



B122 The Effectiveness of Using ATR-FTIR Microspectroscopy and Individual Morphology to Determine the Manufacturers and Brands of 40 Different Unburned Smokeless Gunpowder Samples

Brenda L. Dowell, MFS*, National University, Forensic Sciences Program, 11255 North Torrey Pines Road, La Jolla, CA 92037

After attending this presentation, attendees will understand the value of the combined analyses of ATR-FTIR microspectroscopy and individual morphology in determining the manufacturer and brand of unburned smokeless gunpowder particles.

Unburned smokeless gunpowder particles can be traced back to their manufacturer based on their individual morphology and chemical composition. This presentation will impact the forensic community and/or humanity by providing a vital clue for investigators and possibly lead to the identification of the purchaser/bomber. Additionally, this evidence would be important in the prosecution of a case if the questioned gunpowder particles collected can be shown to be the same brand purchased by the bomber or found at his residence.

When used as an explosive device or weapon, smokeless powder may not be entirely consumed by the explosion, resulting in undamaged and intact particles. The combined use of attenuated total reflectance Fourier-transform infrared (ATR-FTIR) microspectroscopy and individual morphology has the potential to identify the manufacturer and brand of a sample of unburned smokeless powder, or at least narrow the search. This study evaluated the efficiency of these methods in identifying the source of an unknown powder.

First, 145 different brands of powders representing 13 manufacturers were categorized according to their morphology and then analyzed by ATR-FTIR to create a reference database. Second, a total of 40 samples were randomly chosen, morphologically categorized and analyzed by ATR-FTIR. Third, a detailed comparison to identify the manufacturer and brand of each powder using the reference database and the unknown powder data was conducted.

All samples were classified using a previously developed system (1) that places particles into five general categories based on morphological characteristics: lamel, ball, tube, disc, and flattened ball. Subcategories of tube powders include short and long tubes, while subcategories of disc powders include thin and thick discs. Due to the large variation seen in the flattened ball category, two subcategories were created: angular flattened ball, and irregular flattened ball. When further expressions of the powders were necessary, additional descriptive factors were utilized including color, luster, bias, perforations, uniformity of particle size, surface textures, tails and scrap, or any other descriptive qualities and notable observations.

During the initial comparison, possible source powders were systematically eliminated based on morphological inconsistencies with the unknown, thus forming a small group of similar powders. The ATR-FTIR spectra were employed for additional discrimination.

After thorough examination of the morphology and IR spectra, the known powder most similar to the unknown sample was chosen as the source. Thirty-eight out of forty unknown samples were correctly identified to manufacturer and brand of powder. Of the incorrectly identified samples, one sample was misidentified in both the manufacturer and brand of powder. With the second sample, identification of the manufacturer was accomplished but the brand was incorrectly identified.

The ultimate goal of this study was to identify the brand of smokeless powder from a questioned powder. Providing an investigator the correct identity of a questioned powder is the goal, but if this is not possible providing the investigator a short list of two or three powders provides valuable information.

If unburned smokeless gunpowder particles can be traced back to their manufacturer and brand based on their individual morphology and chemical composition, this could be a vital clue for investigators and possibly lead to the identification of the purchaser/bomber. Additionally, this evidence would be important in the prosecution of a case if the questioned gunpowder particles collected can be shown to be the same brand purchased by the bomber or found at his residence.

Reference:

- (1) Moorehead W. The Characterization of Reloading Smokeless Powders Toward Brand Identification. *Proceedings American Academy of Forensic Sciences. Annual Meeting, New Orleans, LA: February 2005; Criminalistics-B93*

Smokeless Powder, ATR-FTIR, Morphology