B88 Analysis of Post-Blast Residues of Black Powder Substitutes by Ion Chromatography and Capillary Electrophoresis

Megan N. Bottegal, BS, and Bruce R. McCord, PhD, Florida International University, 11200 SW 8th Street, Miami, FL 33199; and Leslie Adams, BA, Miami-Dade Bomb Squad, 400 NW 2nd Ave, Miami, FL 33128*

After attending this presentation, attendees will have been introduced to new developments in the analysis and detection of black powder substitutes.

This presentation will impact the forensic community and/or humanity by demonstrating methods to identify both the fuel and oxidizer molecules in the event that a black powder substitute is used in the construction of an improvised explosive device; this information can provide an investigative lead for law enforcement personnel.

Given that black powder substitutes are legal to purchase and possess in significant quantities, their use in improvised explosive devices (IEDs) has become a concern both locally and globally. It is important to be able to identify both the fuel source and the oxidizer during the analysis of post-blast residue in order to identify the original explosive material. This information can provide an investigative lead for law enforcement personnel in the event of an IED blast.

Black powder substitutes are alternative propellants that are formulated to generate less smoke and cause less corrosion to the gun barrel than traditional black powder. These formulations generally contain inorganic oxidizers such as KNO_3 and/or $KClO_4$. While charcoal has been the traditional fuel source in these powders, in recent years, several manufacturers have instead turned to ascorbic acid (vitamin C). This compound has the advantages of water solubility and a reduced smoke output when burned. These characteristics of ascorbic acid result in less fouling of the gun barrel, leading to a faster reloading time.

Little is known about the types of residues formed when these new black powder substitutes are used as the explosive filler in pipe bombs. It is important to determine whether the products of open burning of these propellants are different from those resulting from the heat and pressure of an explosion. Powders from different manufacturers may give different products when deflagrated; this information can be used to identify one powder from another. The identity of these products, and reproducibility of their formation, will be determined.

A series of pipe bombs were constructed and deflagrated under controlled conditions to determine what factors influence post-blast residue formation. Seven different types of black powder substitutes were evaluated to determine what residues they commonly produced when confined and detonated as a pipe bomb. These residues were then compared to those formed in open burning and present in unburned powder. Quantification of levels of anions present allowed for the determination of the percent composition of each powder. This approach allowed for discrimination between different powders. Factors to consider included the temperature of the explosion, the packing density of the powder, brand, and lot of powder, and type of containment material used. The powders used in this study included four ascorbic acid based powders, two charcoal based powders, and traditional black powder. To prevent contamination and contain the pipe fragments, each shot was contained within a plastic bucket. Initiation occurred via an electric match to minimize safety hazards.

Analysis of pre-burn, post-burn, and post-blast residue was carried out using ion chromatography (IC) and capillary electrophoresis (CE). Target analytes included perchlorate, chlorate, nitrate, nitrite, and ascorbic acid. Concurrent use of these two complementary separation techniques allowed for presumptive identification of the compounds of interest.

Explosives, Ion Chromatography, Capillary Electrophoresis

 ** Presenting Author*