B87 Soil Standards for Explosives

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This presentation will discuss the use of a portable, hand-held ion mobility spectrometer (IMS) for the detection of RDX, 1,3,5-TNB, 1,3- DNB, Tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2-NT, and 4-NT in soil matrices. Attendees will become familiar with this application of portable IMS and how the method can be applied in the field, outside of a laboratory setting.

This research and presentation will impact the forensic and environmental science communities by providing a validated method for a variety of explosives in soil matrices to be used with a field portable instrument. This application could potentially be used in post-blast scenarios or scenes where the presence of explosive materials is suspected.

During World War II, the Dolly Sods Wilderness Area of the Monongahela National Forest in West Virginia was used as an artillery and mortar training site for troops destined for combat in the mountains of Italy. In 1995, the Army Corps of Engineers performed site inspections and confirmed the presence of unexploded ordnance (UXO) within this area. As propellants and explosives leach from unexploded ordnance and explosives into the ground, they may be absorbed by soils, taken up by vegetation, or migrate into surface and groundwater. This research, performed in collaboration with the West Virginia Water Research Institute, Army Corps of Engineers, and the West Virginia Parks and Recreation Service, seeks to determine the concentrations of explosives in these abandoned firing ranges. Similar environments, such as post-blast zones of improvised explosive devices, could also be subjected to such analysis. Once the concentrations of these compounds have been determined in soil, water, and plant samples, environmental parameters can be used to model the migration of the explosives and predict the explosives' environmental fate.

The explosives used in this study were chosen from EPA Method 8330, a method used to determine the concentration of HMX, RDX, 1,3,5-TNB, 1,3-DNB, Tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2-NT, 3-NT and 4-NT in a water, soil, or sediment matrix. Due to availability in the laboratory, HMX and 3-NT were not used in this study.

Since the explosives used in this study form negative ions, the portable ion mobility spectrometer was used in the negative ion particle mode. Using a desorber, soil samples are heated and volatiles are driven into the gas phase where they interact with a radioactive ionization source. The gas phase ions are introduced to a drift tube via a gated ion shutter. The time it takes for the ions to travel the length of the drift tube is recorded and used to plot a plasmagram (detector response vs. drift time). The differences in drift times are dependent on the size, shape, and charge of the ions, allowing the individual explosives to be detected qualitatively.

The following IMS conditions were applied for the analysis of all explosives: 113 ˚C drift heater, 180 ˚C inlet heater, 160 ˚C desorber heater, 200cc/min drift flow, 0.025s analysis delay, 22ms scan period, 25s analysis duration, 57 segments per analysis, 20 co-added scans per segment, 23 segments per analysis, 50µs sampling period, and 419 sample points per scan.

Explosives, Portable IMS, Soil

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