Detection of Explosives using a Portable SPME/GC-Cylindrical Ion Trap Mass Spectrometer

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INTRODUCTION:

Long term monitoring at Department of Defense sites is required to demonstrate successful remediation and regulatory compliance. The monitoring programs are expensive with the majority of the costs related to sampling, shipping, and analysis. Field analytical technologies can reduce monitoring costs compared to fixed laboratories, however the field instruments must produce data that are acceptable for regulatory purposes. The goal of this work is to test a field analytical method for munitions constituents found in ground water at a formerly used Department of Defense site.

Figure 1: Sampling well water at a formally used DOD site

PROCEDURE:

Standard low flow sampling was used to collect water from monitoring wells at the site (Figure 1). Samples were extracted with SPME fibers and analyzed immediately on the Minotaur 400. The method developed on the Minotaur 300 was transferred to the field ruggedized Griffin Analytical Technologies Minotaur 400 mass spectrometer for the field work. Additionally 500 mL samples were transported to our fixed laboratory for analysis by the traditional method for explosives, SW-846 EPA Method 8330.

The CIT was equipped with a Restek RTX-TNT heated gas chromatography capillary column, which allowed for confident identification of the target analytes and separation from interferences. Target analytes were identified by comparison to the retention times and mass spectra of known standards. Solid phase micro-extraction (SPME) fibers were chosen to eliminate chemical waste generated in the field and reduce sample volumes.

RESULTS & DISCUSSION:

A Griffin Analytical Technologies Minotaur 300 cylindrical ion trap (CIT) was used to develop an analytical method for the detection of munitions constituents. The munitions constituents of interest were TNB, RDX, 1,3-DNB, TNT and 2,4-DNT, all known contaminants of the field site. Concentrations of the munitions constituents in the ground water of the site ranged from ~40 ppb to 16 ppm.

The results from the samples that were extracted and analyzed immediately in the field show better detection of the low level constituents, compared to SPME fibers collected in the field and run later in the lab (Figures 3 & 4). The traditional EPA method for explosives was able to identify more compounds of interest than the GC-MS SPE results from on the Minotaur 400. We are able to detect RDX but not HMX using direct injection followed by analysis using the Minotaur 400 GC-MS. RDX was not detected from the SPE extractions of the well water. HMX is also a known contaminant of the site.

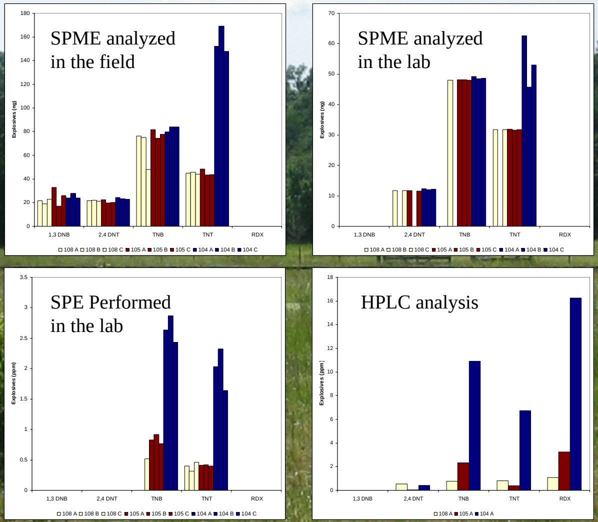

Figure 3: Results from GC-MS and HPLC Analysis of well water

Figure 2: Griffin Analytical Technologies Minotaur 400 Mass Spectrometer

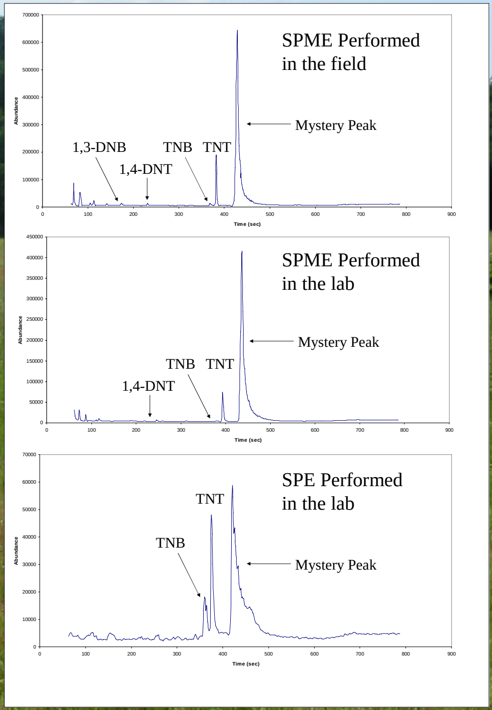

Figure 4: Chromatograms from GC-MS analysis of well 104

CONCLUSION:

The results of this work demonstrate a successful field analytical technology for the detection of munitions constituents in ground water. We are currently investigating other techniques for improved detection of RDX and HMX.