A118 Effects of Various Substrate Types on E1618 Pattern Classification of Ignitable Liquids Present in Fire Debris

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After attending this presentation, attendees will gain an understanding of how substrate type affects the ASTM E1618 classification of ignitable liquids present in fire debris samples. Attendees will also gain an understanding of the methods and techniques currently used in the analysis of debris collected from fire scenes.

This presentation will impact the forensic science community through a discussion of the potential troubles associated with the analysis of specific burned problem substrates, such as misinterpretation and misclassification of ignitable liquids present.

Charred and uncharred substrates of various types will be compared and ignitable liquids, if present, classified according to ASTM method E1618. This presentation will benefit the fire debris analysis community by informing analysts and researchers of the potential of common fire debris substrates to produce products that may interfere with the GC/MS analysis and E1618 classification of ignitable liquid residues in fire debris.

Due to the extraction procedure for ignitable liquid residues, compounds present in the substrate, such as various polymers and glues, may co-adsorb to activated charcoal strips with the ignitable liquid residues present in fire debris. These interfering products will also be present on the chromatograms generated during analysis. Additionally, pyrolysis and combustion products generated from the burning of the substrate may potentially affect the chromatographic analysis of ignitable liquids. As non-wooden substrates (carpet/padding 52%, fabric/paper 11%, and vinyl flooring/plastics 10%) constitute a large percentage of the substrates submitted as fire debris samples to a crime laboratory, it is important for fire debris analysts to be aware of the difficulties such substrates may cause in ignitable liquid analysis.

In this study various fire debris substrates were selected for E1618 analysis of the ignitable liquids gasoline, kerosene, and charcoal lighter fluid. These ignitable liquids are classified as gasoline, heavy petroleum distillates, and medium petroleum distillates, respectively. The substrates chosen were yellow pine, carpet, and carpet pad, which after charring to approximately 50% by weight with a propane torch to simulate burned fire debris, were analyzed with 10µL spikes of 50%, 75%, and 90% ignitable liquid evaporates. Additionally, uncharred substrates were also spiked with 10µL of each of the ignitable liquid evaporates. Un-spiked samples of each substrate, charred and uncharred, were also analyzed as substrate blanks. Ignitable liquid vapors were then concentrated according to the ASTM E1412 method on activated charcoal strips with carbon disulfide as the eluting solvent. 3-phenyl toluene was added to carbon disulfide as an internal standard.

It was experimentally concluded that a substrate may affect E1618 classification. For yellow pine, several notable terpenes were present in the uncharred blanks (1S-α-pinene, 5.6 min; β-pinene, 6.2 min; 1,5-dimethyl-1,5-cyclooctadiene, 7.0 min); however, these peaks were present but effectively buried in the samples that were un-charred and spiked with ignitable liquids. In the charred samples, the terpene chromatographic peaks were severely diminished, nearly undetectable, a phenomenon reasonably explained by the volatility of terpenes. For carpet, several minor precursory products were present in the substrate blanks, mostly olefins from the carpet fibers (such as dodecene, 8.6 min). However these peaks were insignificant in the ignitable liquid spiked samples. Carpet pad had very few detectable compounds in the substrate blanks. These few peaks were present in minor concentrations and easily masked in the baseline of the spiked samples. With kerosene the ignitable liquid pattern was found to shift to the lighter end of the chromatogram for both yellow pine and carpet pad, a phenomenon not observed with the other ignitable liquids or in the other substrates. With yellow pine the entire chromatographic pattern was observed shifting approximately one carbon lower (heavier components not recovered) in comparison to the neat ignitable liquid. This phenomenon did not change the classification of kerosene as a heavy petroleum distillate (C_8-C_{20+}) in this substrate. The relative abundance of the normal paraffins was reduced relative to the branched and cyclic hydrocarbons, as has been reported previously for yellow pine. Thus, during analysis, analysts should be informed and remain cognizant of the substrate being analyzed as it may affect their interpretation and E1618 classification of the results.

Fire Debris Analysis, ASTM E1618, Substrate Effects

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