B64 The Effect of Environmental Conditions and Substrate Material on the Weathering of Gasoline and Light Petroleum Distillates

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After attending this presentation, attendees will understand how different environmental conditions and substrate materials affect the chromatograms of weathered ignitable liquids and how this affects their class identification.

This presentation will impact the forensic science community by offering attendees a better understanding of the consequences various conditions have on the chromatograms of weathered ignitable liquids and the effects these conditions have on their classifications.

In fire investigations, it is often crucial for analysts to determine if an ignitable liquid was present at the scene, as these liquids are often used as accelerants. A wide variety of ignitable liquids exist that can be used to help start or maintain a fire. The most commonly used is gasoline, in part because it is widely available and cost effective. Light petroleum distillates, such as paint thinners, lighter fuels, and cleaning fluids, are also a commonly used class of ignitable liquids because they too are easily obtainable and highly flammable. Both of these classes of ignitable liquids contain many highly volatile compounds and are particularly susceptible to weathering. Weathering is the effect of evaporation on the chemical makeup of an ignitable liquid. Samples recovered from fire scenes rarely show the characteristics of unweathered materials, so criminalists must be capable of recognizing ignitable liquids in their weathered forms.

It has long been stated that a wide variety of conditions may have effects on the weathering process of ignitable liquids. These conditions can include extent, temperature, air composition, airflow, exposure to sunlight (specifically Ultraviolet (UV) light), the chemical makeup of substrates, and several others. Various studies have sought to use pattern recognition software to either classify the ignitable liquids and/or determine the original conditions under which a sample was weathered. Few published studies have investigated how these conditions affect the presence of the various different compounds detected in ignitable liquids.

In this research, samples of three different ignitable liquids were studied: gasoline, lighter fuel, and a simulated ignitable liquid mixture made up of ten compounds from classes commonly found in ignitable liquids (alkanes, aromatics, and condensed ring aromatics). The simulated ignitable liquid mixture serves as a simpler system in which the effects of the different conditions on specific homologous chemicals can be studied before looking at the more complex mixtures that make up actual ignitable liquid samples. All samples were weathered to 25%, 50%, 75%, and 90% extents by volume while varying the following conditions: container size, temperature (a greater range of temperatures than in prior studies), exposure to UV, and substrate identity. Samples of each were analyzed by Gas Chromatography/Mass Spectrometry (GC/MS), and the resulting chromatograms compared to determine any notable differences. Results indicate that extent and temperature have the greatest impact on the pattern of the weathered chromatogram, while other conditions have limited effects. Although the differences in the chromatograms from samples of the same ignitable liquids weathered to the same point are not significant enough to result in one concluding that they come from different classes, the different conditions can cause them to appear as

if weathered to different extents. Consequently, these conditions must be considered and included in calculations if mathematical modeling of weathered ignitable liquids is to have meaningful and successful real-world application.

Arson, Ignitable Liquids, Weathering