A novel fluorescent small particle reagent for detecting latent fingerprints on wet non-porous items

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Abstract A novel, fluorescent small particle reagent (SPR) based on zinc carbonate hydroxide monohydrate, ZnCO3·2Zn(OH)2·H2O – also called basic zinc carbonate – has been formulated. The other ingredients of the formulation are crystal violet dye and a commercial liquid detergent. The composition develops clear, sharp and detailed fingerprints on a large number of non-porous items, after these were immersed in water for up to 36 h. The fluorescent nature of the reagent helps enhance weak, fragmented and chance fingerprints that are often found at crime scenes. The raw materials used to prepare the SPR are cost-effective and non-hazardous. The novel formulation develops prints of a better quality as compared to the conventional, molybdenum(IV) sulfide-based composition.

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1. Introduction

Small particle reagent is the commonly used technique for developing latent fingerprints on moist, non-porous surfaces.1 The base material in conventional SPR formulation is molybdenum(IV) sulfide. Its particles tag the sebaceous components of sweat deposition, imparting it a gray coloration. Molybdenum(IV) sulfide is an insoluble salt that is listed as harmful and a skin irritant.2 Moreover, this composition is not fluorescent in nature. We report in the present communication a fluorescent SPR version, which uses basic zinc carbonate, in concert with crystal violet stain and a commercial liquid surfactant. Not only is this formulation non-hazardous as compared to the conventional one, but it is cost-effective as well. This follows our interest in the investigation of SPR-based compositions for fingerprint development.3

2. Materials and methods

Basic zinc carbonate was purchased from Glaxo Laboratories, while crystal violet was procured from Sigma–Aldrich. General liquid detergent was used as the surfactant.

To a suspension of 5.0 g of basic zinc carbonate in 75 ml distilled water, 0.01 g crystal violet stain and 0.3 ml commercial liquid detergent were added. The contents were thoroughly mixed. The suspension was sprayed on the surface bearing latent impression. This surface was earlier immersed in water from...
zero to 36 h. After waiting for one minute, the item was washed under a gentle stream of water for 30 s and then dried with a hair dryer for 40 s. Clear and sharp fingerprints were developed. The developed fingerprints were illuminated with radiation having 505–550 nm wavelength. When observed through red goggles, the fingerprints showed fluorescence.

Fingerprints were impinged with dry fingers, on dry surfaces.

Latent fingerprints were detected on the following non-porous items: Glass, plastics, laminates, ceramics, steel, aluminium foil and bakelite.

Depletion studies were carried out on polythene items. The test solution remained stable for 6 weeks.

3. Results and discussion

Small particle reagent technique has proved its worth in detecting fingerprints on moist, smooth surfaces. The unique feature of the present formulation was its fluorescent nature. The fluorescence arose because of the incorporation of crystal violet stain in the composition. The other ingredients of the present SPR were basic zinc carbonate and a commercial liquid detergent.

The reagent developed clear and sharp fingerprints on an array of non-porous items like glass, plastics, Polymers, metallic and ceramics. The color of the developed prints was violet and hence good contrast was obtained on light-colored surfaces. Moreover, when illuminated with the radiation of 505–550 nm, and observed with red goggles, the developed fingerprints emitted fluorescence. As a result, the quality of fingerprints enhanced in terms of clarity and details. Due to the fluorescent characteristics of the composition, it is possible to detect fingerprints on multi-colored items as well.

The composition had a shelf life of 6 weeks under ambient laboratory conditions. However, a slight reduction in the level of fluorescence emitted by developed fingerprints was observed after the advent of 4 weeks.

Representative fingerprints on moist glass and steel surfaces are depicted in Figs. 1 and 2 respectively.

Depletion studies to test the validity of the novel composition were carried out on polythene surface. Five fingerprints were impinged on the item in succession. Fig. 3 (A) and (B) show the result obtained for the first and fifth impressions, respectively.

Optimum quality prints were obtained up to the eighth impression.

The present innovation has a wide range of applications. Not only does it work on a broad spectrum of moist non-porous items, it detects latent fingerprints on dry surfaces as well. The method is simple and even an amateurish hand may operate it.

The raw materials used for preparing the present SPR are cost-effective and easily available. These pose no occupational hazard to the user. Crystal violet is used in inks. Zinc carbonate is an astringent and topical antiseptic. It does cause eye irritation. However, this type of problem is encountered when dry powder is being used. When suspended in a non-volatile liquid like water, it is highly improbable that it would injure the eyes. Moreover, since the user would be wearing red goggles to observe fluorescence, the chances of eye injury are all the more remote. In comparison, molybdenum(IV) sulfide, which is used in conventional SPR formulation, is much more hazardous.

A comparison between the quality of fingerprints developed by using the novel reagent and the conventional, molybdenum(IV) sulfide formulation was carried out on lamination sheets. One half of a latent impression was detected by novel composition and the other half by conventional reagent.

As shown in Fig. 4, the quality of prints developed with the novel reagent is better than those developed with the conventional one.
4. Conclusion

The small particle reagent composition involving basic zinc carbonate, crystal violet stain and a commercial liquid detergent offers a convenient, cost-effective and efficient methodology to detect latent fingerprints on a broad spectrum of moist non-porous surfaces, especially the multi-colored ones. Its non-toxic nature not withstanding, the composition has a relatively long shelf life of 6 weeks. Its ability to detect weak and faint fingerprints by virtue of its fluorescent characteristics not only enhances its utility, but also its potentiality in casework investigations.

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References


Figure 3  Depletion studies: Fingerprints developed on polythene for the (A) first and (B) fifth impression in succession.

Figure 4  A latent impression developed by (A) molybdenum(IV) sulfide formulation and (B) novel SPR formulation.