E90 Optimal Headspace Extraction for the Detection of Volatile Organic Compounds (VOCs) Released From Triacetone Triperoxide (TATP) Using Solid-Phase Microextraction (SPME)

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The goal of this presentation is to provide attendees with: (1) more insight into the headspace analysis of TATP; and, (2) detailed information into the VOCs associated with this explosive.

This presentation will impact the forensic science community by presenting a precise, safe, non-explosive, volatile compound in the form of a Controlled Odor Mimic Permeation System (COMPS) that will ultimately equip canine teams with the ability to detect TATP. The dominant headspace odors associated with TATP can be used in the creation of effective canine training aids using COMPS.

Due to its high instability and ease of detonation, TATP is often difficult for canine trainers and handlers to access for regular training purposes. As a result, the majority of canine explosive detection teams are unable to reliably detect this explosive.

TATP, first discovered in 1895, has become very prevalent among terrorist and other malicious groups worldwide since the early 2000s. The infamous 2001 "shoe bomber" utilized TATP, as did terrorists involved in the 2005 and 2006 London attacks. Bombs detonated at the University of Oklahoma in 2005 and Texas City in 2006 also contained traces of the chemical. More recently, this explosive was involved in famous attacks in Paris, Brussels, and Manchester in 2015, 2016, and 2017, respectively. One of the main reasons for TATP's increased use is the fact that it can be easily manufactured using inexpensive, commercially available household items, namely acetone and hydrogen peroxide. More importantly, it is very difficult to detect by traditional security scanners since it does not contain nitrogen. Nitrogen is a common component of explosives that security scanners can successful detect; however, these same scanners are unable to detect TATP. It has been proven that explosive detection canines can successfully detect TATP; however, they are unable to train and maintain proficiency with detecting this explosive because of a lack of availability of TATP during routine maintenance training. To combat this, identification of the TATP VOCs, followed by the development of suitable mimic training aids using COMPS will be conducted.

This study will present results of a developed optimal extraction method for VOCs from TATP utilizing a headspace SPME technique on solid, as well as diluted, TATP samples to reveal those headspace components that are most likely responsible for an alert from explosive detection canines. The dominant headspace odors associated with this explosive will, therefore, be used in the creation of effective canine training aids using COMPS. These peroxide-based COMPS will fill the current law enforcement gap of not being able to train explosive detection canines on peroxide-based explosives by providing an alternative and effective training aid. By using COMPS, the signature headspace odor is housed in a permeable polymer that releases the identified odor at a known and controlled rate. This technique will satisfy the thousands of law enforcement detection canines nationwide that are currently unable to detect peroxide-based explosives as a result of a lack of availability of the material for training purposes. A large number of canine handler teams will, therefore, be able to utilize the developed peroxide-based COMPS to train their canines to recognize these signature odors associated with TATP and, ultimately, improve their detection of the actual explosive.

Triacetone Triperoxide (TATP), Solid-Phase Microextraction, COMPS

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