A96 Analysis and Detection Limits of Smokeless Powder Components by Capillary Electrochromatography – Time-of-Flight Mass Spectrometry

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After attending this presentation, attendees will have learned how the components of commercial smokeless gunpowder can be detected and identified using capillary electrochromatography – mass spectrometry (CEC-TOF-MS).

This presentation will impact the forensic science community by providing the details of a fast and robust analytical method requiring minimal sample preparation that avoids the sample instability and degradation that can occur with methods such as gas chromatography. In this process, unburned particles of smokeless powder such as those that might be found at a bombing scene are analyzed in an attempt to associate evidence found at the crime scene to a particular brand or lot of powder. Using the data obtained from this analysis, investigators may be able to generate leads or narrow the number of potential sources of the smokeless powder used in the bombing.

A mixed standard of commonly found smokeless powder additives was prepared by dissolving 1.0 mg of each standard in 1.0 ml of methylene chloride. A standard calibration curve was prepared by measuring an aliquot of each standard, evaporating the methylene chloride, and reconstituting the sample in a run buffer. Samples were run by capillary electrochromatography on a hexyl acrylate-based monolith. All standards were analyzed with an Agilent capillary electrophoresis unit run in CEC mode, connected to an Agilent time-of-flight mass $C_{2n}H_{2m}$?? 2 2 (HACA) theory of soot formation. At low incident laser power densities, both fuels yield spectra dominated by aromatic compounds such as benzene, naphthalene, and other conjugated ring systems. At these low incident power densities, the spectra for gasoline deposits are dominated by a large peak at *m/z* 202, which may be attributed to several isomers of $C_{16}H_{10}$. This peak is typically significantly smaller for the polystyrene deposits. The relative abundance of other peaks, such as *m/z* 91 and 128, is also a potential indicator of the identity of the initial fuel. The first laser shot in a given location typically yields the greatest relative abundance of high-*m/z* peaks, with later laser shots yielding a range of compounds.

Simple two-layer samples are also prepared and likewise analyzed. Where one layer contains polyurethane deposits, this layer is easily distinguishable by the TAI and TDA peaks. The gasoline and polystyrene layers are more difficult to distinguish, in some cases being spectrometer (TOF-MS). Detection limits were determined for eleven compounds found in smokeless powders: nitroglycerin, diphenylamine, dimethylphthalate, diethylphthalate, dibutylphthalate, methyl centralite, ethyl centralite, 2-nitro- and 4-nitrodiphenylamine, and 2-nitroso- and 4- nitrosodiphenylamine.

The use of CEC-TOF-MS represents a promising analytical scheme for the detection, identification, and quantitation of smokeless powder components. It is a fast, reproducible technique for the discrimination of smokeless gunpowder that avoids the problems presented by the breakdown of thermally labile components of smokeless powder during GC-MS analysis. Resolution in the CEC mode is high and sample preparation requirements are minimal.

Smokeless Powder, CEC-TOF, Improvised Explosive Device