B196 The Determination of Gunshot Residue (GSR) Settling Velocity

Cassidy M. Schultheis, 1420 Centre Avenue, Apt 1413, Pittsburgh, PA 15219; Stephanie J. Wetzel, PhD, Department of Chemistry and Biochemistry, 600 Forbes Avenue, Pittsburgh, PA 15282; Stephanie Horner, MS, RJ Lee Group, 350 Hochberg Road, Monroeville, PA 15146; and Allison Laneve, MS, RJ Lee Group, 350 Hochberg Road, Monroeville, PA 15146*

After attending this presentation, attendees will have a preliminary understanding of the approximate rate at which GSR settles to the ground.

This presentation will impact the forensic science community by providing information regarding the potential GSR contamination of those entering the crime scene following the discharge. This information can be used for crime scene reconstruction and could help explain the presence of GSR on a bystander.

GSR is a type of trace evidence that can be used in any type of forensic case involving a discharged firearm. GSR consists of all particulates expelled from a firearm during discharge. This presentation focuses on primer GSR. During primer GSR analysis, the three main elements of interest are barium, lead, and antimony. Most GSR particles have smooth spherical morphologies and are micron sized. GSR is produced when the firing pin hits the cartridge, which activates the primer. The primer then ignites the gunpowder (propellant) that causes a pressure buildup. This pressure then pushes the bullet down the barrel at a high velocity and the particles are released as a vapor through various openings in the firearm. GSR primer residues are typically analyzed using Scanning Electron Microscopy/Energy Dispersive X-ray Spectroscopy (SEM/EDS). The instrumentation works by irradiating the sample with electrons. The interaction between the sample and the electrons can identify the morphology of the particle and X-rays are emitted to determine the particle's elemental composition.[1]

Previous research has been completed to determine how fast GSR particles settle after discharge. This research used both pistols and revolvers and collected the particles by stacking petri dishes on top of each other.[2] Specific petri dishes were removed at designated time intervals to develop an overall rate.[2] The results demonstrated that the settling velocity ranged between 1.5 to 8 minutes after discharge, depending on the firearm.[2] While this research can be very informative, the mechanism of collection is not advantageous. Contamination may easily occur when entering or leaving the closed room to remove the petri dishes. Also, the stacked petri dishes do not provide a large range in heights that can be used to determine an overall rate because they were only a few inches apart. This research used a more advantageous collection method in determining the GSR settling velocity. The collection method was unique when compared to previous research; GSR samples were collected onto 0.4-micron polycarbonate membrane filters that were held above the ground by metal stands to provide greater height differences. The filters located inside the shooting room were connected to air pumps that were located outside the shooting room; the ability to control all the filters from outside the room limits particle contamination. The filters were placed at various heights above the ground. Once the firearm was discharged, the filters were turned on at different time intervals to determine the settling velocity. The filters were transferred onto SEM stubs and analyzed using the Aspect 75 Scanning Electron Microscope and Zeppelin Energy Dispersive X-ray Spectroscopy Software with a RJ Lee Group Detector. The preliminary data has shown that the particles fall at considerably lower rates than expected. The results revealed that a substantial amount of particles were still in the air after three hours.

Reference(s):

1. The Scientific Working Group on Gunshot Residue (SWGGSR). 2011. Guide for Primer Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-Ray Spectrometry. 11-29-11. 1-100.

2. Fojtášek, Lubor, and Tomáš Kmječ. 2005. Time periods of GSR particles deposition after discharge-final results. *Forensic Science International.* 153 (2–3):132-135. doi: http://dx.doi.org/10.1016/j.forsciint.2004.09.127.

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*Presenting Author