B82 A Survey of 2-Cycle Oils and Their Implications in the Analysis of Fire Debris

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After attending this presentation, attendees will have knowledge of the various different types of 2-cycle oils that are available and understand the difficulty of identifying such oils when they are mixed with gasoline.

This presentation will impact the forensic community by assisting fire debris analysts in the analysis, interpretation, and identification of ignitable liquid residues containing gasoline/2-cycle oil mixtures. It will also provide information for additional research into the detection and identification of such mixtures.

During the course of casework in the fire debris laboratory, various mixtures of different ignitable liquids may be encountered. Some of these mixtures consist of manufactured products that have a specific use, user prepared mixtures with a specific use, and haphazard mixtures that result from mixing anything that might be available. The research contained in this presentation is primarily concerned with mixtures of the second type, particularly gasoline/oil mixtures that are prepared by the user for the operation of various forms of motorized equipment.

It is not uncommon to receive a sample in either the liquid form or as debris suspected of containing volatile residues that is thought to contain gasoline/2-cycle oil mixtures. During routine casework it has been noticed that the 2-cycle oil component of the mixture is typically difficult to identify. This should not be surprising considering the relatively high dilution and low volatility of the 2-cycle oil components. Therefore, the presence of such mixtures may be a source of confusion when interpreting results. The generally high ratio of gasoline to oil (typically either 50:1 or 30:1) might preclude an analyst from identifying the presence of the oil when even a relatively pristine sample is encountered. As samples become weathered, the contribution from the oil component may be enhanced producing a pattern that will reveal itself as a mixture.

The primary goals of this study were: (1) to analyze various different 2-cycle oils to determine the range of products that are available; 2) to determine if these products could be detected in their proper gasoline/oil mixtures; and 3) to examine the effects of evaporation on the patterns that are observed. To this end, sixteen different brands of 2-cycle oil were obtained and analyzed using gas chromatography-mass spectrometry. Analysis of the 2-cycle oils revealed the presence of two distinct components in the product, namely a fuel and a lubricant. The fuel fractions of the sixteen different brands were separated into six different product groups in the medium to heavy range according to the system laid out by ASTM E-1618 (Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry). Analysis of the prepared gas-oil mixtures revealed that it was generally difficult to determine the presence of 2-cycle oils in such mixtures. However, it was easier to do so after evaporation had taken place. Some possible volatile markers for the identification of 2-cycle oils in gasoline that were identified include; elevated alkane profiles in the range of the 2-cycle oil fuel fraction, heavy alkane peaks beyond the gasoline range, 2-cycle oil additives (e.g. anti-oxidants), and non-petroleum lubricant compounds.

This presentation will include brief discussions on the use and application of 2-cycle oils, the various types of 2-cycle oils that are available, and the potential for their detection in mixtures with gasoline. In order to illustrate the points to be discussed, various data will be presented. A brief discussion of future research in this area will also be presented.

Fire Debris Analysis, Gasoline, 2-Cycle Oils

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