B131 Target Compound Analysis for the Individualization of Gasolines

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After attending this presentation, attendees will learn about the importance of creating a collection of gasolines and understand how target response data is used to analyze the gasoline profiles.

This presentation will impact the forensic community and/or humanity by giving forensic chemists a new way of analyzing for the presence of gasoline using target response data and peak area ratios between different components in a sample to be able to compare it to a known sample.

Gas chromatography-mass spectrometry was used to analyze gasoline samples procured from multiple states over 4-year period. The collection has over 200 samples from twenty-four different states. The majority of samples came from West Virginia and the surrounding areas. Samples included gasolines from octane ratings of 87, 89, 93, 100 and 112 (leaded specialty gasolines), E-85, and gasohols (87 and 93 octane).

The samples were prepared by using a neat injection onto the column. Although much of the gas chromatography-mass spectroscopy method was based on research by Dolan, temperature ramping was changed to achieve better separation of later eluting compounds.[1] The data analysis was based upon target response data and the component ratios of thirty-seven target compounds.

Gasoline is the most common accelerant used in arson cases, as well as many domestic and international terrorist bombings using fire bombs. Fire bombs are easy and inexpensive to construct, but can cause significant destruction. However, they also have the potential to leave unburned gasoline on the 'thrower" and even in the bottle. Creating this collection of gasoline profiles is useful in determining the presence of gasoline at the scene of a suspect fire or bombing and then connecting it to its source.

Twenty-two different component ratios were analyzed that spanned thirty-seven components of gasoline, including methyl-tert-butyl-ether (MTBE) and ethanol. The peak areas were analyzed and percent relative standard deviations calculated based upon the component ratios to determine if the GC-MS method and quantification method were reproducible with multiple injections. After analyzing the target ions and new retention times for each of the components with the help of compound standards, better results were achieved; meaning, the results from multiple injections were much more consistent.

These peak ratios are also important in distinguishing gasoline from pyrolysis products produced in a fire according to Lentini.[2] That makes gasoline one of the most common misdiagnosed accelerants. It was, therefore, important to make sure that the ratios used in this study were correct and the results reproducible.

Further research performed in this study included looking for the presence of MTBE and ethanol, as well as differences in octanes, including E-85. MTBE and ethanol are oxygenates that help to reduce engine "knocking" and are better for the environment as they help to reduce engine emissions by replacing unburned hydrocarbons and carbon monoxide with oxygen. It was found that MTBE was present in many early samples, specifically in larger cities and along the east coast. Later samples showed a decrease in the use of MTBE, probably from recent findings of ground leaks and its identity as a possible carcinogen in the drinking water.[3] Results from gasohols were investigated to determine if ethanol was present in samples that claimed it on the gasoline pump and if it was present in samples where it was not claimed.

The findings from this research show promise creating profiles of gasolines using the peak ratios with reproducible results. The potential for comparing the samples of evaporated gasoline with the same unevaporated gasoline should also be investigated using the shorter temperature ramping and new target ion responses for compounds.

References:

1. Dolan JA, Ritacco CJ. Gasoline comparisons by gas chromatography- mass spectrometry utilizing an automated approach to data analysis. Proceedings of the Annual Meeting of the American Academy of Forensic Sciences; 2002 Feb 11-16; Atlanta, GA.
2. Lentini JL. Scientific protocols for fire investigation. Boca Raton: CRC Press, 2006.
3. http://www.epa.gov/mtbe/water.htm

Gasoline Analysis, Fire Debris, Target Compound Analysis