A190 The Association and Discrimination of Gasoline and Lighter Fluid Using Multivariate Statistical Procedures in the Presence of Evaporation, Thermal Degradation, and Matrix Interferences From Surface-Treated Wood

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After attending this presentation, attendees will have an understanding of an objective method that may be used to identify the presence of an ignitable liquid extracted from wood in simulated fire debris. Principal components analysis (PCA) and Pearson product moment correlation (PPMC) coefficients are used to associate an ignitable liquid residue to the corresponding standard, in the presence of interferences from untreated and surface-treated wood, despite evaporation and thermal degradation effects.

This presentation will impact the forensic science community in two ways. First, the compounds inherent to combinations of treated or untreated and burned or unburned wood will be characterized. This may allow analysts to determine if compounds in a chromatogram of fire debris originate from the wood matrix and/or its surface treatment. Secondly, an objective method for identifying the presence of an ignitable liquid will be demonstrated. It has become increasingly important to establish methods in which objectivity replaces subjectivity, especially in light of the National Academy of Sciences report from 2009.

In order to characterize the inherent interference compounds, samples of untreated/unburned and surface-treated/unburned wood were sealed in nylon bags and extracted at 80°C using a passive headspace extraction with activated charcoal strips. Each extract was then analyzed using gas chromatography-mass spectrometry (GC-MS). Separate untreated and surface-treated wood samples were also burned for different periods of time to determine the optimal burn time that generated the maximum amount of matrix interferences. These samples were analyzed in an identical manner to identify the compounds introduced during the burning process.

Next, two ignitable liquids (gasoline and lighter fluid) at four different evaporation levels were individually spiked onto unburned wood samples that were either untreated or surface treated. This allowed the data collected to take into account the effect of evaporation of the liquid. The liquids were also spiked onto burned wood samples that were either untreated or surface treated, which allowed the data to reflect the effects of the matrix interferences as well as the evaporation of the ignitable liquid. Lastly, fire debris was simulated by spiking the liquids onto the unburned wood (untreated and surface treated), which was then burned. This last data set took into account thermal degradation of the sample in addition to evaporation and matrix interferences.

The association of the ignitable liquid residues extracted from the wood to the ignitable liquid standards was assessed using PCA in combination with PPMC coefficients. Principal components analysis identifies the variance among samples and will cluster chemically similar samples accordingly in the scores plot. The PPMC coefficients provide a pairwise comparison between chromatograms and produce a value, which describes the similarity between the chromatograms. Multivariate statistical procedures were used to objectively associate the ignitable liquid residue extracted from the wood to the corresponding standard in spite of evaporation, matrix interferences, and thermal degradation.

Ignitable Liquids, Wood Fire Debris, Multivariate Statistical Procedures

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