## A120 Ignitable Liquid Residue Source Elimination by Molecular Weight Estimation

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After viewing this presentation, attendees will understand a simple method for excluding a suspected source of ignitable liquid residue using basic chemical fundamentals.

This presentation will impact the forensic science community by utilizing this straightforward method of analysis for fire debris analysts in order to provide additional useful information to fire scene investigators.

The literature of fire debris analysis is replete with descriptions of attempts to match an ignitable liquid residue to a suspected source. Many different methodologies have been suggested for making comparisons, and more recent attempts have focused on chemometrics such as principal components analysis. Because gasoline is the single most commonly used accelerant, most of the efforts at identifying the source of ignitable liquid residues have focused on gasoline. In environmental forensics, other methods have been used to identify the source of hydrocarbons spills. Two-dimensional gas chromatography-mass spectrometry and the analysis of biomarkers have been successfully applied. Unfortunately for fire debris analysts, the quantity of extract is often far too small to be analyzed using the same methods available to environmental chemists.

Most forensic science laboratories today follow ASTM E1618, *Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry*. This methodology is, and historically has been, designed to allow for classification of ignitable liquid residues into any number of recognized classes. The 2010 edition of the standard recognizes eight classes of ignitable liquid: gasoline; petroleum distillates including de-aromatized distillates, isoparaffinic products; aromatic products; naphthenic-paraffinic products; normal alkane products; oxygenated solvents; and others-miscellaneous. Most of these classes of ignitable liquid residues can be further subclassified as light, medium, or heavy. Gasoline has no subclasses, and oxygenated solvents are only characterized as light or medium.

Making distinctions within a class, or finding the source of an ignitable liquid residue are outside of the scope of ASTM E1618. The standard states, “This test method is intended to allow identified ignitable liquids to be characterized as belonging to one of the classifications. Distinguishing between examples within any class may be possible, but such further characterization is not within the scope of this test method.”

Two case reports will be presented. In each case, an attempt was made to connect a suspect to a fire scene by comparing ignitable liquid residues. In one case, a plastic milk jug was found a few blocks from the scene, and was suspected as being the container used to carry a heavy petroleum distillate (HPD). In the second case, medium petroleum distillate (MPD) found in two samples of fire debris from the scene was believed to have come from the same source as medium petroleum distillate found on the suspect’s shoes. In both cases, analysis of the average molecular weight (expressed as carbon number range) revealed that the suspected source was heavier than the extract from the scene.

When exposed to a fire, ignitable liquid evaporates, and its average molecular weight necessarily increases. No predictable experience will cause the average molecular weight of the fire-exposed liquid to decrease. If the suspected source of an ignitable liquid, which was not exposed to the fire, exhibits a higher average molecular weight than the residue extracted from samples collected at the scene, the suspected source can be conclusively eliminated.

Using this straightforward method of analysis, fire debris analysts will be able to provide additional useful information to fire scene investigators.

**Accelerant, Ignitable Liquid, Identity of Source**