B31 Rapid Identification of Accelerants in Arson Analysis Using GC/ToF-MS and Automated Chromatogram Matching

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This presentation will discuss how the application GC/ToF-MS using fast GC techniques can greatly reduce the data acquisition period and, when coupled with an automated processing method, ultimately reduces the total analysis time.

The investigation of suspected arson cases is both a time and labor-intensive operation; not only is the work highly repetitive in nature, but very large volumes of data are generated which need to be reviewed. A skilled fire debris investigator can often identify an accelerant hidden in complex chromatographic data by recognizing patterns formed by the relative abundance of key compounds. The specialized skills of an experienced analyst can be significantly augmented by the use of a sophisticated data collection and analysis system, relieving many of the more tedious aspects of the work and delivering a rapid identification. Historically, fire debris analysis has consisted of long GC/MS run times, followed by review of the mass chromatographic data. The data discussed here describes the rapid analysis of arson samples using GC/ToF-MS and automated chromatogram matching.

Fire debris samples were analyzed as follows. Fire debris is incubated in a steel can containing a carbon strip suspended from the lid. The strip is then placed in a vial and carbon disulfide is added to desorb the entrained material. Samples were analyzed by GC/ToF-MS. Data was automatically processed and results generated using Xaminer software. The chromatograms acquired during the analysis of fire debris cases can be complex and typically require lengthy oven programs to sufficiently resolve components to allow for accurate identification of the accelerant in question. When fire debris samples are analyzed with a high speed time of flight (ToF) instrument, run times were drastically reduced while retaining resolution, sensitivity that approaches that of selected ion monitoring data, and full screen spectra. Due to higher data acquisition rate of the ToF, use of fast GC techniques were employed, reducing the run time to approximately one quarter of the time required for the conventional quadrupole run. In addition to reduction of run time, the chromatographic resolution of the ToF data is maintained due to high data acquisition rates.

The ability to acquire data rapidly still leaves the analyst with the perhaps more daunting task of analyzing data, therefore, the use of an automated data processing program would be beneficial to the analyst. If an automated approach to data processing is undertaken, it is important that the system be validated by use of simple examples. An accelerant containing methyl esters of dicarboxylic acids was analyzed; the resulting trace contained four peaks also found in the authentic standard, and the relative amounts of the corresponding peaks in the fire debris sample are consistent with the standard. Thus, it was shown that a simple mixture could be analyzed and processed, but most fire debris samples are of a more complex nature. A more complex arson sample was analyzed and matched with the 25% Weathered Gasoline authentic standard.

In addition to rapid analysis, the ToF is extremely sensitive, thus enabling identification of fire debris samples with minute amounts of residual accelerant. The analysis of a fire debris sample that contained extremely low levels of accelerant was performed. The automated matching program identified the sample as 75% Weathered Gasoline in the absence of any detectable peaks on the TIC. The basis for identification of this sample as gasoline is only obvious when the summed ion chromatograms and individual extracted ion chromatograms are reviewed showing a high correlation with the naphthalene profile of the standard.

Currently, the analysis of fire debris samples is laborious and time consuming. This fact is due to both the actual data acquisition and the subsequent manual data analysis. It was shown that through the use of GC/ToF-MS analysis and automated pattern matching software (Xaminer), that fire debris cases can be rapidly and accurately analyzed. Actual data acquisition time is reduced by the fact that the high-speed acquisition rate of the ToF enables the use of fast GC techniques without loss of resolution or sensitivity. The application of automated chromatogram pattern matching software resulted in accurate and rapid identification of actual fire debris samples. The reduction of both run time and analysis time increases sample throughput and productivity. Finally, a repetitive and arduous task is removed from the analyst while the analyst's confidence is increased in the ultimate identification of the accelerant.

Fire Debris Analysis, GC/ToF-MS, Automated Chromatogram Matching

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