B192 A 12-Year Study of Brake Dust From 123 Vehicles for Particles Similar to Gunshot Residue

Mary Keehan, MS, Virginia Department of Forensic Science, 700 N 5th Street, Richmond, VA 23219; and Douglas DeGaetano, MS, Commonwealth of VA, Dept of Forensic Science, 700 N 5th Street, Richmond, VA 23219*

After attending this presentation, attendees will better understand the nature and composition of brake dust and its significance for Gunshot Residue (GSR) examinations. Attendees will also learn methods for discriminating brake dust from particles of GSR.

This presentation will impact the forensic science community by documenting clear differences between brake dust samples collected in Virginia over a 12-year period and previous reports of brake dust collected in Europe that contained particles of lead (Pb), barium (Ba), and antimony (Sb). The results suggest that the chance of misidentifying brake dust as GSR can be considered remote.

It has been previously reported that brake dust can contain particles similar in composition to particles characteristic of GSR.[1-3] This is a concern for examiners who may receive samples from people with a profession or hobby that puts them in frequent contact with brake dust. The American Society for Testing and Materials (ASTM) E1588-17 includes as characteristic of GSR: particles with a spherical or molten appearance that contain the elements Pb, Ba, and Sb.[4] This study sought to look at samples of brake dust from vehicles in Virginia to determine if particles with compositions considered characteristic of GSR could be found. An effort was made to include vehicles of the same makes and models previously reported in Europe to produce particles containing Pb, Ba, and Sb, namely: Audi®, Volkswagen®, and Land Rover®.[1,3]

Samples were collected and analyzed over a 12-year period using half-inch-diameter aluminum stubs covered with double-sided carbon tape. Sampling was performed by repeated dabbing of the stub on the brake disc and wheel of the vehicle. Information about the vehicle make and model was recorded and the Vehicle Identification Numbers (VINs) were used to determine the year of the car where possible. Samples were then analyzed using a Scanning Electron Microscope with Energy-Dispersive X-ray Spectrometer (SEM/EDS) including automated GSR software detection capability. An analysis was used that mimicked the analysis used for the identification of GSR in casework samples. From this analysis, particles were either accepted or rejected as being characteristic of, or consistent with, GSR as outlined by the most current ASTM 1588 document and laboratory protocols in use at the time of analysis.

Many particles were placed in classifications during the automated analysis that might be of interest as possible GSR; however, after manual review, none of the particles met the criteria to be considered characteristic of, or consistent with, GSR. The most common reason for exclusion was the presence of high sulfur and the absence of lead in particles that were classified as containing lead. Other reasons for exclusion included high levels of sulfur and iron in particles containing barium and antimony, the presence of disallowable elements, and morphology that was not spherical or molten. The samples were also examined for particles containing barium and aluminum (a type of particle consistent with GSR). Where aluminum was found in association with barium, it was typically at low levels in conjunction with high levels of sulfur. These particles were usually irregular in shape and were not classified as particles consistent with GSR.

After the analysis of samples from 123 vehicles and more than 300,000 particles, no particles were found that could be considered characteristic of, or consistent with, GSR. The exclusion of particles from being classified as characteristic was not only by morphology, as had been previously reported in some European studies, but also because of an absence of lead.[1,3] These results, in addition to a recent study from Australia, primarily on brake pads, suggest that the chance of misidentifying brake dust as GSR can be considered remote.[5]

Reference(s):

1. Bruno Cardinetti, Claudio Ciampini, Carlo D'Onofrio, Giovanni Orlando, Luciano Gravina, Francesco Ferrari, Donatello Di Tullio, Luca Torresi. X-ray mapping technique: a preliminary study in discriminating gunshot residue particles from aggregates of environmental occupational origin. *Forensic Science International.* 143 (2004) 1-19.
2. L. Garofano, M. Capra, F. Ferrari, G.P. Bizzaro, D. Di Tullio, M. Dell'Olio, A. Ghitti. Gunshot residue: Further studies on particles of environmental and occupational origin. *Forensic Science International.* 103 (1999) 1-21.
3. Carlo Torre, Grazia Mattutino, Valentina Vasino M.D., Carlo Robino M.D. Brake linings: a source of non-GSR particles containing lead, barium, and antimony. *Journal of Forensic Sciences.* 47(3) (2002) 494-504.
4. Standard practice for gunshot residue analysis by scanning electron microscopy/energy dispersice x-ray spectrometry. *ASTM International.* ASTM E1588-17 (2017) www.astm.org.
5. William Tucker, Nick Lucas, Kelsey E. Seyfang, K. Paul Kirkbride, Rachel S. Popelka-Filcoff. Gunshot residue and brakepads: compositional and morphological considerations for forensic casework. *Forensic Science International.* 270 (2017) 76-82.

Gunshot Residue, Brake Dust, Primer Residue

*Presenting Author