A94 Detection and Forensic Analysis of Triacetone Triperoxide (TATP) in Uninitiated and Initiated Samples

Michael E. Sigman, PhD, and Charles D. Clark, BA, BS, National Center for Forensic Science, University of Central Florida, PO Box 162367, Orlando, FL 32816-2367; and Kimberly Painter, BS, 802 Crest Pines Drive, Apartment 824, Orlando, FL 32828*

After attending this presentation, attendees will have learned about current analytical methods used for the analysis of triacetone triperoxide.

The presentation will impact the forensic science community by teaching new methodology in explosives analysis.

Triacetone triperoxide (TATP) is a cyclic organic peroxide that is extremely unstable and is classified as a primary explosive. TATP has been used frequently by Palestinian extremists in improvised explosive devices (IEDs) against Israeli military and civilian targets for over twenty five years. TATP use in terrorist attacks has not been limited to just the Middle East. Over that past ten years TATP has been linked to bombing attacks, and attempted attacks, in Asia, Europe, and the United States. Research at the National Center for Forensic Science (NCFS) has focused on both the detection and the forensic analysis of uninitiated and initiated TATP samples, as well as the characterization of precursor chemicals used in the synthesis of TATP.

Optimized methods have been developed for the detection of TATP using gas chromatography mass spectrometry (GC-MS), electrospray ionization mass spectrometry (ESI-MS), atmospheric pressure chemical ionization mass spectrometry (APCI-MS), and ion mobility spectrometry (IMS). Our optimized GC-MS method, utilizing a lower source temperature and injection port temperature, has yielded picogram levels of detection for TATP using both electron ionization and chemical ionization. Analysis of TATP by GC-MS using chemical ionization with ammonia as the reagent gas is the preferred method as it not only gives detection at the picogram level, but also provides a diagnostic $[TATP+NH_4]^+$ ion. This method has also been successful in identifying diacetone diperoxide (DADP) and the cyclic tetramer tetraacetone tetraperoxide (TrATrP) via their ammonium adduct ions. Detection of TATP by ESI-MS and APCI-MS gave higher limits of detection, but these methods proved to be more sensitive in the detection of linear oligoperoxides that are formed in the TATP synthesis reaction and often present in the final "crude" product.

Rapid detection of TATP, both solid and vapor samples, has been achieved using ion mobility spectrometry (IMS). Though detection of TATP in the negative ion mode is possible, detection in the positive ion mode gave better limits of detection by at least one order of magnitude. Field detection of TATP was performed on post-blast samples by directly swabbing the debris, and by sampling the headspace over the debris.

Forensic analysis of TATP samples to obtain information about the precursor chemicals used in its synthesis was also investigated. Acetone obtained from twenty seven different commercial sources was used to synthesize TATP. Many of the acetones contained organic additives and impurities that were found to carry through the synthesis reaction and could be detected in the final TATP product by GC-MS analysis using electron ionization. In some cases the additives could be detected in post- blast samples.

The influence of the acid used to catalyze the TATP reaction was also investigated. TATP was synthesized using H_2SO_4, HCl, HNO_3, H_3PO_4, CH_3CO_2H, and $SnCl_5$ as the acid catalyst. In some cases samples could be discriminated based on the acid used to catalyze the synthesis reaction.

To confirm results obtained from microscale syntheses, large scale syntheses (2g-88g) of TATP were also performed. Detonation of these large scale synthesis samples were conducted in the field at a test range, and post-blast samples were collected and analyzed both in the field and later in the laboratory.

Views presented do not reflect the position of the government or infer endorsement.

Triacetone Triperoxide, Analytical Chemistry, Trace Evidence

 ** Presenting Author*