

2024

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# Visualization of Gun Shot Residue (GSR) distribution on dark garments using the Video Spectral Comparator (VSC) and using the Modified-Griess (MG) test

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## INTRODUCTION

- **Gunshot Residues (GSR)** are expelled from the openings of a firearm during a discharge of a firearm. Identification of GSR plays an important role in firearms related crimes.
- Some GSR particles can be visible to the naked eye or with a slight magnification if the background provides the necessary contrast, but **due to the lack of contrast, visualization of GSR is difficult on dark garments.**



Figure 1: Expelling of GSR during a fire of a revolver

- **The Modified-Griess test** is a colour development test which is commonly used to detect the GSR and can be used for the dark garments. This detects the Nitrites which is a by-product of the combustion of the Nitrocellulose (NC). NC is a main component in the gun powder.
- **Partially burnt and unburnt gunpowder** possess **Infra Red (IR) luminescent properties**. This property can be used to visualize GSR deposited on dark coloured garments.
- **The Video Spectral Comparator (VSC)** is an imaging device which is commonly used to examine altered and counterfeit documents. VSC has an IR light source which can be used to detect GSR.

## OBJECTIVES

- The study was conducted to determine the possibility of using the VSC (with the IR source), to visualize the GSR on dark garments. The results were compared with the results of the Modified-Griess test which is a well established method of detecting GSR.
- Meanwhile two main factors effecting the GSR distribution were also evaluated in this study. They were,
  - The effect of the firearm type
  - The effect of the distance

## METHODOLOGY

- One cartridge each from both types of cartridges (0.38 special, 9x19 mm) were disassembled and the unburnt propellant was observed using the VSC to study their original **optical properties**.
- **The effect of the firearm on the GSR distribution** was studied by carrying out test firing on black colored targets with four different handguns at the distance of 10 cm.



Figure 2: Firearms used: (A) Arminius Long barreled revolver (0.38 Special), (B) Arminius short barreled revolver (0.38 Special), (C) CZ Pistol (9x19 mm), (D) NP 22 pistol (9x19 mm).

- **The effect of the distance on the GSR distribution** was studied by carrying out test firing on black colored targets with two handguns at five distances (10 cm, 20 cm, 40 cm, 80 cm and 120 cm).
- The shot targets were,
  - First Examined using the VSC under the IR radiation
  - Then, the Modified- Griess test was performed

## RESULTS

### Optical properties of Propellants

Table 01: Images of the unburnt propellants, observed using the VSC under visible and IR radiation

Cartridge	VSC images under visible radiation	VSC images under IR radiation
0.38 Special		
9 X 19 mm		

Unburnt particles of 0.38 Special Cartridges- IR Active  
Unburnt particles of 9 X 19 mm Cartridges- IR Inactive

## RESULTS (Cont...)

### The effect of the Firearm on the GSR distribution

Table 02: VSC images and results of the Modified-Griess test of GSR distribution of the 10 cm distance shot

Firearm	GSR distribution from the VSC under	
	IR radiation	Griess Test
Arminius Long barreled revolver		
Arminius short barreled revolver		
CZ Pistol		
NP 22 Pistol		

### Comparison of VSC Vs MG test methods

- GSR distributions obtained from both methods were similar
- **Comparison of GSR distribution of Revolvers Vs Pistols**
- GSR Distribution of revolvers- More concentric, more denser than pistols
- GSR Distribution of pistols- More homogenous, less denser than revolvers
- Therefore, it is possible to differentiate the GSR distribution of a revolver and a pistol at a short distance shooting. (More studies on this is required)

### Changes of the optical property of propellants while shooting

- Of 9 x 19 mm cartridges,  
Unburnt propellant- IR inactive, Partially burnt particles- IR active

## RESULTS (Cont...)

### The effect of the Distance on GSR distribution

Table 03: VSC images and results of the Modified-Griess test of GSR distribution of the shots at 10 cm, 20 cm and 40 cm distances

Distance / cm	Arminius Long barreled revolver (0.38 Special)		CZ Pistol (9x19mm)	
	GSR distribution from the VSC under IR radiation	GSR distribution from the Modified-Griess Test	GSR distribution from the VSC under IR radiation	GSR distribution from the Modified-Griess Test
10				
20				
40				

- Density of the GSR distribution reduces and the area of distribution increases with the distance
- GSR can be identified using the VSC using the IR source  
Revolvers- up to 80 cm      Pistols- up to 40 cm

## CONCLUSION

GSR distribution results obtained from the VSC( with the IR source) are similar to those of the Modified Griess test. Therefore, images taken using the VSC( with the IR radiation) can be used to identify and visualize the GSR distribution on dark garments.

A combination of both techniques would suit more for the identification as they determine two properties of GSR.

## ACKNOWLEDGEMENT

- Mr. P.G. Madawala, Deputy Government Analyst, Mr. W.M.A.Kumara, Senior Assistant Government Analyst. Staff of the Firearms and Ballistics Laboratory and the Forensic Questioned Document Examination Laboratory of the Government Analyst's Department