

A PRELIMINARY SEM/EDS STUDY OF GSR-LIKE PARTICLES FROM BRAKE LINING PADS IN BRAZIL. Andrea Martiny(1), Ladário da Silva(2), Andréa Porto-Carreiro Campos(3), André Luiz Pinto(4) (1) Fundação Oswaldo Cruz, Salvador, BA; (2) Escola Naval - Marinha do Brasil, Rio de Janeiro, RJ; (3) Instituto de Criminalística Carlos Éboli, Rio de Janeiro, RJ; (4) Instituto Militar de Engenharia, Rio de Janeiro, RJ; E-mail: deiamartiny@gmail.com

The detection and identification of gunshot residues (GSR) on suspect's body and/or objects have always represented an important information in crime investigation. GSR is composed of burnt and unburnt particles from the propulsive charge, primer, bullet, cartridge case and the firearm, but the elemental composition is strongly connected to the primer, usually composed from lead styphnate (initiator), barium nitrate (oxidizer) and antimony sulphide (fuel). The particular conditions of high temperature and pressure during the firearm discharge contribute to rapid condensation of these elements in a distinct morphological shape, which are deposited on the hands, face, clothes and near objects as an aerosol. Understanding the origin and formation of GSR is essential to distinguish them from occupational/environmental particles. Residues derived from the handling of motors, batteries, paints, hardware, furniture finishing, petrol derivatives, specific industrial tools, fireworks, automobile industry and many other activities can be similar in composition to GSR leading to misinterpretation of evidence. Friction material used in the production of car brake linings may contain lead and antimony sulphide and barium sulphate in different combinations. During braking, friction causes the temperature at the metallic disk surface to exceed 600 °C, sometimes reaching 1,200 °C (Rosendo Paixão, Ford Nordeste, personal communication). Combination of heat and mechanical action wears the lining pad and pulverizes the blend components, releasing microscopic residues with similar composition to GSR. Previous studies have shown that both unique and indicative elements can be found in samples from automobile brake pads [1, 2], nevertheless none of these studies focused on the manufacturers/brands of brake pads but in the car models. We decided to test the presence of GSR unique and characteristic elements in brake lining pads commercially available and produced in Brazil aiming at the creation of a databank, which would be available for the Crime laboratories. Used brake lining pads were collected from brake repair auto offices in Rio de Janeiro, Campos dos Goitacazes and Salvador and were individually stored in plastic zipper bags. Double face carbon tape-coated aluminum stubs in storage tubes for pin mounts were used to collect the blackish dust residues derived from wearing. Brake pads were then washed, identified and fragments of the friction material were prepared for metallographic analysis. Samples were analyzed in a SEM Jeol JSM-6460LV equipped BSE detector and a Thermo dispersive X-ray analyzer (EDS). A working distance of 10mm, an accelerating voltage of 25 keV and manual search were used in all analysis. Some samples were also analyzed in a Zeiss DSM940A equipped with an IXRF Systems EDS and the Particle Analysis V. 1.2 software. We analyzed 9 brake lining samples: Fras-Le PD/25 (1), PD/42 (1) and PD/985-V (1), Cobreq CO-733 (2) and N-534 (1), ATE 20.5100 8076 (1) and 20.5100 7787 (1) and Tecpads F0 (1). Using manual search the main GSR-like elements detected were Ba and Pb. Sb was detected only in Cobreq CO-733 samples. Fe was always present as well as Mg; Cu and Zn were sometimes present. Automated search resulted in a high number of particles analyzed containing GSR unique elements (PbBaSb). The results show that wearing of friction material used in brake lining pads available in Brazil may produce particles similar in composition to GSR. These particles are however morphological heterogeneous but even primer discharge residues are not always spherical so this may not be considered a parameter for discriminating occupational residues from true GSR. Brake pad-derived particles are typically larger than GSR, but different ammunition can also result in different size particles. Nevertheless, occupational particles in most cases present other elements such as Fe, Zn, Cu, Mg and even Sr.

REFERENCES

- [1] B. Cardinetti, C. Ciamprini, C. D'Onofrio, G. Orlando, L. Gravina, F. Ferrari, D. Di Tullio and L. Torresi. Forensic Science International 143 (2004) 1-19.
- [2] L. Garofano, M. Capra, F. Ferrari, G. P. Bizzaro, D. Di Tullio, M. Dell'Olio and A. Ghitti. Forensic Science International 103 (1999) 1-21.

Table 1: GSR elements found in Brazilian Brake lining pads

Brand	Pad model	Unique	Indicative	Search
Fras-Le	PD/25			Manual
	(= PD/25-A, PD/25-B) (1)	1	27	
	PD/42 (1)	1	8	Manual
Cobreq	PD/958-V (1)	0	20	Manual
	CO-733 (2)	9	23	Manual
	N-534 (1)	0	15	Manual
ATE Freios	20.5100 8076 (1)	0	11	Manual
	20.5100 7787.3 (1)	0	11	Manual
Tecpads	F0 (1)	162	59	Auto

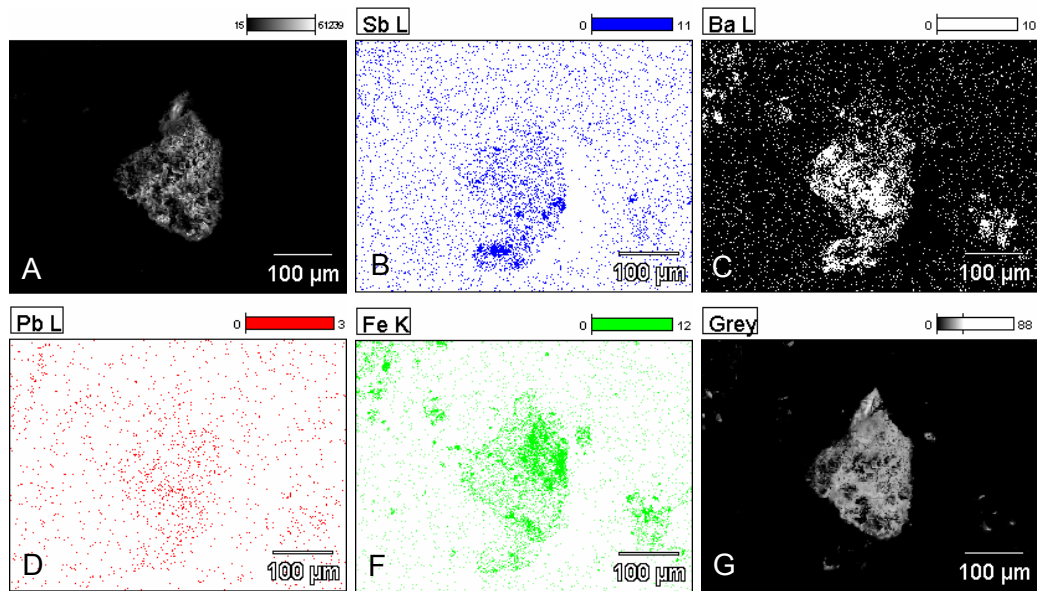


Fig. 1A-G: BSE image (A) and elemental mapping (B-G) of a particle found in the blackish dust from Fras-Le PD/42 brake lining pad. Antimony (B), barium (C), lead (D) and iron (F).

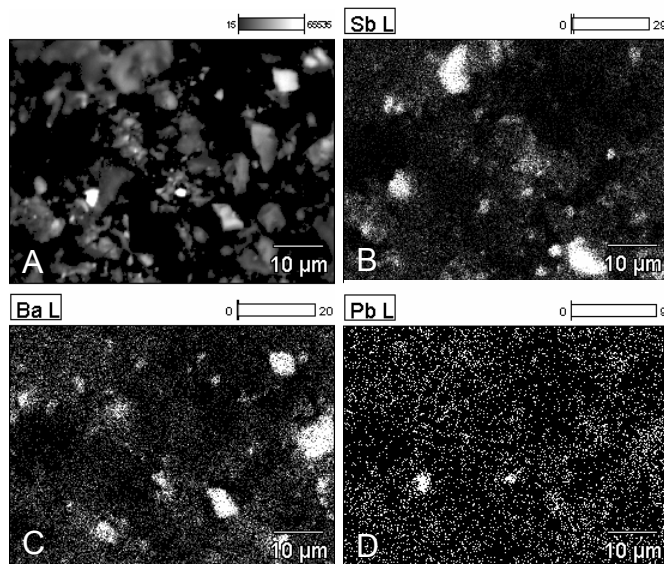


Fig. 2A-D: BSE image (A) and elemental mapping (B-D) of blackish dust from Cobreq CO-733 brake lining pad. Antimony (B), barium (C) and lead (D).