# D15 Comparison of Extraction Methods: Extracting Explosives From Soil Matrices

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After attending this presentation, attendees will have a basic understanding of effective ways to extract explosives from soil matrices. More specifically, attendees will become familiar with the differences between using ionic liquids, common solvents, and the Environmental Protection Agency (EPA) method 3535A to extract explosives from soil.

This presentation will impact the forensic science community by providing a comparison of extraction methods for explosives in soil matrices. To date, there is not one single commonly used method to extract explosives from soil. Most of the current extraction processes take ample amounts of time to complete, and/or can yield inconclusive results. This study will evaluate and determine the most efficient extraction method presented in comparison to currently used methods.

Terrorism is a common threat throughout the world. Many terrorist attacks involve the use of secondary explosives and, when detonated, can leave trace amounts of explosives in surrounding soil matrices. Currently, there are many different methods that forensic scientists utilize to extract explosives from these soil matrices, most of which are time-consuming and dependent on the analytical technique being used.

While many studies have explored the use of one specific extraction method with one analytical technique, this study explores three separate methods to extract explosives from soil matrices in order to see which method is more sensitive, effective, and cost beneficial. In addition to using three different methods of extraction, three separate analytical techniques were utilized for each extraction method.

For this study, RDX and TNT, two commonly found secondary explosives, were added to two different types of soil matrices. Each soil sample was then run through each of the three following extraction methods: use of ionic liquids; saturation in common solvents; and EPA method 3535A. When using the ionic liquid method, the explosive containing soils were completely saturated in ionic liquids or the ionic liquids were placed on a swab that was run across the top of the soil. Ionic liquid samples were then run through Solid Phase Extraction (SPE) before being analyzed. For the common solvents method, soil samples were fully saturated in a solvent, and without going through any further processes, were analyzed. The EPA 3535A method saturated the soil samples in water, then the soil samples were run through two different SPE methods prior to analysis.

Once each extraction method was complete, the samples were analyzed for the presence of RDX and TNT with the following three analytical techniques: Direct Analysis in Real Time (DART®); Gas Chromatography-Mass Spectrometry (GC/MS); and Liquid Chromatography-Mass Spectrometry (LC/MS). DART® was utilized because of its fast turn-around time; however, because it is only a screening method, both GC/MS and LC/MS were used as confirmatory tests. At the moment, GC/MS is the most common analytical technique used for explosives in a forensic laboratory. However, LC/MS is becoming more prevalent in labs and has demonstrated greater sensitivity when analyzing chromatographic data.

After all three extraction methods were utilized and samples were run on the DART®, GC/MS, and LC/MS, the chromatographs were analyzed. A comparison was carried out to determine which extraction method was most beneficial based on the chromatographic results, extraction preparation time, and analysis time, combined with the overall cost of each method.

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**Extracting Explosives, Extraction Method, Explosive Analysis**

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