B117 Adsorption Saturation and Chromatographic Distortion Effects on Passive Headspace Sampling With Activated Charcoal in Fire Debris Analysis

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Attendees will emerge from the talk with an appreciation for the complicating effects of adsorbent saturation on the resulting chromatographic profile in ignitable liquid analysis. Audience members will be provided with an understanding of the causes of chromatographic distortion and ways to alleviate these effects in arson investigations.

This presentation will impact the forensic community and/or humanity by presenting results which will be discussed along with their relevance to ASTM methods and possible impacts on the analysis of ignitable liquids residues for pattern matching and source identification.

The recovery of hydrocarbons from an equimolar test mixture containing C7 – C10 components has been investigated to determine the influence of hydrocarbon vapor phase concentration on the molar quantities and ratios of the components recovered by passive headspace sampling with activated charcoal. In a one-quart container, hydrocarbon volumes as small as 24 µl (liquid) were sufficient to saturate a 99 mm^2 activated charcoal square. Hydrocarbon displacement from the saturated surface of the activated charcoal resulted in significant distortion in the molar ratio and chromatographic profile of the recovered hydrocarbons. Hydrocarbon adsorption data for the C7 – C10 equimolar mixture was used to estimate the average surface area of the activated carbon at 1128 ± 197 m^2/g. In order to demonstrate the effect of adsorbent saturation on a commonly encountered commercial accelerant, similar experiments were performed with gasoline. Passive headspace sampling of similarly small volumes of unweathered gasoline resulted in significant distortion of the chromatographic profile of the components recovered from the headspace by passive sampling. The chromatographic profile of the recovered hydrocarbons closely resembled 75% weathered gasoline. A method of subsample collection and analysis was demonstrated as a way to alleviate distortion from samples containing heavy loadings of ignitable liquids. Carpet and carpet padding were placed in a quart container and a heavy loading of unweathered gasoline was placed in the center of the carpet and padding. The container was closed and heated to 60ºC for a period of 16 hours to bring the volatile components from the gasoline into the vapor phase. The container was then cooled to room temperature and a subsample of the carpet padding was removed and placed into an empty one-quart container along with a 99 mm^2 activated charcoal strip. The subsample was heated to 60ºC for a period of 16 hours and the activated carbon was subsequently extracted with CS_2 and analyzed by GC/MS. The resulting chromatogram closely resembled the chromatographic profile of the unweathered gasoline.

These results will be discussed along with their relevance to ASTM methods and possible impacts on the analysis of ignitable liquids residues for pattern matching and source identification.

Fire Depris, Ignitable Liquids, Trace Evidence

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