A202 Characterization and Analysis of Blackhorn 209: A New Black Powder Substitute

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After attending this presentation, attendees will have learned about the physical and chemical properties of Blackhorn 209 and the analytical methods for analyzing the intact powder and the post-burn/post-blast residues of this new black powder substitute.

This presentation will impact the forensic community by providing a comprehensive description of this newest black powder substitute on the market.

For many years, black powder has been one of the most commonly used propellants in improvised explosive devices (IEDs) in the United States. Black powder contains 75% potassium nitrate (KNO_3), 10% sulfur (S) and 15% charcoal. However, there are drawbacks with black powder, such as the presence of sulfur in its composition. Sulfur generates the solid combustion products sulfate and sulfide, which can corrode the barrel of a muzzle loading firearm over time. This led to the development of alternative formulations by various companies, replacing sulfur with organic compounds such as carboxylic acid or its derivatives. These modified black powders are known as black powder substitutes (BPS). BPS have been designed to have a more controlled burn rate, generate less smoke upon firing, and improve the safety of storage. They are also classified as flammable solids by the United States Department of Transportation, so they do not have the same restrictive storage requirements as traditional black powder, making them more appealing to retailers. There are currently two main groups of black powder substitutes on the market. One group, which includes Jim Shockey's GoldÔ and Goex Pinnacle Replica black powder, utilizes ascorbic acid as a replacement fuel for sulfur. Another group, containing PyrodexÒ and Triple SevenÒ manufactured by the Hodgdon Powder Company, uses the sodium salt of benzoic acid and dicyandiamide (DCDA) as fuels. Sulfur is absent in the composition of Triple Seven®, but still present in Pyrodex®.

Blackhorn 209 is the newest BPS on the market. The preliminary results from this study show that Blackhorn 209 is very different from other BPS on the market. The intact powder sample has morphology similar to tube-shaped smokeless powder, but the data collected from analytical techniques such as X-ray Powder Diffraction (XRD), Gas Chromatography-Mass Spectrometry (GC-MS), and Ion Chromatography-Mass Spectrometry (IC-MS) show that Blackhorn 209 contains ingredients from both black powder (potassium nitrate and sulfur) and double-base smokeless powder (nitrocellulose, nitroglycerine, and ethyl centralite). In addition, a special compound, acetyl triethyl citrate (or citroflex A), was identified by GC-MS and trace levels of perchlorate were identified by IC-MS in the de-ionized (DI) water extract of the intact powder. The analysis of the post-burn residues shows that Blackhorn 209 generates inorganic combustion products similar to black powder, including potassium sulfate, potassium carbonate, and thiocyanate. Trace levels of perchlorate were also identified in the post- burn DI water residue extract. The original organic ingredients - nitrocellulose, nitroglycerine, ethyl centralite, and citroflex A - were also detected in the dichloromethane (DCM) extract of post-burn residues. This presentation will also report on the analytical results obtained for Blackhorn 209 post-blast residues from pipe bomb fragments. **Explosive, Black Powder Substitute, Blackhorn 209**

 ** Presenting Author*