the leak rates of ignitable liquids from commercial containers used for fire debris evidence storage. This presentation will provide information on the reliability of commercial containers as fire debris evidence containers and methods for handling and analyzing the evidence.

This presentation will impact the forensic community and/or humanity by presenting the results from this long-term study by monitoring hydrocarbon retention in quart volume containers of metal cans, glass jars, and polymer bags. Data revealing leak rates of the containers and the behavior of the hydrocarbon vapors will be discussed along with the significance to methods in fire debris collection and analysis.

A common type of evidence collected at a fire scene is the debris suspected of containing ignitable liquids. The total or partial loss of the volatile ignitable liquids in a container subject to leaking can lead to an altered hydrocarbon profile. Previous investigations have reported significant leak rates for various commercial containers primarily paint cans and polymer bags. This study will differ from previous studies based on its approach for determining the leak rates of the commercial containers for fire debris evidence.

One approach utilized in this study was based on the ideal behavior of a hydrocarbon solution in the C7-C10 range in accord with Raoult's law. Leaks in the container would result in a change in vapor phase composition and a subsequent change in the mole fraction of each component in solution. The more volatile components decrease first, and the change is reflected in both the vapor and liquid phase compositions. The composition of the vapor phase thus provides a way to directly monitor the weathering of an ignitable liquid mixture. The composition of the headspace vapors of the containers was monitored by repeated removal of small (c.a. 20 µl) vapor samples from large (c.a. 1 gal.) containers through a septum inserted into the container lid. The dynamic behavior of a mix of volatile hydrocarbons inside a closed container, coupled with vapor adsorption by the portion of the septum exposed to the interior of the container complicated analyte sampling and analysis. The statistical variation in the resulting data did not allow for the determination of slow leaks in the containers.

A second method employed in this study was sampling by passive headspace concentration with activated charcoal. This method utilized activated carbon strips to adsorb the hydrocarbon mixture then elute the hydrocarbons from the activated carbon with a solvent. Early experiments by this method were complicated by the preferential adsorption of aromatic and higher molecular weight hydrocarbons by the activated charcoal. Extensive research into the adsorption properties of activated charcoal was conducted[1], and the results from the research provided a sampling methodology for monitoring the mole fraction of the C7-C10 hydrocarbon mixture remaining in the container over an extended period of time. A set of four types of quart volume commercial containers held for six different time intervals are undergoing extended time testing. Containers subject to induced leaking are under investigation as positive controls for observable changes in the recovered hydrocarbon mole fraction in the presence of a slow leak. Leak proof systems are under investigation as negative controls against unanticipated changes in the adsorptive function of the activated charcoal over long periods of exposure to hydrocarbon vapors.

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Fire Debris, Ignitable Liquids, Trace Evidence

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