B48   Application of Principal Components Analysis in the Individualization of Gasolines by GC/MS

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After attending this presentation, attendees will understand the usefulness of multivariate statistics to forensic applications in particular GCMS.

This presentation will impact the forensic community by demonstrating the usefulness of multivariate statistical analysis to large data sets especially in comparisons between GCMS data in gasoline individualization.

Gasoline is an accelerant frequently used by arsonists. Identification of gasoline in fire debris is relatively easy even when greatly evaporated. When a suspect is apprehended with gasoline residue on his clothes or a gasoline can in his vehicle, the question arises if the gasoline residue from the fire debris can be matched with that found with the suspect. This has proven to be a more difficult challenge. Further recent legal challenges to comparison evidence have stressed the necessity of establishing a statistical probability for that match.

Julia Dolan (ATF National Research Lab, Ammendale, MD), at the Atlanta meeting of AAFS, presented a high-resolution GCMS method for comparing gasolines based on 20 sequential area ratios of 34 target compounds from 3-methylpentane through the 1-methylnaphthalene. Her data set included 36 different gasolines, including both regular and premium, mostly from around the Washington, DC area. In addition to neat gasolines, 25% and 50% evaporated samples were analyzed.

We have applied principal components analysis (PCA) to her data set as well as our own collection of over 60 gasoline samples from across the US that we analyzed by her method. Most of the sequential ratios are reproducible in triplicate analysis to less than 5% relative standard deviation. The ratios show little, if any, change between un-evaporated and 50%-evaporated gasoline. However, based on our PCA results, of the 20 ratios, only a few show a significant contribution to the betweengasoline variation thus being able to distinguish one gasoline from another. Because some of these distinguishing ratios are in the light petroleum distillate range, they may be lost in higher evaporated gasolines.

Gasoline Analysis, Principal Components Analysis, Fire Debris