Y16 Accuracy of Ammunition With the Addition of Luminescent Markers

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Learning Overview: The goal of this presentation is to educate attendees on the possible benefits of using luminescent markers in gunpowder for Gunshot Residue (GSR) detection, as well as explain how they affect the accuracy of ammunition.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by potentially allowing GSR analysis to be conducted in a timely manner, as well as limiting false positive and false negative results from the Scanning Electron Microscope coupled with Energy Dispersive X-ray Spectroscopy (SEM/EDS), without affecting the accuracy of ammunition

When firearms are discharged, this creates a plume of particles known as GSR composed primarily of lead, barium, and antimony. This residue can be collected and analyzed from a person's hands, face, or the clothing that they were wearing when the firearm was discharged. GSR is commonly analyzed using SEM/EDS, but can also be analyzed using other technologies, such as Raman spectroscopy. The downside to SEM/EDS is the length of time it takes to analyze samples, as well as becoming less robust as manufacturers are ceasing to use lead in their ammunition. The addition of luminescent markers within the gunpowder has been shown to be a viable technique to enhance the collection of GSR, while also having the potential to eliminate collection of non-GSR samples, by using an Ultraviolet (UV) light.

The accuracy of ammunition with the addition of luminescent markers was tested on three different firearms: a .222 rifle, a 30-06 rifle, and a .357 revolver, each at their optimized range (50 yards, 100 yards, and 25 yards, respectively). Ammunition was hand re-loaded while adding luminescent markers in varying weight percentages to the gunpowder that was used in each specific firearm, including 2%, 4%, and 6%. Five samples were loaded in each of the different groups, including a control group in which no luminescent markers were added. After the first and fifth shot in each trial, the hands were observed under a UV light where some particles could be observed. A *t*-test concluded that there was no significant difference between the accuracy of the control groups for each firearm and any of the samples with the luminescent markers. A second trial was performed by removing gunpowder equal to the amount of luminescent powder that was added to ensure that the overall amount of powder remained the same within each cartridge. The same procedure was performed as in the first trial. The results showed at low amounts of luminescent markers replacing gunpowder (98%:2% and 96%:4%), there was no significant difference in the accuracy when a *t*-test was performed comparing them to the control. As more gunpowder was replaced with luminescent markers, the accuracy became significantly worse than the control. Velocities were tested for a sample in each trial at Peterson Cartridge in Warrendale, PA, to see the effects of the luminescent powders. It was found that luminescent markers did affect the velocity for the .222 rifle and 30-06 rifle, but not the .357 revolver.

Production of luminescent markers with a higher temperature resistance is needed for further trials to optimize the ratio of gunpowder to luminescent markers. If it is possible to create ammunition that contains luminescent powders and not significantly affect accuracy, this could greatly increase the potential for GSR analysis being conducted in a timely manner, as well as help limit false negative or false positive results from the SEM/EDS.

Gunshot Residue, Luminescent Markers, Accuracy