A86 Physical and Chemical Description of Barnes XLC Coated X-Bullets

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The goal of this presentation is to present a physical and chemical description of the Barnes XLC Coated X-Bullets before and after being fired. It employees several instrumental and microscopic techniques used in chemical and materials analysis, most of which are available in well equipped crime laboratories.

This presentation will impact the forensic science community by providing Information contained in this presentation can be used by firearms examiners as a reference standard to identify Barnes XLC Coated X-Bullets recovered at crime scenes.

Barnes XLC Coated X-Bullets are specialty bullets for the ammunition reloader enthusiast. The solid copper hollow point bullets are distinguished by their blue coating that acts as a lubricant to improve ballistic performance. Microscopic examination showed it to be a sprayed-on single layer coating similar to automotive paint finishes. Coating thickness was determined with a stereomicroscope equipped with imaging software capable of making measurements to be 24.2 microns with a standard deviation of 0.76 microns. The color spectrum with a maximal peak at 495 nm was obtained with a microspectrophotometer. Fourier transform infrared (FTIR) spectral analysis of the unfired bullet provided a reference spectrum for forensic identification. When the bullet is fired, the coating is lost from the surfaces that come in contact with the barrel, but because of mushrooming petals that form upon impact at the tip of the bullet, the coating is protected and remains intact. Heat, pressure, and impact due to firing do not change the IR spectrum of the coating, thus providing a comparison link between the unfired standard reference to bullets recovered at crime scenes.

Further chemical analyses were conducted to determine the lubricant, coloring agent, and binder. Starting with the reference IR spectrum, spectral matching techniques were used to identify polytetrafluoroethylene (PTFE) as the lubricant by its characteristic twin peaks at 1210 and 1150 nm. Its presence was confirmed by pyrolysis-gas chromatography-mass spectrometry (Pyr-GC-MS). The pyrolysis product of PTFE appears early in the pyrogram as a single large peak of tetrafluoroethylene, and this results agrees with peer reviewed literature.

After subtracting the PTFE spectrum, searches for other matching spectra suggested methylmethacrylate, a group of “drying oils like tung oil and fatty acids, and cyclic compounds as the most likely components. Pyr-GC-MS analysis suggested methylester-2-methyl-2-propenoic acid, many cyclic compounds some of which containing nitrogen, fatty acids, and a small peak identified as Blue Pigment 15. Because mixtures of polymers, co-polymers and cross-linkers are specifically formulated to produce desired properties, exact identification is often not possible. However, taken together the binder composition is rationalized to be a mixture of methylmethacryate and alkyd drying oils.

Blue Pigment 15 is member of the copper cyanin dye family that is modified with slight variations to produce different shades of blue. Pyrolysis of these large heterocyclic compounds produces a large variety of smaller heterocycles, some of which are direct components of the parent molecule and others that are structural rearrangements. Exact reconstruction of a specific copper cyanin was not possible. However, Raman spectrometry supports the presence of a copper cyanin compound in the coating.

Reference Standard Barnes XLC Coated X-Bulltes, Blue Bullet, Chemical Analysis

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