B141 The Detection of Arson Accelerants Using Porous-Layer Open-Tubular (PLOT) Cryoadsorption

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Learning Overview: After attending this presentation, attendees will gain an understanding of: (1) the basic principles and practice of Porous-Layer Open-Tubular (PLOT) Cryoadsorption as a sample preparation technique, and (2) the advantages of using PLOT-Cryoadsorption in place of carbon strips for the extraction of accelerant residues.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating that, compared to the conventional method of extraction using carbon strips, arson samples extracted using PLOT-Cryoadsorption yield higher signals and lower background when analyzed by gas chromatography/mass spectrometry (GC/MS).

Arson crimes have an extremely low conviction rate due, in part, to the challenge of isolating and identifying the small amount of accelerant residue that remains after a fire is extinguished. Most techniques currently used to collect accelerant residues are based on headspace sampling vapors (i.e., accelerant) in the headspace above suspected arson evidence are collected onto adsorbent media such as activated charcoal. The primary disadvantage of these techniques is that they often require hours to collect a detectable amount of accelerant residue. A new technique for the headspace sampling of accelerant residues, porous-layer open-tubular cryogenic headspace sampling (PLOT-Cryoadsorption), is being investigated. In PLOT-Cryoadsorption, suspected arson evidence is placed in a sealed container and heated in a modified gas chromatograph (GC) while a flow of helium is applied to sweep the resulting headspace gasses from the sample container into a PLOT capillary. This PLOT capillary, which is simply a short section of gas chromatography column, is housed in a cryogenic chamber held at low temperature to trap the analytes. The analytes are then desorbed by passing a solvent through the PLOT capillary and collecting it in a vial for analysis by gas chromatography-mass spectrometry (GC/MS). In the current study, PLOT-Cryoadsorption was compared to the conventional method of isolating accelerants by heating suspected arson evidence in a sealed container containing an activated carbon strip. Mock arson samples were prepared by spiking 1-inch squares of clean cotton rag with 250 µL of accelerant (kerosene, gasoline, or diesel). The mock samples were analyzed after burning for varying lengths of time ranging from 0 seconds (neat samples) to self-extinction at ~ 1 minute. Duplicate samples were extracted using carbon strips and PLOT-Cryoadsorption to allow for direct comparison of the two techniques. The ASTM standard for analysis of arson samples by carbon strip extraction recommends heating for anywhere from 30 minutes to 16 hours. In this study, the carbon strip extractions were performed at 60°C for 5, 15, 30, 60, and 120 minutes. The PLOT-Cryoadsorption extractions were carried out at 125°C for 0.5, 1, 5, 10, and 15 minutes. Across the board, the chromatograms for residues collected using PLOT-Cryoadsorption gave higher abundances and lower background signals compared to those collected using carbon strips. Further, PLOT-Cryoadsorption gave distinct accelerant residue patterns in little as 30 seconds of extraction time. The results indicate that the use of PLOT-Cryoadsorption in arson analyses could allow for the detection of accelerant residues in less time and with greater precision than that achieved using the current method of activated carbon strips. Hence, PLOT-Cryoadsorption could help drastically improve the rate of arson convictions.

Arson, Accelerants, PLOT-Cryoadsorption