Julie B. Kempton,[1] *M.S. and Walter F. Rowe,*[1] *Ph.D.*

Contrast Enhancement of Cyanoacrylate-Developed Latent Fingerprints Using Biological Stains and Commercial Fabric Dyes

REFERENCE: Kempton, J. B. and Rowe, W. F., **"Contrast Enhancement of Cyanoacrylate-Developed Latent Fingerprints Using Biological Stains and Commercial Fabric Dyes,"** *Journal of Forensic Sciences*, JFSCA, Vol. 37, No. 1, Jan. 1992, pp. 99–105.

ABSTRACT: Cyanoacrylate-developed latent fingerprints may be difficult to see or photograph if they are on light-colored surfaces. Biological stains and Rit® fabric dyes were tested for their ability to stain cyanoacrylate-developed latent fingerprints. Methanolic solutions of gentian violet, safranin bluish stain, diamond fuchsin, methyl green, iodine green, and Janus green B were found to stain cyanoacrylate-developed fingerprints on polyethylene, porcelain, and aluminum beverage cans. Hot (60°C) aqueous solutions of seven different shades of Rit® fabric dyes were found to stain cyanoacrylate-developed latent fingerprints on polyethylene, porcelain, aluminum beverage cans, and Styrofoam cups. The latent fingerprints stained with safranin bluish stain were strongly fluorescent under 312 nm ultraviolet light; latent fingerprints stained with gentian violet and diamond fuchsin were weakly fluorescent.

KEYWORDS: forensic science, fingerprints, dyes, cyanoacrylate

A number of techniques have been developed for the visualization of latent fingerprints. Cyanoacrylate (Super Glue®) fuming to develop latent fingerprints [*1–13*] has recently been adopted by many laboratories. In this procedure, cyanoacrylate monomer is vaporized, either by heating or by reaction with cotton gauze pads impregnated with sodium hydroxide. The vaporized cyanoacrylate polymerizes on the latent prints, presumably reacting with the residual moisture in the fingerprint residue [*13*].

Cyanoacrylate fuming has proven to be very convenient for development of latent fingerprints simultaneously on a large number of items of evidence, as well as for the development of latent fingerprints on surfaces in rooms or automobiles. The major disadvantage of this technique is the poor contrast between the developed latent fingerprints and light-colored backgrounds. Because the cyanoacrylate-developed latent fingerprints are white, they are easily visible on dark-colored surfaces, but may be all but invisible on light-colored ones. The contrast of cyanoacrylate-developed latent fingerprints may be enhanced by dusting with black or fluorescent fingerprint powders [*5,8,13*], by staining with a fluorescent dye followed by laser excitation [*12*], or by staining with gentian violet [*10*].

Olsen [*14*] has noted that Rit® fabric dyes may be used satisfactorily in some cases to develop latent fingerprints on paper. We therefore decided to evaluate their effect following cyanoacrylate development of fingerprints.

Received for publication 15 March 1991; accepted for publication 14 May 1991.

[1]Graduate student and professor, respectively, Department of Forensic Sciences, The George Washington University, Washington, DC.

Materials and Methods

Latent fingerprints were placed on a variety of substrates: polyethylene dinner plates, Styrofoam cups, a porcelain bowl, textured Formica, latex paint chip samples, aluminum beverage cans, and sheets of paper. The latent fingerprints were developed with cyanoacrylate ester (Elmer's Wonder Bond) in a modified fish tank, using a 40 W light bulb as a heat source [*7,11*]. All surfaces were exposed to cyanoacrylate vapor for 40 min to ensure complete development of the latent fingerprints.

Solutions of the biological stains were prepared by dissolving 0.3 g of stain in distilled water or methanol. The following biological stains were tested for their ability to enhance the contrast of cyanoacrylate-developed latent fingerprints: gentian violet (Coleman and Bell Co.); methylene blue (Fisher Scientific Co); Nile blue A (Allied Chemical and Dye Corp.); aniline blue (Matheson, Coleman and Bell Co.); safranin bluish stain (methylene violet, water soluble) (Allied Chemical and Dye Corp.); acid fuchsin (Fisher Scientific Co.); diamond fuchsin (Chroma-Gesellschaft, Schmid and Company, Stuttgart-Untertürkheim); Congo red (Allied Chemical and Dye Corp.); methyl green (Allied Chemical and Dye Corp.); iodine green (Coleman and Bell Co.); Janus green B (Coleman and Bell Co.); hematoxylin; Sudan black B (Fisher Scientific Co.); and nigrosine (Coleman and Bell Co.). These stains were chosen because of their use in histology to stain lipids and other cellular components that would be expected to be present in fingerprint residue [*15,16*].

Solutions of Rit® fabric dyes (CPC International, Inc.) were prepared by dissolving 0.75 g of dye in 40 mL of distilled water. Six different Rit dyes were used: dark green, navy blue, purple, fuchsia, scarlet, dark brown, and black. The dye solutions were used at both room temperature and at 60°C. The dyes were applied to the cyanoacrylate-developed latent fingerprints by immersion, painting, and spraying.

Results and Discussion

Generally, the aqueous solutions of the biological stains did not adequately stain cyanoacrylate-developed latent fingerprints, the exception being aqueous gentian violet. On the other hand, cyanoacrylate-developed latent fingerprints on polyethylene, porcelain surfaces, and aluminum beverage containers were successfully stained by methanolic solutions of gentian violet, safranin bluish stain, diamond fuchsin, methyl green, iodine green, and Janus green B. These stains also stained cyanoacrylate-developed latent fingerprints on Styrofoam cups; however, because of the texture of these surfaces and the weak staining, the ridge detail of the fingerprints was difficult to discern. Figures 1 through 3 show cyanoacrylate-developed latent fingerprints on polyethylene dinner plates stained with gentian violet, diamond fuchsin, and Janus green B. The success in staining cyanoacrylate-developed latent fingerprints with methyl green and iodine green is not surprising because these two stains belong to these same arylmethane class of dye as gentian violet [*15,16*]. Janus green B is an azo dye that also contains an azin chromophore; it is closely related in chemical structure to the safranin dyes [*15,16*].

At room temperature, the solutions of Rit fabric dyes stained both fumed and unfumed latent fingerprints on the polyethylene dinner plates. The development of color was slow, with immersion for 5 to 10 min being required for adequate color development. On the other hand, when the 60°C dye solutions were used, the cyanoacrylate-developed latent fingerprints were highly stained after immersion for 5 to 10 s. Figures 4 through 7 show cyanoacrylate-developed latent fingerprints on polyethylene dinner plates stained with hot aqueous solutions of black, dark brown, dark green, and scarlet Rit fabric dyes, respectively. Unfumed latent fingerprints were generally destroyed by the hot dye solutions. The Rit dye solutions produced little or no staining of the polyethylene substrate.

FIG. 1—*Cyanoacrylate-developed latent fingerprint on polyethylene dinner plate stained with gentian violet.*

FIG. 2—*Cyanoacrylate-developed latent fingerprint on polyethylene dinner plate stained with diamond fuchsin.*

FIG. 3—*Cyanoacrylate-developed latent fingerprint on polyethylene dinner plate stained with Janus green B.*

FIG. 4—*Cyanoacrylate-developed latent fingerprint on polyethylene dinner plate stained with black Rit® fabric dye.*

FIG. 5—*Cyanoacrylate-developed latent fingerprint on polyethylene dinner plate stained with dark brown Rit fabric dye.*

Because of the success with staining cyanoacrylate-developed latent fingerprints on polyethylene dinner plates with hot aqueous solutions of Rit fabric dyes, all subsequent staining experiments with Rit fabric dyes used hot dye solutions. Cyanoacrylate-developed latent fingerprints on Styrofoam cups (Fig. 8), porcelain bowls (Fig. 9), and aluminum beverage cans (Fig. 10) were successfully stained with Rit fabric dyes. The methanolic gentian violet solution also stained cyanoacrylate-developed latent fingerprints on these surfaces; however, in the case of the Styrofoam cups the Styrofoam substrate was also heavily stained.

Rit fabric dyes are inexpensive and readily available. They come in 35 different shades, and the different shades can be blended to produce custom made colors. The compositions of Rit fabric dyes are proprietary; however, the material safety data sheets (MSDSs)[2]

[2]Available from Technical Services, CPC International, Inc., 1437 West Morris Street, P.O. Box 21070, Indianapolis, IN 46221.

FIG. 6—*Cyanoacrylate-developed latent fingerprint on polyethylene dinner plate stained with dark green Rit fabric dye.*

FIG. 7—*Cyanoacrylate-developed latent fingerprint on polyethylene dinner plate stained with scarlet Rit fabric dye.*

for these dyes indicate that they contain azo and anthraquinone dyestuffs (from 0.5 to 35.5% by weight), mixed with sodium chloride. If the anthraquinone dyes are involved (as they seem to be) in staining the cyanoacrylate-developed latent fingerprints, this would be the first example of staining of cyanoacrylate-developed fingerprints by this category of dyes.

The fingerprints stained with gentian violet, diamond fuchsin, and safranin bluish fluoresced under long-wavelength ultraviolet light (312 nm). The fluorescence of gentian violet and diamond fuchsin was much weaker than that of safranin bluish stain. The fingerprints that were stained with the other biological stains and the Rit fabric dyes did not fluoresce when illuminated with 312 nm ultraviolet light.

Attempts to develop and stain latent fingerprints on paper, latex paint chips, and textured Formica were uniformly unsuccessful. In all cases, the substrates were heavily stained by the biological stains and the Rit fabric dyes.

FIG. 8—*Cyanoacrylate-developed latent fingerprint on Styrofoam cup stained with navy Rit fabric dye.*

FIG. 9—*Cyanoacrylate-developed latent fingerprint on porcelain bowl stained with black Rit fabric dye.*

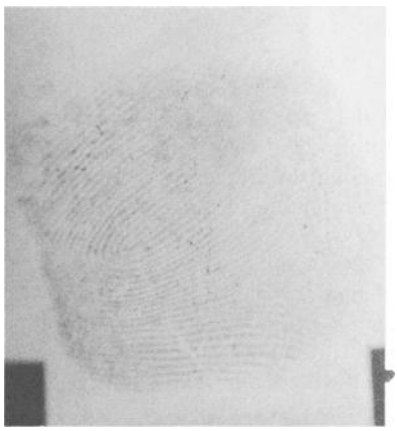

FIG. 10—*Cyanoacrylate-developed latent fingerprint on aluminum beverage can stained with black Rit fabric dye.*

Summary

Our research has shown that cyanoacrylate-developed latent fingerprints on a variety of common substrates (polyethylene, porcelain bowls, aluminum beverage containers, and Styrofoam) can be stained with biological stains or Rit fabric dyes to enhance the contrast between the white cyanoacrylate-developed latent fingerprints and their backgrounds. Cyanoacrylate-developed latent fingerprints stained with safranin bluish stain were fluorescent.

References

[1] Dabbs, M. D. G. and Jones, R. J., "The Development of Fingerprints Using Cyanoacrylate Esters: A Feasibility Study," *Home Office Crime Research Establishment Fingerprint Report No. 2*, United Kingdom Home Office, London, Oct. 1980.

[2] Kendall, F. G., "Super Glue Fuming for the Development of Latent Fingerprints," *Identification News*, Vol. 32, No. 2, Feb. 1982, pp. 3–4.

[3] Kendall, F. G., "Rapid Method of Super Glue Fuming for the Development of Latent Fingerprints," *Identification News*, Vol. 32, No. 6, June 1982, pp. 3–4.

[4] Tuthill, H., "Cyanoacrylate Development of Latent Prints, A Preliminary Report," *Fingerprint World*, Vol. 8, No. 29, July 1982, p. 11.

[5] Kerr, F. M., Barron, I. W., Haque, F., and Westland, A. D., "Organic-Base Fluorescent Powders for Latent Fingerprint Detection on Smooth Surfaces: II." *Journal of the Canadian Society of Forensic Sciences*, Vol. 16, No. 1, Jan. 1983, pp. 39–44.

[6] Olenik, J. H., "Super Glue®—A Rapid Method," *Identification News*, Vol. 33, No. 1, Jan. 1983, pp. 9–10.

[7] Bensonen, J. A., "Heat Acceleration of the Super Glue® Fuming Method for Development of Latent Prints," *Identification News*, Vol. 33, No. 2, Feb. 1983, pp. 3–4.

[8] Menzel, E. R., Burt, J. A., Sinor, T. W., Tubach-Ley, W. B., and Jordan, K. J., "Laser Detection of Latent Fingerprints: Treatment With Glue Containing Cyanoacrylate Ester," *Journal of Forensic Sciences*, Vol. 28, No. 2, April 1983, pp. 307–317.

[9] Kendall, F. G. and Rehn, B. W., "Rapid Method of Super Glue® Fuming Application for the Development of Latent Fingerprints," *Journal of Forensic Sciences*, Vol. 28, No. 3, July 1983, pp. 777–780.

[10] Kobus, H. J., Warrener, R. N., and Stoilovic, M., "Two Simple Staining Procedures Which Improve the Contrast and Ridge Details of Fingerprints Developed with 'Super Glue' (Cyanoacrylate Ester)," *Forensic Science International*, Vol. 23, No. 2/3, Nov./Dec. 1983, pp. 233–240.

[11] Olenik, J. H., "Super Glue®, A Modified Technique for the Development of Latent Fingerprints," *Journal of Forensic Sciences*, Vol. 29, No. 3, July 1984, pp. 881–884.

[12] Burt, J. A. and Menzel, E. R., "Laser Detection of Latent Fingerprints: Difficult Surfaces," *Journal of Forensic Sciences*, Vol. 30, No. 2, April 1985, pp. 364–370.

[13] Pounds, C. A., "Development in Fingerprint Visualization," *Forensic Science Progress*, Vol. 3, A. Maehly and R. L. Williams, Eds., Springer-Verlag, New York, 1988, pp. 91–119.

[14] Olsen, R. D., *Scott's Fingerprint Mechanics*, Charles C Thomas, Springfield, IL, 1978.

[15] Gurr, E., *The Rational Use of Dyes in Biology and General Staining Methods*, Williams and Wilkins, Baltimore, MD, 1965.

[16] Lillie, R. D., *H. J. Conn's Biological Stains*, 8th ed., Williams and Wilkins, Baltimore, MD, 1969.

Address requests for reprints or additional information to
Walter F. Rowe, Ph.D.
Department of Forensic Sciences
The George Washington University
Washington, DC 20052