A116 Target Compound Ratio Analysis of Medium Petroleum Distillates

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The goal of this presentation is to present initial results of a quantitative method developed to differentiate between medium petroleum distillates (MPD) and residues of MPDs. The method is an extension of a method developed for the differentiation of kerosene samples as neat liquids and residues using Gas Chromatography/Mass Spectroscopy with a target compound ratio analysis method. Comparison to determine if a sample is from a specific source is a problem in the application of fire debris analysis. The long-term goal of the project is to develop a uniform statistical method to determine degrees of similarity between any two ignitable liquid residues in fire debris analysis.

This presentation will impact the forensic science community by providing a methodology and a statistical basis for declaring similarities between any two medium petroleum distillate samples as required by the courts and the National Academy of Sciences Report.

Petroleum-based products are the most commonly used accelerants in the United States. Most of these products are readily available to the public and are flammable. Gasoline is the most often encountered ignitable liquid, followed by kerosene and medium petroleum distillates. Medium petroleum distillates as classified by the American Society for Testing and Materials (ASTM) E1618 include paint thinners, dry cleaning solvents, and charcoal lighters. Medium petroleum distillates have a boiling point range of 120 to 240°C and contain C_8 to C_{13} compounds, which include normal and branched alkanes, some cycloalkanes, and some aromatics. Differences between manufacturing processes should provide variation between medium petroleum distillates, which is often seen in reference collections because of the lack of homogeneity within the class of MPDs. This research was performed to determine the key components and peak ratios of medium petroleum distillates to provide an analytical and statistical basis for the differentiation between these products.

High resolution GC/MS data was analyzed using target compound ratios from key compounds found in medium petroleum distillates. Compounds eluting off of the non-polar polydimethylsiloxane column generally elute in order of increasing boiling points. Therefore, peak ratios comparing closely eluting compounds are less affected by preferential evaporation in the course of a fire.

Previous research performed on kerosene and gasoline has established a number of compounds that can be used to distinguish kerosene and gasoline samples from different sources. In this work, seventeen compounds have been identified from mass spectra and retention times in medium petroleum distillates as possible candidates. From those compounds, sixteen ratios were calculated and compared for reproducibility within ignitable liquid and significant differences between liquids. Evaporation and burn tests were also performed to test the robustness of the ratios under conditions that may occur during an actual fire.

Several "green" paint thinners and solvents have been analyzed which are listed as non-flammable. The composition of these newer products, although not likely to be used by an arsonist, may occur as incidental liquid residues in fire debris.

A database of gasoline, kerosene, and MPD analyses is being developed from a large number of samples in each class and a variety of different sources, which will be used to establish statistical criteria for comparison between two different samples with a probability of error.

Medium Petroleum Distillates, Fire Debris Analysis, GCMS

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