EVALUATION OF PARAMETERS INFLUENCING GSR'S RETENTION ON SHOOTER'S HANDS

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ABSTRACT: Many articles were published in the literature dealing with the persistence of gunshot residue on shooter's hands. This work studies different physical parameters characterising GSR particles such as shape, dimensions and nature, in order to determine each factor's influence on the retention of GSR on shooter's hands. The present study uses the results obtained by shooting with the same weapon (a SIG Sauer semi-automatic pistol, model P220, caliber 9 mm Parabellum) and three different types of ammunition (Geco Sinoxid, Geco Sintox and Winchester Super-X). The GSR were collected from the shooter's hands with gold coated polycarbonate membrane filters; these filters were then examined using a SEM coupled with an energy dispersive X-ray spectrometer.

Interpretation of results allows the extraction of predictive findings and/or exclude alleged circumstances.

KEY WORDS: Transfer; Persistence; GSR; Data interpretation.

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INTRODUCTION

Weapon used is a Sig Sauer, model P220, calibre 9 mm Luger semi-automatic pistol. Experimental conditions are: 1 shooter, 3 types of ammunitions (see Table I), 4 retention's time (0, 2, 4 and 6 hours); the whole experiment was repeated to produce two sets of data. The tester was instructed to continue his normal daily office activity.

TABLE I. AMMUNITIONS USED IN THE STUDY

Brand	Bullet	Cartridge case
GECO Sintox®	123 grains (8.0 g) Totally metal jacketed (brass)	Brass
GECO Sinoxid®	124 grains (8.0 g) Full metal jacketed (brass)	Brass
Winchester Super-X Primer Pb-Ba-Sb	115 grains (7.5 g) Hollow Point Silvertip® (electroplated brass)	Brass

The particles collected were characterised with a fully automated scanning electron microscope, in backscattered electron (BSE) mode, with an automated stage and an energy dispersive X-ray spectrometer (EDX).

Samples were taken from the right hand back, right hand palm, left hand back, and left hand palm. About 2500 particles were detected and catalogued on the basis of their elemental analysis and shape. Particles were classified into 4 different categories according to their shapes (spherical regular, spherical irregular, nodular and others).

PRELIMINARY

Jalanti et al. [1] have already highlighted the following results:

- a poor reproducibility was observed between the two sets of data;
- most of GSR's particles were lost within 2 to 4 hours after the shot;
- the retention does not depend on the chemical nature of the particle;
- after 2, 4 and 6 hours, the ratio between the number of GSR found on the shooting hand and the other one is not forseeable;
- the memory effect was observed [2]; particles of Pb, Ba and Sb were found with the GECO Sintox® ammunition.

HYPOTHESIS

1. The number of particles is decreasing with time;
2. the retention of GSR particles is influenced by their size;
3. the retention is influenced by the shape of the particles;
4. the retention is influenced by the chemical nature of the particles;
5. the shape is correlated with the chemical nature of the particle;
6. the size is influenced by the presence of different elements;
7. the presence of additional elements influences the retention.

GUNSHOT RESIDUES (GSR)

GSR includes powder, primer and metals occurring upon discharging a firearm [3]. Particles such as Pb, Ba and Sb are coming most of the time from the primer.

In order to give any conclusions, research with SEM/EDX must be focused on particles such as Pb, Ba and Sb and a combination of these particles [1].

TABLE II. CLASSIFICATION OF GSR PARTICLES

Unique	Characteristic	Others
PbBaSb	**PbBa**	Ba
PbBaSbSn	PbBaS	BaS
BaSb	PbBaSn	BaSn
BaSbS	PbBaSnS	BaSnS
BaSbSn	PbSb	Pb*
BaSbSnS	PbSbSn	
	Sb	
	SbS	
	SbSn	
	SbSnS	

* Pb pure or in combination with elements other than Ba or Sb (Pb rich).

A distinction between "unique" and "characteristic" particles should be done, because only these particles are flagged as potential GSR. Wolten and Nesbitt [4] and Zeichner and Levin [5] have proposed other combinations of these particles. In this study, only the combinations in bold-faced type are considered (see Table II).

DATABASE

On the basis of the results obtained in this experiment, a database FM Pro V. 4.1 was developed. In this database, all the particles collected were registered, using different fields such as their size, their shape, their chemical nature and so on. The print screens below illustrate some details of the database.

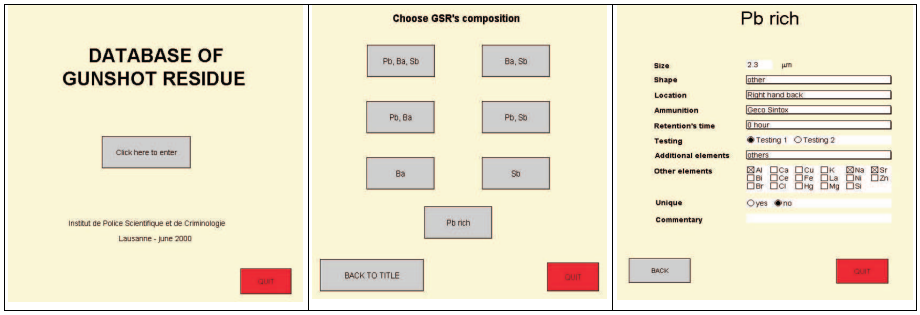
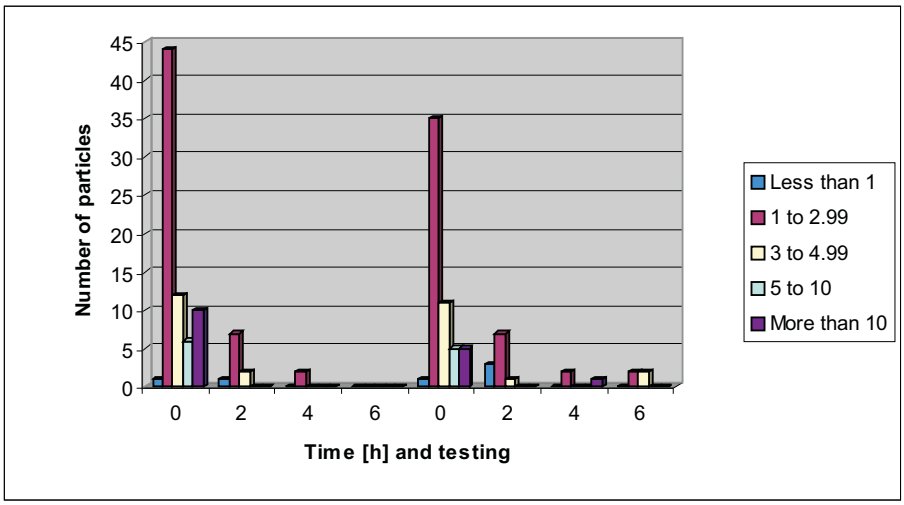


Fig. 1. Database of gunshot residue.

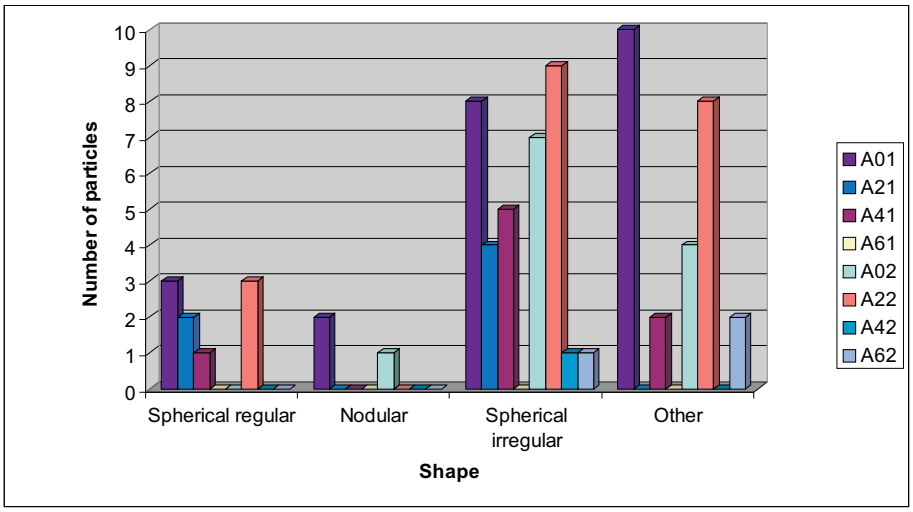
RESULTS

Hypothesis 1: The number of particles is decreasing with time.

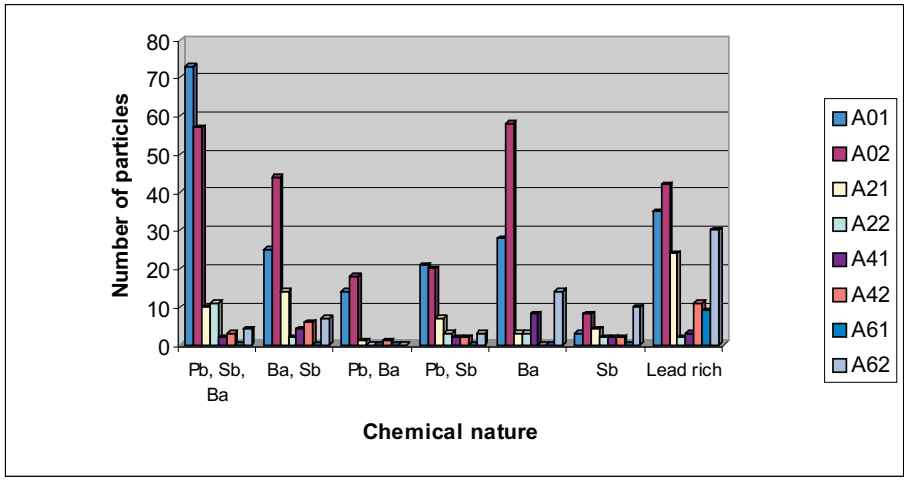
Hypothesis 2: The retention of GSR particles is influenced by their size.



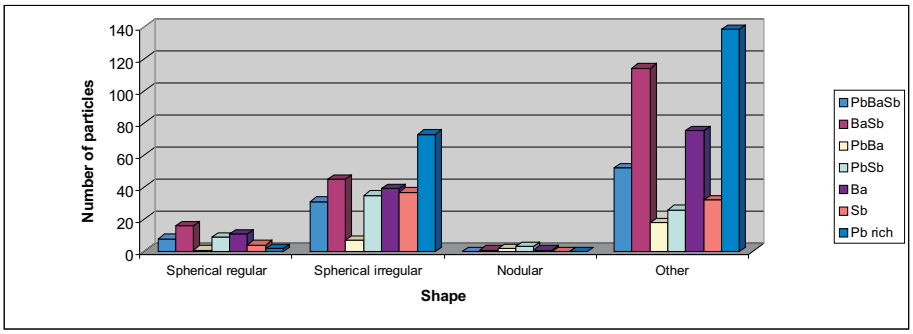
Hypothesis 3: The retention is influenced by the shape of the particles.



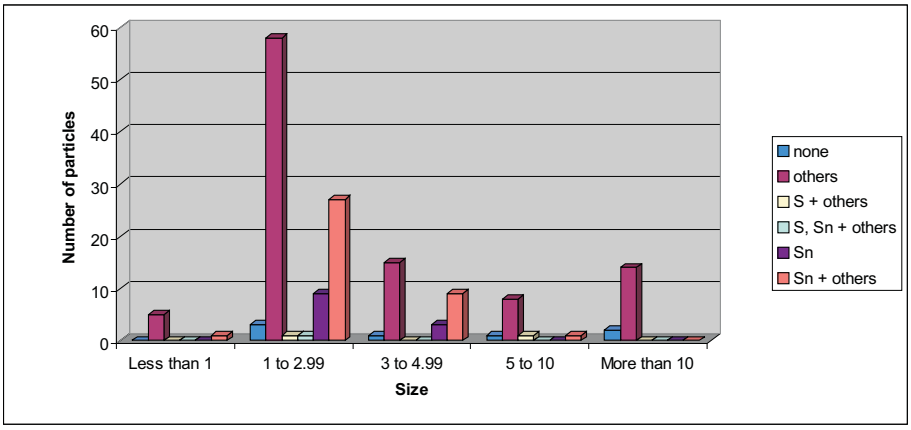
Hypothesis 4: The retention is influenced by the chemical nature of the particles.



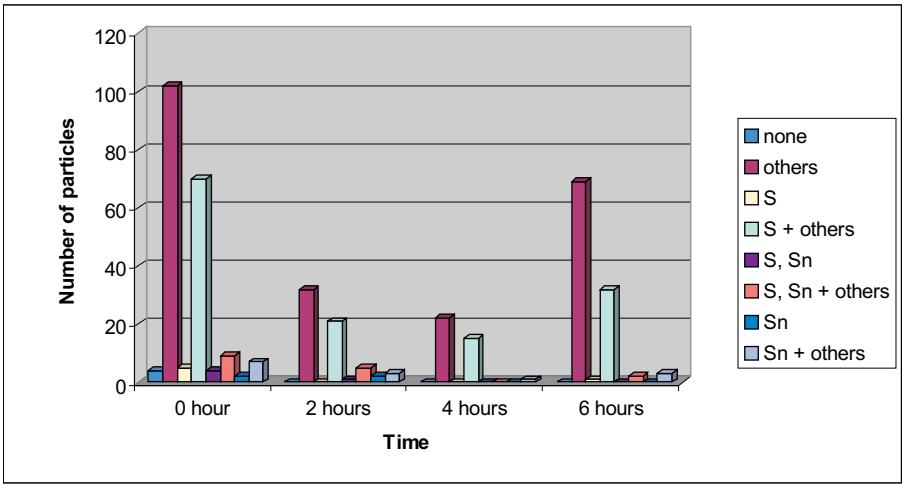
Hypothesis 5: The shape is correlated with the chemical nature of the particle.



Hypothesis 6: The size is influenced by the presence of different elements.



Hypothesis 7: The presence of additional elements influences the retention.



CONCLUSIONS

This study highlighted the following guidelines:

– the amount of residues on hands or other skin surfaces varies with the type of weapon and ammunitions used [3];

– we got some problems of evaluation with the shape, the chemical nature and the classification of the particles; in this way, it was sometimes difficult to see what was a tendency and what was not!
– we have observed an exponential loss of GSR with time, independent of factors such as the size, the shape and the chemical nature;
– no preferential retention of GSR according to the size, the shape and the chemical nature was observed.

THE FUTURE...

This study brings some tendencies, but some work has still to be done in the following ways:

– others types of tester, firearms, ammunitions should be experimented;
– the influence of others elements (such as Al, Cu and so on) on GSR retention should be determined;
– include statistics in;
– put in relation more than two parameters at the time.

References:

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