B122 Realizing the Science Behind Canine Detection of Explosives

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Attendees will learn scientifically sound methods and applications of canine detection of explosives, an understanding of the ability and limitations of canine detection, and the future of this recognised method of explosives detection.

This presentation will impact the forensic community and/or humanity by allowing members of the forensic community who are not familiar with canine detection to become familiar with the abilities and limitations of explosives detection canines, whilst at the same time providing specific scientific suggestions to those in the field who wish to improve upon training and operating practices.

Police and private agencies have used canines for many years now, to locate items of forensic interest such as explosives, controlled substances, currency, ignitable liquid residue, hidden or missing persons, and human remains. Up until recently however, this practice has remained more of an art than a true science, and with the increasingly strict standards of forensic evidence admissibility, including *Frye* and *Daubert*, validation of canine detection, to provide peer reviewed acceptance of scientifically sound practices, is becoming urgently required. Although viewed as older technology, now competing with microchip laboratories and micro sensors, the canine must still be considered one of the best real-time methods for the detection and location of explosives.

Solid Phase Microextraction has been combined with Gas Chromatography - Mass Spectrometry (SPME-GC-MS) and Gas Chromatography - Electron Capture Detection (SPME-GC-ECD) to analyse the headspace of samples of explosive obtained from local and state law enforcement agencies. The SPME-GC-ECD method used in this study is also being optimised for potential field application. A rapid SPME exposure followed by a 15 minute GC program provides ECD spectra of all EPA 8330 explosives, in addition to EGDN, NG, PETN and DMNB. A dual column method is under investigation for confirmatory analysis.

Samples analysed include cast explosives, plastic explosives, detonation cords, powder explosives, and commercially available nonexplosives training aids. Results of analysis indicate highly similar odor signatures within the cast and the plastic explosive groups. The cast explosives feature predominantly 2,4-dinitrotoluene and other aromatic mono-, diand tri-nitrates, whereas the 2,3-dimethyl-dinitrobutane taggant and 2ethyl-1-hexanol plasticiser are common in the plastic explosives. Unlike the high explosives, the odor signatures of the powder explosives are not similar within the group, with the odor chemicals highly dependent upon the manufacturer's choice, with no common chemical observed within all samples. Chemicals detected within the powder explosive headspace include dinitrotoluenes, ethyl centralite, diphenylamine, nitrodiphenylamine and nitroglycerin. The non-explosive training aids have been analysed in the same manner as the explosive samples, and whilst TNT, RDX and PETN were detected at low levels in the headspace of the silica powder based products, the petrolatum jelly aids do not have significant odor headspaces, above the petrochemical background matrix.

Fieldwork with local and state police agencies is currently a multifaceted project. The effectiveness of commercially available training aids has been studied using canines previously trained using actual explosive material, in addition to use as a training medium for new canines. It has been observed that dogs trained on actual explosive have difficulty in locating the non-explosive counterparts, but that dogs trained on the inert aids have little problem in crossing over to the real explosives. Fieldwork is also ongoing with the odor chemicals detected in the headspace of the explosive samples. To date, 2,4-dinitrotolene and 2-ethyl-1-hexanol have been identified as active odors for cast/powder and plastic explosive respectively. The 2,3-dimethyl-dinitrobutane taggant is not utilised by the canines, and is classed as an inactive odor, along with diphenylamine and ethyl centralite, all of which the canines show little or no interest towards.

Further research has focussed upon the permeability of explosive odors through assorted plastic and polymer containers. By varying the thickness and chemistry of the polymer, the rate of odor permeation may be controlled. In-house training aids have been developed utilising the active odors and the permeation study, and these aids are currently in applicability trials with selected law enforcement agencies. Work continues to identify the active odors of explosive samples, and to present figures on the reliability of local and state agency trained canines when presented with hidden explosives. Development of inert training aids that mimic explosive odor is ongoing, and these aids have been designed to release odor at a controlled rate of permeation, giving the ability to 'calibrate' the canines and calculate minimum detection levels. It can be shown, with the data on reliability, and minimum detection levels, that canine detection may be considered a scientifically sound method of detection.

Canine Detection, Explosives, Solid Phase Microextraction