D17 The Potential of Comprehensive Gas Chromatography (GC) in Forensic Fire Investigations

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After attending this presentation, attendees will have insight into the potential use of comprehensive chromatography for forensic applications as well as its limitations. Attendees will be able to assess whether comprehensive 2D GC (GCxGC) and comprehensive GCxGC/Mass Spectrometry (MS) will meet their case work needs and make a valuable contribution to their forensic laboratory.

This presentation will impact the forensic science community by illustrating how detailed chemical information as revealed by comprehensive chromatography can lead to new dimensions in chemical analysis of forensic evidence.

The COMprehensive FORensics (COMFOR) project is a collaborative effort between the University of Amsterdam and the Netherlands Forensic Institute to develop forensic methods based on comprehensive GCxGC and GCxGC/MS. Comprehensive chromatography has been successfully applied in many areas, including the petrochemical and food industry; however, its potential has not been fully exploited in forensic science. The multidimensional separation principle and modulation process lead to enhanced separation power, peak capacity, and sensitivity. This creates new opportunities when performing targeted trace compound analysis, broad untargeted screening, class characterization, and chemical comparison of complex samples of forensic interest.

Chemical analysis in forensic fire investigations deals with complex and highly variable fire debris samples in which the presence of minor residues of ignitable liquids may be indicative of arson. As ignitable liquids are often oil distillates of complex composition, the use of GCxGC and GCxGC/MS is especially promising in the field of forensic fire investigations. In this presentation, the latest results of the COMFOR project will be presented. This includes a detailed study into the chemical variation of white spirits in the Dutch market as analyzed by GCxGC and GCxGC/MS. Despite the very complex chemical composition, production and distribution conditions are such that chemical variation at a given point in time is actually quite limited for different white spirit brands; however, within-class differentiation is still feasible through detailed comprehensive analysis in combination with data processing and chemometric tools. Additionally, small-scale fire experiments were developed and conducted to efficiently generate realistic fire debris samples under controlled conditions. Fire debris head space was sampled on carbon traps which were extracted with DCM. The DCM extracts were subsequently analyzed with GCxGC and GCxGC/MS to detect ignitable liquid residues.

Current research focuses on the use of comprehensive chromatography in combination with chemometric methods and forensic statistical data analysis to classify ignitable liquid residues with greater objectivity. Finally, this project explores the possibly of within-class differentiation of ignitable liquids in fire debris samples. The COMFOR research shows the benefit of chemists, chemometricians, and forensic statisticians working together to ensure state-of-the-art chemical techniques to be applied in forensic practice and resulting in an assessment of evidential value.

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