B162 Modern Challenges in Fire Debris Analysis

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After attending this presentation, attendees will understand current issues faced by fire debris chemists. This will include issues classifying ignitable liquids, identifying matrix interferences, non-routine analysis, and incendiary devices.

This presentation will impact the forensic science community by serving to help fire debris chemists identify issues they may face in more complex casework.

There has been extensive literature addressing the challenging nature of fire debris analysis. This presentation serves as a continuation and expansion of the literature by providing several examples of such challenges encountered during research or casework. The range of current issues faced by fire debris examiners is vast and extends to neat liquids, debris or matrix effects, and other non-routine samples. Though the majority of liquid samples encountered in the analysis of ignitable liquids are easily identified, some liquids are difficult to classify using the widely recognized and accepted American Society for Testing and Materials classification protocol. This presentation provides several examples of such liquids. Additionally, the presentation examines the variations observed in the alkane, indane, and polynuclear aromatic content among several geographically diverse gasoline samples. Another issue addressed in this presentation, which has been discussed previously in the fire debris community, are the limitations in identifying specific products. These limitations is due both to the change in formulation of a product over time as well as different products with nearly identical chemical compositions. These limitations should be considered in cases where an investigator requests the identification of a specific source of an ignitable liquid beyond the ignitable liquid class.

Matrix effects of further concern to the fire debris examiner include inherent petroleum products and microbial degradation. These two issues have been previously studied in the literature; however, this presentation expands on both. Inherent petroleum products are widespread and should be well understood by all fire debris chemists. As such, several examples are reviewed such as isoparaffinic products in various plastic products, limonene in tires, and gasoline in shoes.

In recent years, fire debris chemists have become increasingly responsible for additional analyses, which may require alternative sample preparation techniques and instrumentation. Among these analyses are alternative fuels such as E85 and biodiesel, vegetable oils, lubricating oils, and petroleum greases. Alternative fuels can typically be identified using general fire debris analytical procedures and their prevalence in casework is increasing. Vegetable oils may be of interest due to the propensity of some oils to self-heat and potentially cause ignition of surrounding fuel. Analysis of vegetable oils requires conversion of the fatty acids in the oil to methyl esters and analysis by a Gas Chromatograph/Mass Spectrometer (GC/MS) equipped with a specific column not commonly used for ignitable liquid analysis. Lubricating oils and petroleum-based greases are an extension of petroleum-based ignitable liquids, but much less volatile. These products may be identified using a standard GS, but can be further characterized, and possibly compared, using a high-temperature GS.

Unconventional ignition methods are often incorporated into improvised incendiary devices and as such are very wide ranging. Some examples that have been encountered include flares, thermite mixtures, and improvised napalm. These types of analyses typically require additional instrumentation outside of the typical GC/MS such as infrared spectrometry, X-ray powder diffraction, and scanning electron microscopy. This presentation hopes to provoke discussion of these various issues as it is important to keep an open dialog among current fire debris examiners.

Fire Debris, Ignitable Liquids, GC/MS