B78 Source Inference of Gasoline: The Contributions of Gas Chromatography/Mass Spectrometry (GC/MS) and Gas Chromatography/Isotope Ratio Mass Spectroscopy (GC/IRMS) Analyses

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After attending this presentation, attendees will understand the possibilities and limitations of GC/MS and GC/IRMS results, used separately or in combination, for the comparison of gasoline samples from a source inference perspective.

This presentation will impact the forensic science community by providing new knowledge regarding the contribution of fire debris analysis in the association between ignitable liquid traces and possible ignitable liquids.

When gasoline is used to start and/or propagate arson, source inference of gasoline can establish a link between the fire and a potential source. This source inference is an interesting alternative to provide evidence in the event where physical traces (DNA, fingerprints, shoe prints, etc.) left by the perpetrator are rare, or more often than not, disregarded.

The main goal of this research was to develop a GC/IRMS method for the analysis of gasoline samples and to assess its potential to infer the source of gasoline traces compared to the GC/MS performances. An instrument that simultaneously analyzes samples by MS and IRMS was used in this research. An analytical method was developed, optimized, and validated for this instrument. Next, a large sampling of gasoline was collected at several time intervals, representing a regional area market and gasoline of different octanes. After collection, the samples were analyzed, either at that time or after several degrees of evaporation, by GC, then by MS and IRMS. In this research, isotope ratios were confined to measurements of $\delta^{13}C$. Finally, obtained data were processed and interpreted using chemometric methods.

The analyses revealed that the methodology, both for MS and for IRMS, allowed differentiation of unweathered gasoline samples from different gas stations. It also demonstrated that each new filling of gas station tanks generates an almost unique blend of gasoline. GC/MS achieved a better discrimination of samples from different stations, while GC/IRMS was more effective in distinguishing samples collected after each tank filling. Thus, these results indicate that the two components of the analytical strategy can be complementary to the analysis of unweathered gasoline samples.

The results also illustrated that the evaporation of gasoline samples does not compromise the possibility of grouping samples derived from the same source by GC/MS; however, it is necessary to make a selection of variables in order to eliminate those which are influenced by evaporation. Conversely, results demonstrate that the evaporation of gasoline samples has such a strong influence on the isotopic composition of the samples that it is not possible, even by performing a selection of variables, to properly group evaporated samples by GC/IRMS.

Arson, Gasoline, Source Inference