GUN SHOT RESIDUE

Entry & Exit Wound?

- GSR - Minute particles of un-burnt or partially burned powder and propellant which expelled out of muzzle or breach area, when the gun is fired.
- Also known as -
  CDR - Cartridge Discharge Residue
  GFR - Gunfire Residue
  FDR - Firearm Discharge residue
- These particles have diameter varying from 1 - 10 microns. About 70% particles are spherical and others are irregular.
- 65% of the particles have dia. of 3 micron.
- Where we can find - on hand, hair, face, clothing, entrance wound, etc. web area, on wall & furniture.

- GSR analysis will be helpful in solving various problems:
  1. Has the given firearm been fired or not?
  2. Has the given ammunition been fired or not?
  3. What type of ammunition is used in firing?
  4. Who fired the gun?
  5. Is it a case of homicide or suicide?
  6. Is the present wound a firearm injury?
  7. What was the range of firing?

6. Is it an entry or exit wound?

1. Chamber marks is a conclusive mark.
2. Deposition of GSR.

- Tattoing - deposition of unburnt & partially burnt propellant.

Components of GSR

1. Formulation of primer
2. Formulation of propellants
3. Barrel scrapings
4. Composition of projectile

Detectable inorganic components of GSR

1. Lead
2. Barium
3. Antimony
4. Iron from barrel of firearm
5. Nitrates and Nitrites
6. Copper, Nickel, Zinc from bullet jacket
7. Mercury

Detectable organic components of GSR

1. Nitro cellulose: unburnt or semi-burnt
2. Nitroglycerine
3. Diphenylamine (Stabilizer)
4. Di-nitro-toluene (Plasticizer)
5. Bullet lubricant materials

Detection of GSR

1. Residues should initially be observed and evaluated by naked eyes or low power stereomicroscope.
2. X-ray photography
3. UV imaging or IR imaging for detection of heavy soot on dark or bloody clothes and also on multicoloured surfaces.
4. Chemical methods

Collection of Gun Shot Residue

1. Inorganic
   - Wet method
   - Dry method
2. Organic
   - Swabbing
   - Vaccum lifting
   - Tape lifting

Dry Method for collection of Inorganic residues

- WAX METHOD - Molten wax of suitable melting point is gently brushed over the hand, till it acquires significance thickness (1 to 2mm) when dried, the wax is peeled off for analysis of GSR particles.
- CELLULOSE ACETATE METHOD - A solution of cellulose acetate is placed on hands and is peeled off once dried up.
- CELLOPHANE SHEET - Cellophane sheet impregnated with acetic acid, is pressed against the site for collection of GSR particles.

d. REINFORCED FILM - The site bearing the powder marks is sprayed with collodian solution. The film is reinforced with nylon fibers. The reinforced film bearing GSR particles is peeled off after drying for further analysis.

e. TAPE LIFTING - The site bearing GSR is pressed with an inert adhesive tape or adhesive aluminium foil to pick the particles. The tape is then preserved safely in a vial.

WET METHOD — (INORGANIC)

a. USING FILTER PAPER - a filter paper moistened with dilute acetic acid if pressed against the suspected site to lift GSR particles.

b. SWABBING - a cotton cloth of cotton swab moistened with 10% HCl or 5% HNO_3 is swabbed against the suspected site to lift GSR particles.

c. DISTILLED WATER - the residues in the barrel are collected by washing it with hot distilled water. The water thus collected is sent for further testing for residual components of GSR.

COLLECTION OF ORGANIC RESIDUES

a) <u>Swabbing</u> - cotton cloth or wool or filter paper moistened with organic solvents like acetone, ether or alcohol, is pressed against the site. The residues are then extracted from these swabs.

b. Tape lifting - particles are lifted from site using inert tape of suitable width (2 - 3 cms).

c. Vacuum lifting - specially used for collection of GSR from clothes. The material deposited on filter disc is extracted using appropriate solvent and then subjected to further analysis

Chemical test for GSR

GRIESS TEST
Sample + ether < ½ - 2 div.
Caustic soda, - 1 div and Griess Reagent - pink.
2nd div - only griess - colourless

① Griess test
- Also known as N-(1-Napthyl) ethylenediamene test.
- Used to detect the presence of nitrates and nitrites
- Modified griess reagent showed detection limit of 0.1 microgram.

② Sodium Rhodizonate test
Brown aqueous sol. of sodium rhodizonate ($C_6Na_2O_6$) produces violet coloured precipitates of Pb - Rhodizonate from neutral or slightly acidic lead sol.

③ Rubinic acid (dithio - oxamide) test
- Used for detection of copper
- The yellow alcoholic sol. of Rubinic acid gives green Black ppt of Cu - rubinate.

(4) Ammonium thiocynate and O- Toludine test -
It is used for detection of copper. The sol. of 0.1 g O- toludine and 0.5 g ammonium thiocynate in 5 ml acetone is prepared. A drop of reagent and test sol. are mixed on filter paper to give blue stain if copper is present.

(5) Barrel Wash - Detects GSR. sulphanilic
Sol 1 - 1 g of sulphathalic acid + 17 ml of distilled water + 30 ml of glacial acetic acid.
Sol 2 - 30 g of alpha napthalayl amine boiled at 70 ml of distilled water then cooled. 30 ml glacial acetic acid added into it.

WORKING reagent - 50 parts of sol. 1 and 50 parts of sol. 2 is taken in a tube and passed through the barrel.

Observation - If pink colour appears it indicates presence of nitrites.

(6) WALKER'S TEST - Nitrite sensitive paper is created by coating the paper with sulphanic acid and α - napthathylamine. This nitrite sensitive paper is pressed against bullet entry hole on clothes the combination is heated about 5 min. Orange spots reveal the presence of nitrite particles.

⊕ Harrison and Gidroy's test - Cotton swab dipped in 0.1 N HCl is pressed on the hand of the shooter.

↓

2-3 drops of 2-10% of triphenylmethyl arsonium iodide sol. is added to a cotton. Presence of orange coloured ring indicates presence of antimony.

↓

After drying for 2-3 min, add 5% freshly prepared sodium rhodizonate sol.. Red colour indicates presence of lead or barium.

↓

Confirmatory - Add 1:20 HCl. If red colour changes to blue lead is present if the blue colour is persisted then barium is also prent

ELEMENTAL ANALYSIS :-

① SEM EDX (Scanning Electron Microscopy with electron ~~diffraction~~ dispersive x-ray)

② Atomic Absorption Spectroscopy (AAS)

③ ICPMS

④ Neutron - actuation analysis

ORGANIC RESIDUES

① HPLC

② HPLC - MS

③ Capillary Electrophoresis