Gun Shot Residue Pattern Enhancement on Fabric: An Alternative Chemical Method Utilizing Sodium Hypochlorite[1]

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After attending this presentation, the participant will understand: (1) the application of a sodium hypochlorite solution as an agent for enhancing gun shot residue (GSR) powder patterns, (2) the results of spraying a 5.25 % solution of sodium hypochlorite on different types and colors of fabric, and (3) the advantages and disadvantages of using a sodium hypochlorite solution to enhance powder patterns. The purpose of this presentation is to present the results of an experiment that evaluates the use of a sodium hypochlorite solution for enhancement of GSR powder patterns at specific distances on fabric targets. The estimation of distance from the weapon's muzzle to an article of clothing can be an important factor in an investigation or it can be used to reconstruct the events surrounding the shooting. The basis for estimating these distances is based on the size and intensity of the powder pattern produced by a weapon with known specifications using specific ammunition. The visualization of powder patterns on light colored fabric is obvious; however, the powder patterns on dark colored or multi-patterned fabric is problematic due the carbonaceous residue being dark in color.

Examining powder patterns is not a test that will establish a precise muzzle to target distance with a high degree of accuracy even when the specific type of weapon and ammunition is known, but the investigator can rule out certain ranges based on the GSR pattern characteristic. Di Maio has classified gunshot wounds on skin as contact, near contact, intermediate-range, and distant based on an examination of the wound and the GSR pattern. The GSR principally consist of nitrates and nitrites from burned and partially burned propellant, carbon, and traces of barium, lead and antimony from the use of lead styphnate, barium nitrate and antimony sulfide in the production of ammunition primers. Trace amounts of other elements may also be present in some ammunition. When a weapon is fired the exiting gases deposit certain amounts of these materials on a target depending on the distance, type of weapon, condition of the weapon and ammunition.

Typically, GSR patterns are enhanced on fabric with the modified Greiss test. This reagent test for the presence of nitrites and a positive reaction yields an orange color on specially treated photographic paper. The sodium rhodizonate test is a test that can be used to test for lead in the GSR. An alternate method for enhancing GSR patterns on dark or multi-colored clothing is with the application of a 5.25 % solution of sodium hypochlorite. Some dyes are affected more by sodium hypochlorite than others; therefore, bleaching may not enhance visualization of the patter in all fabrics. An area can be tested before the fabric is sprayed.

A model 686 .357 S&W revolver, with a four-inch barrel was used to produce GSR patterns by firing .38 caliber 3D ammunition with semi-wad cutter lead bullets into samples of dark and multi-colored fabric with a muzzle-to-target distance of 2.54 cm (1 in) for one group of seven samples and a muzzle-to-target distance of 7.62 cm (3 in) for a second group of seven samples.

A 5.25 % solution of sodium hypochlorite was sprayed onto fourteen samples of dark colored fabric to determine if bleaching the fabric would enhance visualization of GSR patterns. The solution was sprayed in a mist on each piece of fabric until saturated. In two to three minutes, the fabric colors began fading and losing color due to application of the sodium

hypochlorite solution. A significant amount of the color was removed with the first application, and there was an observable difference in the visualization of the GSR patterns after sodium hypochlorite was applied. After thirty minutes the fabric was sprayed with a second application. However, after the second application, there was minimal observable change in the visualization of the GSR pattern.

The seven types and colors of fabric tested included: black, purple, navy, and dark blue cloth with a small floral design woven with 100 % cotton; navy blue cloth woven with 65 % polyester and 35 % cotton; black with a white floral design fabric woven with 65 % polyester and 35 % rayon; and black fabric woven with 50 % polyester and 50 % rayon.

Samples in both the 2.54 cm (1 in) and 7.62 cm (3 in) groups yielded GSR patterns that were difficult to differentiate and measure on the untreated samples of fabric. However, after applying a 5.25 % solution of sodium hypochlorite to bleach the dye from the fabric, visualization of the GSR patterns were enhanced in 12 of the 14 samples. The two samples failing to yield improved visualization of the GSR patterns were the black fabric with white floral designs woven with 65 % polyester and 35 % rayon as well as the black fabric woven with 50% polyester and 50 % rayon at a distance of three inches.

The GSR maximum pattern diameters ranged from 6 cm (2.36 in) to 9 cm (3.54 in) for the group fired from 2.54 cm (1 in) with and average maximum diameter of 7.42 cm (2.92 in). The GSR maximum pattern diameters ranged from 8 cm (3.14 in) to 12 cm (4.72 in) for the group fired from 7.62 cm (3 in) with and average maximum diameter of 9.57 cm (3.76 in).

In conclusion, an advantage with the use of sodium hypochlorite for examining GSR patterns is the elimination or partial elimination of the dark colors or patterns on dark colored and multi colored clothing where the clothing colors or patterns obscure the GSR pattern. Also, after treatment, there is an increased contrast in GSR patterns that allows routine photography of the fabric. A sample of the 100 % cotton and cotton blend fabrics were tested for lead and antimony using flame atomic absorption spectrophotometer to determine the presence of lead and antimony after treatment with sodium hypochlorite. The lead content on the 100 % cotton was 1.5 mg/L (1.5 ppm). The 65 % polyester and 35 % cotton was 5.0 mg/L (5 ppm), the 65 % polyester and 35 % rayon was .08 mg/L (.08 ppm), and the 50 % polyester and 50 % rayon was 0.4 mg/L (0.4 ppm). The antimony content on the 100 % cotton was .98 mg/L (.98 ppm), the 65 % polyester and 35 % cotton was 2.5 mg/L (2.5 ppm), the 65 % polyester and 35 % rayon was 8.0 mg/L (8 ppm), and the 50 % polyester and 50 % rayon was 3.7 mg/L (3.7 ppm).

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