A177 Utilizing GCxGC/TOF-MS to Improve the Data Quality for the Analysis of Fire Debris

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After attending this presentation, attendees will understand the ability of Comprehensive Gas Chromatography – Time-of-Flight Mass Spectrometry (GCxGC – TOFMS) to differentiate between gasoline samples as well as identify marker compounds that can help aid in arson investigations. The attendees will also recognize the difficulties associated with an arson investigation, the current extraction methodologies, and the reason a more sensitive and selective technique may be beneficial. The attendees will also be introduced to the use of Principal Component Analysis (PCA) for the evaluation of the site samples.

This presentation will impact the forensic science community by developing a technique that can allow for the differentiation of fresh and burnt gas samples and identifying marker compounds that indicate combusted gasoline versus gasoline that has been environmentally weathered.

Arsons can be particularly difficult crimes to investigate, due to the nature of the fire, which generally destroys most of the material evidence. Due to the lack of material evidence at the scene, the analysis of volatiles that may still be present from the use of common materials for fire initiation is typically evaluated. These volatiles, left from the fuel source used at the scene, may provide the evidence needed to connect an arsonist with their crime, and also determine the type of accelerant used. Historically, specific sources of accelerant were not able to be determined, in part due to the lack of selectivity of the analytical methods which have been previously employed.

The extraction methods utilized for these volatiles include gas headspace (under static or dynamic conditions), Solid Phase Micro-extraction (SPME), and activated carbon strips with carbon disulfide. The most common extraction method, accepted for fire debris analysis and arson investigations, is headspace extraction of the fire debris with carbon strips followed by the extraction of the carbon strip with carbon disulfide. Appropriate instrumental techniques for the analysis of fire debris and ignitable liquid residues include GC/FID, GC/MS and/or GC/MS (SIM), and GCxGC/TOF-MS. The lack of selectivity of GC/FID has resulted in the more common use of GC/MS and/or GC/MS (SIM) because of the ability to evaluate the chromatogram for specific mass-to-charge ions, allowing for interpretation based upon compound classes. More recently, GCxGC has been considered for use in this application because of its ability to further separate compounds prior to detection. The resulting ability of the chromatograph to separate a hydrocarbon mixture based upon its compound classes (aliphatic, branched aliphatic, aromatic, etc.) enables the user of the data to quickly determine and describe the composition of the potential accelerant. Additionally this technique, due to its ability to provide higher data density, may allow for the identification of marker compounds to link the fuel with specific sources, and differentiate between gasoline used as an accelerant versus gasoline that has merely evaporated (weathered) as a result of normal degradation.

A case study from an active arson investigation of a forest fire utilized GCxGC/TOF-MS will be presented The technique's ability to identify the differences between un-weathered and weathered samples as well as pre- versus post-burn samples will be highlighted. Due to the environmental location of the fire, the differentiation between combusted gasoline and environmentally-weathered gasoline will also be noted. Statistical analysis was used to assist with the data sets and provide a convenient way to observe the similarities and differences between the samples.

GCxGC/TOF-MS, Fire Debris, Investigation

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