B83 Alternative Fuels and Their Impact on Fire Debris Analysis

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The goal of this presentation is to introduce two alternative fuels to fire debris analysts. The presentation will show analysts the features to look for when considering the presence of an alternative fuel in fire debris samples.

This presentation will impact the forensic community and/or humanity by demonstrating how, with the emergence of alternative fuels in the commercial marketplace, it is important that fire debris analysts familiarize themselves with these alternative fuels and understand their chromatographic fuels.

With the rising cost of crude oil and the resulting economic impact on consumers, there has been an outcry to reduce the country's reliance on foreign oil. In addition, environmental groups have called for fuels with reduced emissions. In order to address these issues, alternative fuels have been developed and some of them are becoming more available to the general public.

Biodiesel is typically produced by converting vegetable oils into methyl esters. Pure biodiesel (B100) can be used as a fuel in modified diesel engines. B100 can also be blended with petroleum diesel in various proportions. B20 (20% biodiesel), B5 and B2 are the most popular biodiesel blends because they can be used in diesel engines with essentially no modifications. E-85, a blend of 85% ethanol and 15% gasoline, is another alternative fuel that is gaining acceptance as a commercial fuel, especially in the Midwest and in government and corporate vehicle fleets. As with B100, this fuel can only be run in modified engines. The emergence of these alternative fuels may lead to their use by arsonists. Therefore, it is important for fire debris analysts to familiarize themselves with these alternative fuels and understand their chromatographic features as well. Both B100 and B20 samples were analyzed as neat liquids extracted from a simple substrate, and from burned samples using the passive headspace concentration method (ASTM E 1412) with a charcoal strip. These samples were analyzed with a gas chromatograph mass spectrometer equipped with a nonpolar column and a typical fire debris analysis temperature program with a final temperature of 300°C. The methyl ester components of biodiesel are readily apparent in the neat liquids and the extracted samples. These same components may be obscured in debris samples, but extracting ions specific to each methyl ester helps elucidate these compounds.

The E-85 fuel was evaluated at various stages of evaporation. At each stage, ethanol was still present along with the corresponding evaporated gasoline pattern. Small scale burn studies were conducted to determine if the method of extinguishment would affect the retention of the ethanol portion of the E-85 fuel. Samples of the E-85 fuel were placed on carpet samples and ignited. The modes of extinguishment included self-extinguishment, water extinguishment, and extinguish- ment with a CO_2 fire extinguisher. Each of these samples was extracted using the passive headspace concentration method (ASTM E 1412) with a charcoal strip and analyzed with a gas chromatograph – mass spectrometer. The ethanol portion of the fuel was present on the carpet sample that self extinguished, but the relative intensity of the ethanol to the gasoline was extremely low. The same was true for the samples that were extinguished with water. The proportion of ethanol in these samples was much lower than the ethanol in a proportionally evaporated sample of E-85 fuel. For the sample extinguished with a CO_2 fire extinguisher, a significant amount of ethanol was detected. The relative intensity of the ethanol to the gasoline in this sample was consistent with the evaporated E-85 samples.

Fire Debris, Alternative Fuels, Biodiesel

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