B85 Detection of Explosives in Soil Utilizing Pyrolysis-GC-MS

Melissa M. Pablic, and Suzanne C. Bell, PhD, West Virginia University, Department of Chemistry, PO Box 6045, Morgantown, WV 26506-6045*

After attending this presentation, the audience will become familiar with the application of pyrolysis gas chromatography-mass spectrometry (Py-GC-MS) as a method for the detection of explosives in soil.

This presentation will impact the forensic community by providing an alternative, rapid method for the extraction and detection of explosives in soil. In the future, this method may be expanded to other difficult matrices such as fingernails, toenails, and insects.

Generally, pyrolysis is a technique used to study the thermal degradation products of a substance by applying high heat. These high temperatures can also be used as a mechanism to extract analytes from matrices. Coupling this technique with an analytical tool such as GC-MS provides structural and confirmatory information of the resulting products. Py-GC-MS has been previously used in forensic science to study a wide variety of analytes such as drugs of abuse, paints, photocopier toners, polymers, and fibers. Prior studies of the pyrolysis of hair samples have given this method a promising future as an extraction tool. The present work employed a pyroprobe coupled with a GC-MS for the pyrolysis analysis of explosives in a soil matrix. Explosive compounds and degradation products are commonly found in the soil of post blast environments. EPA methods using liquid chromatography-UV-vis and gas chromatography-electron capture detection are still the most widely used for the detection of explosives in soil. Disadvantages to using these methods include the laborious sample preparation and time intensive extraction procedure and instrumental analysis.

An advantage to using this method includes little or no sample preparation, therefore, eliminating the extraction step that normally increases the analysis time. With the elimination of the extraction step, Py-GC-MS can be used as a sample profiling tool that is not only rapid, but semi-quantitative as well. In addition, this method is widely available for laboratory use. While the list of advantages is extensive for Py-GC-MS, the method remains underutilized in the forensic laboratory.

This study focused on new and extended applications of Py-GC- MS in the field of forensic science. In this experiment, the explosives and degradation products listed in the EPA 8330 method were pyrolyzed in soil. These analytes include 2,4,6-trinitrotoluene, 2-amino-4,6- dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2,6-dinitrotoluene, 2- nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, tetryl, 1,3-dinitrobenzene, 2,4-dinitrotoluene, HMX, RDX, nitrobenzene, and 1,3,5- trinitrobenzene. The conditions of the pyroprobe consisted of an initial temperature of 400°C and with a ramp rate of 100°C/sec, reached the final temperature of 1000°C. The GC conditions included an oven temperature of 320°C held for 10 min and a carrier split ratio of 20:1. The Py-GC-MS method shows potential in the area of explosives detection through direct analysis of soil samples. This technique shows promise to be utilized in pre and post-blast investigations as well as in environmental forensic analyses.

Pyrolysis, Explosives, Soil Analysis

 ** Presenting Author*