B43 Using Atmospheric Pressure Chemical Ionization/Mass Spectrometry (APCI/MS) and Flow Injection for the Screening of Arson Accelerants

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After attending this presentation, attendees will understand a new approach to fire debris analysis and how carbon disulfide, in combination with an APCI source, contributes to a more efficient screening process.[1]

This presentation will impact the forensic science community by providing a new perspective on accelerant detection methods. Some advantages to this method include: (1) the MS-only and precursor scans for the same compound classes as in the American Society for Testing and Materials (ASTM) methods only take minutes to perform; (2) carbon disulfide, the solvent of choice for extraction with carbon strips and passive headspace analysis, has shown the ability as an efficient charge transfer agent in APCI with hydrocarbons; and, (3) using Tandem Mass Spectrometry (MS/MS) analysis provides prominent molecular ion peaks in Q1 scans, as well as provides precursor scans, that identify the same compound classes as the standard Gas Chromatography/Mass Spectrometry (GC/MS) -extracted ion chromatograms.[2,3]

Every year in the United States, millions of dollars and thousands of businesses and private properties are lost due to intentionally set fires. The forensic fire debris field is a continuously shifting one, which presents constant challenges to those who are involved with the investigations. Arson investigations depend largely on quick detection and determination of ignitable liquids and their residues. Arson fires affect many people across the United States each year and the people responsible for deliberately setting the fires should be caught and held responsible for their crimes.[4,5]

In this study, an APCI-MS/MS method has been developed which has been used to screen common ignitable liquids. A passive headspace sampling technique, along with activated charcoal strips, were used to collect samples. A carbon disulfide reagent was added to each strip once the headspace was collected. The carbon disulfide extract was injected into the MS/MS using a flow injection technique. The MS/MS, an ABI® SCIEX™ 3200 Qtrap® triple quadrupole mass spectrometer, utilized an APCI source and positive-ion mode. A peak-hopping scan mode was employed, along with a step size of 1amu. A Q1 scan and precursor scans were run for each accelerant sample.

Ignitable liquids such as gasoline, diesel, lighter fluid, mineral spirits, turpentine, paint thinner, WD-40®, and kerosene were sampled. Prominent molecular ion peaks provided indications that each accelerant presented a different profile. Five different commercial gasolines were studied as well as four different commercial diesels. The gasoline samples presented similar profiles to each other. The diesel samples presented similar profiles as well. Precursor scans at 91amu and 128amu provided an insight into what contributed to prominent peaks seen in each accelerant sample. Sample profiles were completed using mass range binning and peak intensity sums to create bar graphs for each.[6]

In conclusion, this method could potentially be used in forensic fire debris analysis to screen for accelerants. This method could shorten analysis time considerably. According to the ASTM Standard, GC/MS methods include a total run time of 25.0 minutes.[7] This method cuts down run time to less than three minutes, with no cool-down time.

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Fire Debris, Accelerants, APCI