A107 Detection of Ammonium Nitrate and Ammonium Nitrate Mixtures in Soil

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After attending this presentation, attendees will learn a minimal preparation methodology to rapidly identify ammonium nitrate and ammonium nitrate mixture particles while in the presence of various soil matrices.

This presentation will impact the forensic science community by providing a methodological model for analytical processes to identify ammonium nitrate mixtures that is conducive to an in-theatre environment.

Homemade explosives (HME's) are commonly encountered in theatre, in both pre- and post-blast scenarios. In post-blast scenarios, the burned and unburned particles can settle onto the surrounding soil or sand. It can be difficult to physically separate residual explosive particles from soil for instrumental analysis. Several types of explosive mixtures can be used in improvised explosive devices (IEDs). One of the more commonly used HMEs is ammonium nitrate (AN) because it is readily accessible. While AN can be used alone as an explosive, it is generally mixed with a fuel, commonly referred to an ammonium nitrate mixtures (ANM).[1] It can be difficult to identify these fuels which can be a key identifier for the bomb builder, especially in post-blast scenarios. With the increase of soil samples being sent to forensic labs to be analyzed, this study will help analysts by giving them a methodological model for extraction and analytical processes that is conducive to an in-theatre environment.

The objective of this study was to determine if AN and ANM can be identified in different soil matrices using the following in-theatre hand-held instrumentation: Raman Spectroscopy, Infra-red (IR) spectroscopy, and an ion-trap gas chromatograph – mass spectrometer (GC-MS). The more commonly identified fuels used in this study were: powdered aluminum, powdered sugar, spics, and diesel fuel. Ammonium nitrate was powdered and mixed with the powdered fuel to simulate the close contact necessary to create a significant blast. This was not necessary to do for the ammonium nitrate mixed with diesel fuel because the fuel is absorbed into the AN pill providing the a similar close contact. Each ANM was analyzed and compared to the analysis of the individual components to determine if each fuel could be identified in the presence of the AN. Subsequently, these ANM were mixed with soil samples at predetermined concentrations and analyzed to determine if either the AN or the ANMs were readily identifiable. The soil samples matrices were silicon band sand, red clay, and humus (garden-top) soil.

The resulting spectrum or chromatogram of the individual components, ANMs, and soil mixtures were compared by a Pearson correlation with a Student's t-test to determine if samples were significantly different or similar (~1900 pair-wise comparisons made). Based on research thus far individual fuels can be identified in the presence of AN at a concentration of 10% w/w. For the ANMs, the hand-held IR instrument had the ability to identify residual components (the fuel), which when analyzed had a higher correlation value with the individual fuel than the mixture itself. When the ammonium nitrate mixtures were mixed in the sand, high correlation values ($R_2 = \sim 0.8$) were achieved between ANM in sand and the pure ANM. Similar correlation coefficients for the mixture and the individual components were achieved for the Raman spectroscopy analysis. The GC-MS analysis did not provide any identifiable peaks for AN nor the fuels except for the diesel fuel at 1mg/ml and a 5mg/ml concentrations. Current results suggest it will be possible to identify AN and the fuels in a soil matrix.

The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

Reference:

1. Beveridge, A.D.; Development in the Detection and Identification of Explosive Residue, *Forensic Science Review*, **1992**, 4(1), 18,32

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