B10 Forensic Analysis of Explosive Residue Background

Steven H. Wise, Olivier Collin, BS, John A. Mathis, MS, and Bruce R. McCord, PhD, Ohio University, 136 Clippinger Laboratories, Athens, OH 45701*

After attending this presentation, attendees will understand the methods for the detection of background levels of high explosives.

This presentation will establish parameters for detection of traces amounts of explosives based on a nationwide, background-levels survey, which will help investigators in eliminating false positives.

The ability to detect trace amounts of explosives is important in forensic investigations. Various analytical techniques are effective for the detection of explosives. In recent years, the sensitivity for the detection of explosives has greatly increased. This often leaves the forensic investigator in a situation where the significance of a result is not just the detection of an explosive residue, but rather its concentration when compared to that normally found in the environment. In order to give the investigator the concentration threshold that minimizes false positives, the background levels of explosive residues and interfering compounds found in public places needs to be determined. The goal of this project is to develop gas chromatography (GC) methods for trace detection of organic residues of high explosives in environmental samples.

This study involves the development of robust analysis methods for trace amounts of the following compounds: ethylene glycol dinitrate (EGDN), 4-nitrotoluene (4-NT), nitroglycerin (NG), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2,4,6-Trinitrotoluene (TNT), pentaerythritol tetranitrate (PETN), hexogen (RDX), octogen (HMX), and tetryl. Sampling is done using store bought cotton swabs rinsed with deionized-distilled water and isopropyl alcohol to remove impurities. Samples are collected by a thorough swabbing of the area of interest with dry, sterile cotton. Organic residues from each cotton swab are removed by an acetone extraction followed by a volume reduction under nitrogen flow. The extract is then screened for the presence of organic explosives using an HP 6890 GC with electron capture detection. The separation method involves a split-less injection at 180º C with helium carrier gas and a ten-minute temperature program between 50 and 250º C. To reduce sample degradation during the separation, a megabore capillary column is used; HP-5 (DB5 type, 95% dimethyl 5% diphenyl polysiloxane; 10m length, 0.53mm diameter, 2.65µm film thickness). This separation allows for presumptive identification and quantification of each compound by external standards. Detection limits in the low ng/ml range are possible for all compounds. The samples found to have a positive screening result are then confirmed by GC-mass spectrometry (MS) using negative chemical ionization with methane reagent gas. To verify the presence of the selected explosives, GC-MS is performed using a Finnigan GCQ equipped with a megabore Restek Rtx5MS (DB5 type, 15m, 0.53mm, 1.5µm film thickness) column that is split in the GC by sliding the analytical column over a 0.1mm fused silica transfer line, thus venting part of the flow into the oven. The risk of false positives is reduced by the use of selective detectors and compound identification by mass spectrometry. The analytical methods developed in this study will allow for the creation of a database using samples collected across the United States. To insure an accurate determination of background levels in different environments, sampling will be done in many public places. Such places include: malls, police stations, airports, taxis, and buses; where door knobs, hand rails, counters, floors, walls, and furniture will be sampled. The compilation of the results obtained from this study will give the investigator a much needed tool for the analysis of organic explosive residue in public places. In addition, this study addresses the issues for the admissibility of explosives analysis results in court under the Daubert ruling.

Explosives, Gas Chromatography, Mass Spectrometry

 ** Presenting Author*