A12 Fire Debris Software

Mary R. Williams, MS*, and Michael Sigman, PhD, University of Central Florida, National Center for Forensic Science, PO Box 162367, Orlando, FL 32816-2367

After attending this presentation, attendees will be introduced to newly developed software for the analysis of fire debris.

This presentation will impact the forensic science community by utilizing the newly developed software for the analysis of fire debris. The software combines current data analysis methods along with newer methodology. Features of the software include some data analysis methods described in ASTM E1618-10 and automated searching procedure based on the total ion spectrum from gas chromatography/mass spectrometry (GC/MS) of libraries of liquid residues and substrate materials.

In fire debris analysis, a residue is extracted from the fire debris and analyzed by GC/MS. Currently, data analysis methods include total ion chromatograph, extracted ion chromatograph and target compound chromatograph visual pattern recognition of the residue against a known reference liquid. One or all of these methods are used to characterize the liquid residue into one of seven major classes based on the chemical composition of the residue and then further sub-classified by its carbon range. An extracted fire debris residue can be compared to a reference liquid by visual comparison of their stacked total ion chromatograms within in the software. In cases where the analyses have been performed with different GC/MS methods, the total ion chromatogram plots can be aligned within the windows of the software for better visualization. Extracted ion chromatograms for the residue and the reference liquid based on characteristic ions of the same functional groups can be aligned and plotted. The relative contribution of the characteristic ion groups can be calculated and plotted within the software. These tools will support and facilitate current methodologies of fire debris data analysis.

A newer data analysis method is utilized in the software to automate searching a library or libraries of reference liquids and substrate materials. The search is performed on the total ion spectrum of the GC/MS data which is the sum of the intensity of each m/z across the chromatographic time range. A result from the search is a list of the reference liquids from the library in rank order from most similar to the least similar compared to the residue. The libraries are obtained from the Ignitable Liquids Reference Collection and Substrate Databases, which are joint projects between the National Center for Forensic Science and the Technical/Scientific Working Group for Fire and Explosions. A sample reference number, product name, and classification are given for the selected library reference liquid or substrate material. In a click of a button the software will connect the user (on an internet accessible computer) to the entry in the database for that selected reference liquid or substrate material to obtain more information. A subsequent result from the library search is a posterior probability of class assignment based on Bayesian Decision Theory.

The software developed for fire debris analysis will provide information in a suitable format for fire debris analysts to perform data analysis by current methods. New methods incorporated into the software will analyze the data in a complimentary fashion with the ability to rapidly search an extensive library of reference materials and provide a posterior probability for the assigning a classification.

Fire Debris, Ignitable Liquids, Software