A142 Factors Affecting Comparisons of Lubricating Oils

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After attending this presentation, attendees will be aware of factors that could potentially affect the outcome of comparisons between known and questioned lubricating oil samples. This project will discuss and evaluate the potential effect of the following factors when comparing lubricating oils: collection techniques, sample variation over time, and mixtures.

This presentation will impact the forensic community by providing valuable information to both forensic scientists and crime scene investigators. Crime scene investigators will learn a collection technique that can be used to safely collect lubricating oil samples for laboratory analysis. Forensic scientists will be presented with data that addresses possible concerns arising during comparison of known and questioned samples, such as interferences from the collection substrate, changes in a known sample over time, and the presence of fluid mixtures. This project will also benefit investigating officers, as the research will provide information regarding the association of a suspect vehicle to a lubricating oil sample present at the crime scene.

The analysis of lubricating oils can provide important information in a variety of forensic investigations such as automobile accidents and arson scenes. Forensic investigators and scientists should be aware of factors that could potentially affect the outcome of comparisons between known and questioned lubricating oil samples, so that the misinterpretation of data can be avoided. This project will discuss and evaluate the potential affect of the following factors when comparing lubricating oils: collection techniques, sample variation over time, and mixtures.

Lubricating oils are comprised of a wide variety of hydrocarbons including alkanes, branched alkanes, cycloalkanes, and aromatics, with alkanes and branched alkanes being the principal components in the mix. As oils in an automobile undergo continued use and are exposed to high ambient temperatures, variations may be seen in the composition of the oil. Detecting these changes and determining when they occur can provide valuable information when comparing oil collected from a crime scene to oil from a suspected source vehicle.

In order to investigate collection techniques, all-purpose absorbent pads designed for clean room use, cotton swabs, sterile gauze pads, and paper towels were tested in regards to their ability to collect oil spots placed on concrete and asphalt. Oil samples were collected by rubbing the collection media over the oil spots. After collection, the oil soaked collection devices were extracted using pentane, filtered, and analyzed by high temperature gas chromatography-mass spectrometry (HTGC-MS). Blank collection substrates without oil were also analyzed by HTGC-MS to confirm that no interfering peaks were present in the chromatograms. The authors will present chromatographic data from each of the different collection media, discuss the significance of the data in regards to the effectiveness of each technique, and will address any possible interference of the concrete and asphalt in the chromatographic data.

To study potential changes over time, motor oils from eighteen different automobiles were sampled, in triplicate, from the oil crankcase dipstick of the automobiles using cotton swabs, three times over a 2 ½ month period. Extra samples were taken as necessary if an automobile received an oil change in between sample dates. Each sample was extracted from the cotton swab and analyzed using HTGC-MS. Any changes seen in the sample chromatograms will be presented, and the significance will be discussed.

Maintenance of automobiles often results in the mixing of automobile fluids (e.g., lubricating oils), which can influence the results of a comparison between known and questioned samples. Various mixtures of lubricating oils were prepared in different ratios. HTGC data for the sample mixtures will be presented and the implications of the data will be discussed.

A naturally-occurring power steering fluid (PSF) leak, from an automobile in the sample set, was used to simulate a type of lubricating oil sample that may be encountered at a crime scene. Samples were collected from the PSF leak spot on the asphalt underneath the automobile. Exemplar samples were collected from the undercarriage of the automobile where the PSF was dripping and from the PSF reservoir in the engine compartment of the automobile. The authors will introduce data that implicates the proper sampling location for exemplar samples and will address the issue of correlation between known and questioned samples.

High Temperature GC - MS, Lubricating Oils, Motor Oils

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