A164 Effects of Competitive Adsorption on Interpretation of Ignitable Liquid Residues in Fire Debris Analysis

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After attending this presentation, attendees will gain an understanding in the effects of competitive adsorption among various substrates and the relationship it poses on fire debris analysis data interpretation. Also, attendees will better understand the methods commonly used in fire debris analysis to date.

This presentation will impact the forensic science community by discussing the possible misinterpretation and classification of the results, especially at low residual levels and possible pyrolysis products from the substrate.

Charred and un-charred substrate will be compared in the classification of ignitable liquids according to American Society for Testing and Materials (ASTM) method E1618. This presentation will impact the forensic community by demonstrating and providing an explanation for distorted chromatograms obtained from fire debris samples collected on a gas chromatography mass spectrometer (GC/MS). This research project is important to the fire debris analysis community due to the possible misinterpretation and classification of the results, especially at low residual levels and possible pyrolysis products from the substrate. This work will help to validate the methodology currently in use under a variety of conditions.

This presentation aims to show how various charred substrates may cause misinterpretation of the E1618 class of ignitable liquids in samples from fire scenes due to competitive adsorption. Also, it aims to demonstrate that amount the substrate is charred may have an influence on the relative height of certain key components in ignitable liquid chromatograms.

Understanding the key aspects of fire debris analysis can aid in isolating areas that potential problems can and do arise from when interpreting data. Ignitable liquids are the most common form of accelerants found at fire scenes across the United States. Most importantly gasoline and kerosene are the two most commonly recovered and identified. The common practice utilized today for analysis of these ignitable liquids is the ASTM E 1412 method, passive headspace concentration using activated charcoal strips. Though a reliable method, there are areas for potential problems when performing this technique. It has been previously reported that competitive adsorption of the charred wood present in the samples may affect the interpretation of the ignitable liquid class. The work presented here is an in depth study of the effects of substrate and amount of charring on the recovered ignitable liquids using E1412 and E1618 methods.

Several different substrates were used to demonstrate that competitive adsorption could lead to misinterpretation of results, as well as to describe the differences in peaks obtained in the chromatograms. Different wood samples were used at a set amount of charring on the wood to demonstrate the actual effects of competitive adsorption. Percent weight loss was how the degree of charring was calculated throughout the experiment. Samples were then spiked with gasoline and kerosene, as well as other ignitable liquids to test the effects of the solvents. Carbon disulfide was added to samples and analysis on a GC/MS were performed using an E1618 standard and method blank with each set of samples. Un- charred substrates, with and without ignitable liquid spikes, were also used for comparison and to identify any background interferrents.

Though most samples exhibited some form of decrease in liquid present on the charred substrate in the chromatograms, some were more pronounced than others. Whether the main reason for the loss in area is the competition on the carbon strip or from retention of the liquid on wood was the main cause, conclusions that the difference was caused by competitive adsorption were made. Initial percent charred studies (by weight) demonstrated that the more charred the surface, the smaller the peaks on the chromatogram compared to those that were not charred as significantly. Overall, further development and studies should and will be performed to see how varying the amount of charring could also be a factor in explaining the difference in the chromatograms and mass spectra. This work was also used to test the robustness of the target compound ratio method for the further discrimination of gasoline and kerosene residues.

Fire Debris Analysis, Competitive Adsorption, GC/MS