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TECHNICAL NOTE

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A Method for Impregnating Nylon Transfer Membranes with Leucocrystal Violet for Enhancing and Lifting Bloody Impressions*

ABSTRACT: The objective of this research project was to demonstrate a quick and easy method for impregnating nylon transfer membranes with leucocrystal violet (LCV) for the purpose of lifting and enhancing impressions made in blood. A stamp that would simulate fine detail found in fingerprints or footwear was used to create impressions on a variety of substrates. Four different LCV formulations were tested to determine the effectiveness of the prepared membranes in lifting and enhancing the impressions. Further investigation involved the feasibility of using the LCV membranes in the field by studying the shelf life and storage of the impregnated membranes and the longevity of the lifted impressions. One of the formulations studied demonstrated superior lifting and enhancing capabilities, as well as a prolonged shelf life and a resilience of the lifted impressions, thus proving LCV to be an extremely valuable technique.

KEYWORDS: forensic science, bloody impressions, bloody impression lifters, leucocrystal violet (LCV), nylon transfer membranes

There are many chemicals and techniques commonly used to aid in recording and enhancing bloody impressions. These techniques, whether used in the lab or at a crime scene, may have limitations.

Straight photography of the impression is not always possible if there is not enough contrast between the bloody impression and the color of the substrate that bears the impression. In order to create greater contrast, chemicals such as amido black, coomassie blue, or leucocrystal violet (LCV) may be applied as a liquid directly onto the impression to react with the blood and create a dark-colored complex. This technique is not useful when the impressions are deposited on a dark-colored substrate. In the case of a dark-colored substrate, chemicals that cause the impression to luminesce, such as luminol or fluorescein, may be used. These chemicals may be cumbersome, often requiring a darkened and well-ventilated room as well as special photographic techniques. The resulting image from this type of enhancement often lacks detail.

Another technique often employed for the enhancement of bloody impressions is the use of an alternative light source. Although blood itself does not fluoresce under any wavelength of light, some substrates may fluoresce with the use of an alternative light source, thus creating the necessary contrast between the substrate and the impression. As much as this is a useful technique for impressions made on substrates that fluoresce, not all substrates will fluoresce with the use of the alternative light source.

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Finally, many bloody impressions at crime scenes are made on surfaces that cannot be easily transported to the laboratory for closer examination. In these instances, the ability to lift and enhance the impressions would be invaluable.

In 1994, Stow (1) detailed a method for impregnating nylon transfer membranes with leuco malachite green for enhancing and lifting bloody shoe impressions. Although the leuco malachite green worked well as an enhancement technique for blood, LCV has been more widely utilized in recent years because of its ease of use and excellent enhancement qualities. Since there are no other widely used methods for lifting bloody impressions, it was felt that the research begun by Stow should be expanded upon and a technique should be developed for impregnating the nylon membranes with LCV.

The first goal of this research project was to determine the best formulation of LCV for impregnating the membranes. A literature search determined that three primary formulas are being used to make up the liquid form of the LCV enhancement spray (2,3). A fourth formulation was developed by the authors for the purposes of this research. The second goal of the research project was to find the best method for impregnating the membranes with the LCV solution. Using the four formulations, the LCV solutions were applied to the membranes by spraying or soaking, and then the membranes were allowed to dry. Finally, a method had to be developed to re-moisten the LCV impregnated membranes for use in the field. Therefore, the third goal of the research project was to determine the best solvent and application method to use. A variety of different liquids were tested with each of the four formulations to determine which would provide the best results.

In order to determine the effectiveness of the prepared membranes, a number of test impressions were made. Using a rubber stamp with fine detail to simulate a fingerprint (Fig. 1), impressions were placed on a variety of substrates using varying amounts of

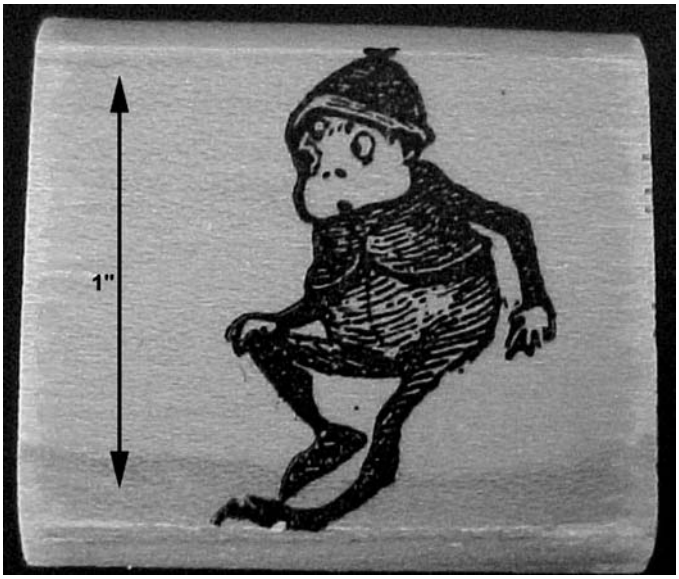

FIG. 1—*Stamp used to make the bloody impressions for the project.*

blood. The substrates included glass, plastic, paper, cloth, tile, linoleum, metal, untreated wood, carpet, cardboard, and skin. The membranes that were impregnated with each of the four formulations and re-moistened using different solvents were then used to lift the prepared impressions in order to evaluate which provided the best sensitivity, detail, and contrast.

Materials and Methods

A number of test impressions were made with the stamp on a piece of glass using varing amounts of blood. The subsequent lifts were evaluated (refer to Table 1) and the following formulation outlined by Miller (4) was chosen to impregnate the membranes:

Ten grams of 5-sulfosalicylic acid were dissolved in 500 mL of 3% hydrogen peroxide, then 0.7 g of leucocrystal violet was added while stirring vigorously with a magnetic stirrer. The nylon membranes employed in this project are generally used for DNA analysis. The nylon membrane chosen was a 0.4-μm neutral nylon 66 membrane which comes in a long continuous roll that was purchased from Hoefer Pharmacia Biotech. These were cut to desirable sizes and placed in a glass baking dish where they were soaked in the LCV solution for 5–10 min. The membranes were then hung up to dry and refrigerated in an airtight container.

To use the membranes, they were sprayed with distilled water until soaked, then blotted to remove excess water. The membranes were then applied directly onto the bloody impressions with gentle, even, pressure. After approximately 10–15 s the membranes were lifted and allowed to dry.

Results

The LCV-impregnated membranes provided excellent enhancement and lifting capabilities on all of the nonporous surfaces tested (Figs. 2 and 3). None of the impressions were harmed, and in many cases the membranes enhanced and "fixed" the original impression to the substrate even when the membrane itself did not produce a useable impression (Figs. 4 and 5).

LCV-impregnated membranes proved to be more useful for enhancing the impression itself on porous surfaces (Figs. 6–8); however, in some instances, the lift provided some useful information with regards to class characteristics (Figs. 9 and 10). Although generally this technique does not harm the impression, membranes should be tested on an insignificant area of the substrate first to be sure background coloration does not occur.

Detection and collection of bloody impressions on human skin are often difficult; therefore, an additional study was conducted to determine if the LCV-impregnated membranes could be useful for lifting and enhancing impressions on skin. For that study, bloody fingerprints were made on the wrist area of a living test subject. The resulting lifts of the impressions were evaluated by a latent fingerprint examiner to assess the quality of the prints. In their opinion, the quality of many of the lifts provided sufficient detail for comparison (Figs. 11 and 12).

Table 2 lists the substrates that were tested and the observations made.

After the LCV-soaked membranes were determined to be a useful technique, it was felt that a time study needed to be conducted. The first part of the study dealt with the shelf life of the prepared membranes. Membranes were prepared and stored for up to eight months and provided excellent lifting and enhancement capabilities

TABLE 1—*LCV bloodstain lift evaluation.*

	Observations Over Time			
Test Solution	0 hr	5 hr	72 hr	20 days
Fischer Method				
Rewet with:				
H_2O	Dk purple/sharp	Same/no background color	Slight background color	Faded/good detail
Solution	Dk purple/blurred	Lt blue/faded	Faded	Faded
Miller Method				
Rewet with:				
H_2O	Dk blue/sharp	Same	Good detail/no background	Good detail/no background
Solution	Dk blue/blurred	Blue-green/faded	Faded	Faded
Swander/Stoddard Method				
Rewet with:				
H_2O	Lt green blue/blurred	Faded/heavy background color	Heavy background color	Extreme background
Solution	Lt green blue/sharp	Faded/heavy background color	Heavy background color	Extreme background
Author's Method				
Rewet with:				
H_2O	Dk blue/sharp/fast fade	Faded	Faded	Lt green/barely visible
Solution	Dk blue/sharp/fast fade	Faded	Faded	Lt green/barely visible

NOTE: Solutions used in each method to rewet the membranes were the same solutions used to initially soak the membranes.

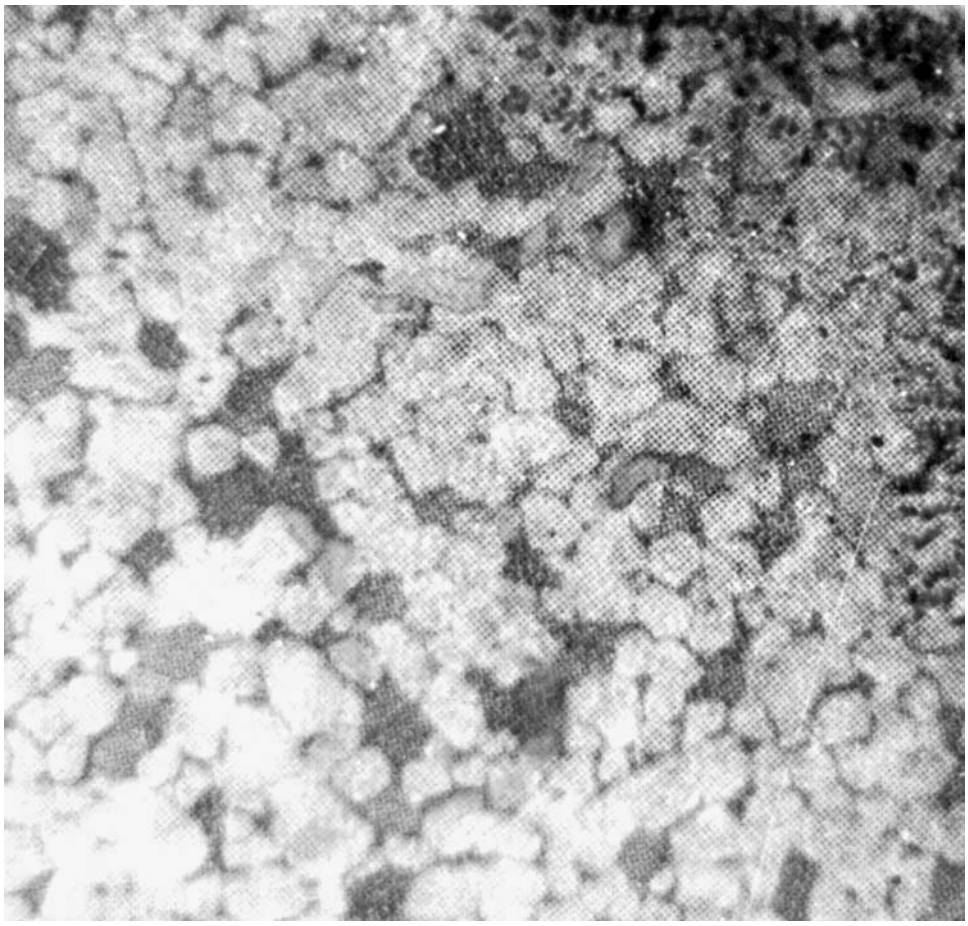

FIG. 2—*Bloody impression on linoleum prior to contact with LCV-impregnated membrane.*

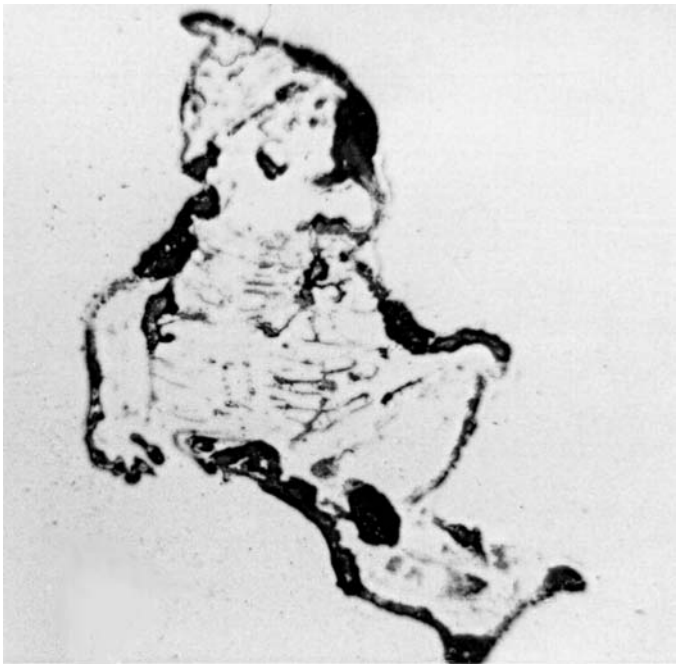

FIG. 3—*Lift of the bloody impression depicted in Fig. 2.*

FIG. 4—*Bloody impression on tile prior to contact with LCV-impregnated membrane.*

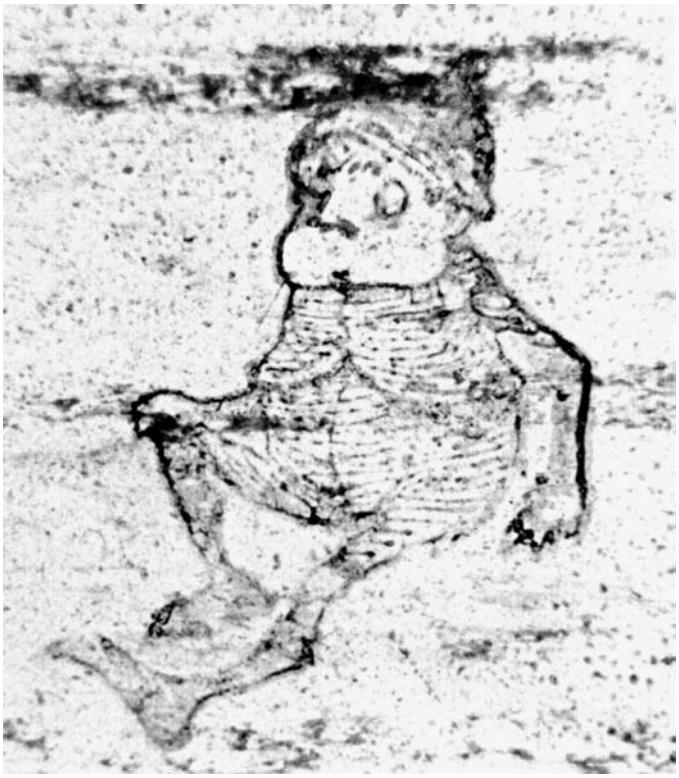

FIG. 5—*Tile in Fig. 4 showing enhancement of the actual impression after use of the LCV-impregnated membrane.*

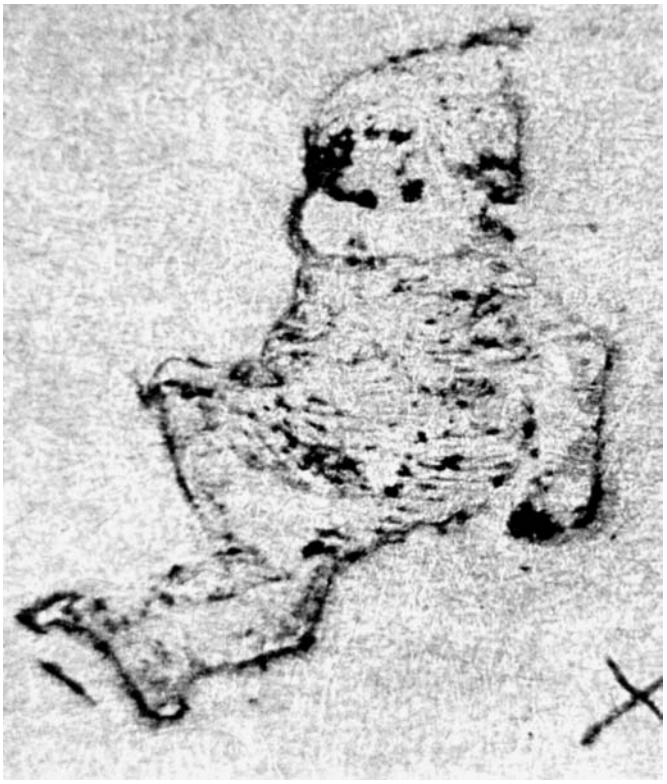

FIG. 7—*Cardboard in Fig. 6 showing enhancement of the actual impression after use of the LCV-impregnated membrane.*

FIG. 6—*Bloody impression on cardboard prior to contact with LCV-impregnated membrane.*

FIG. 8—*Lift of the bloody impression depicted in Fig. 6.*

when used after two months. After eight months, the membranes still provided excellent lifting capabilities; however, they lost their ability to enhance the impression.

An additional study that was undertaken dealt with the longevity of the lifted impressions on the membranes. Enhanced impressions were clearly visible even after three years (Fig. 13); however, some darkening of the background occurred and the membranes became brittle. For this reason, the authors suggest that the enhanced impressions on the membranes and/or the substrate be photographed shortly after processing.

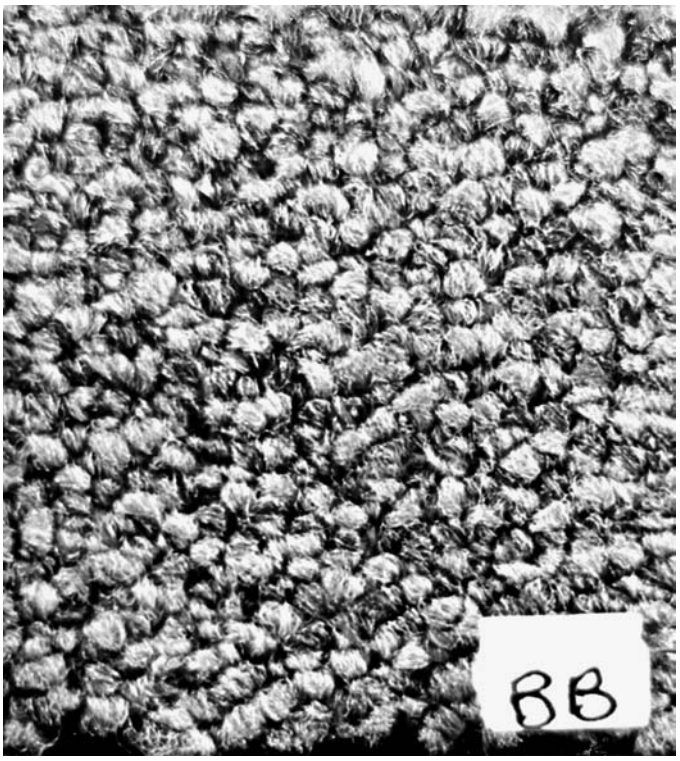

FIG. 9—*Bloody impression on carpet prior to contact with LCV-impregnated membrane.*

FIG. 10—*Lift of the bloody impression depicted in Fig. 9.*

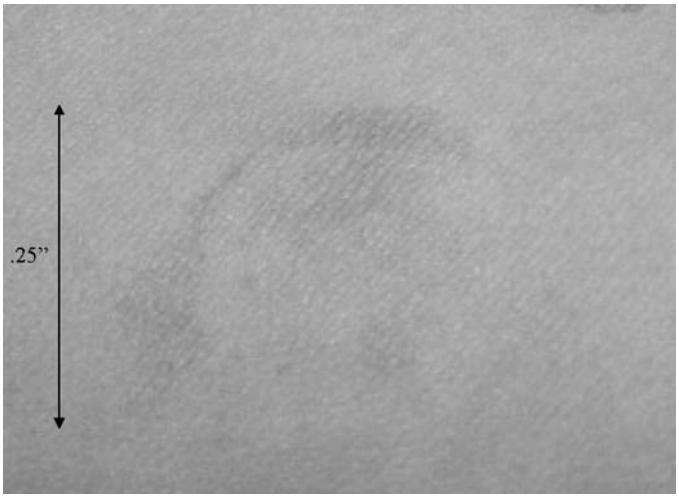

FIG. 11—*Bloody fingerprint on skin prior to contact with LCV-impregnated membrane.*

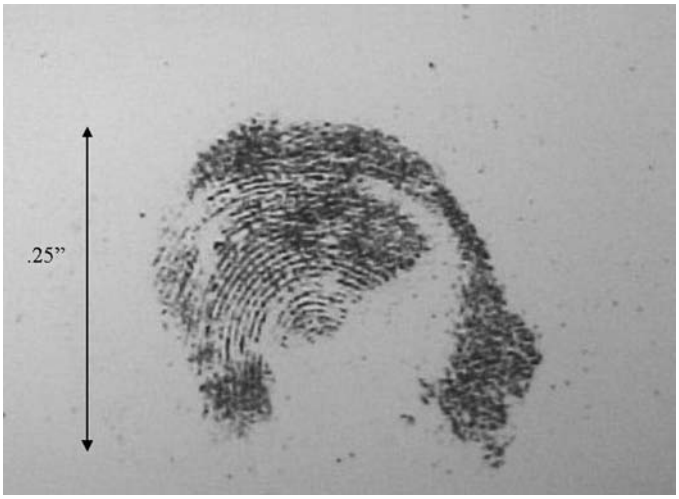

FIG. 12—*Lift of the bloody fingerprint depicted in Fig. 11.*

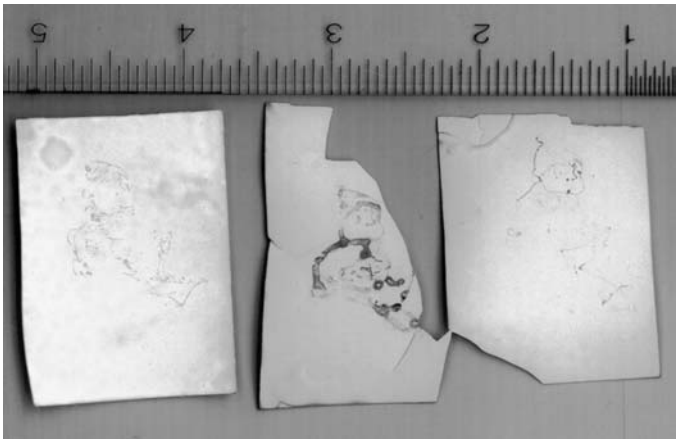

FIG. 13—*Lifts of bloody impressions after three years at room temperature.*

TABLE 2—*Tested substrates.*

Substrate	Lift	Impression	Comments
Nonporous			
Glass	3	*	
Plastic	3	*	
Tile	3	3	
Linoleum	3	*	
Metal	3	*	
Untreated wood	0	3	
Skin	3	1–2	
Porous			
Carpet	2–3	0	
Cardboard	1	3	
Newspaper	1	3	
Copy paper	1	3	Some substrate staining
Notebook paper	1–2	3	
Cloth	0	3	

Ratings: 0 = no enhancement, 1 = poor enhancement, 2 = some enhancement, 3 = excellent enhancement\detail.

* = Impressions were lifted completely off substrate onto membrane and were enhanced.

NOTE: Ratings address the enhancement and lifting abilities of the membranes and not the quality of the impression.

Conclusions

LCV-impregnated membranes are proven to be a valuable technique for lifting and/or enhancing bloody impressions. The lifted and/or enhanced impressions exhibit excellent detail, especially when the impression is made with very small quantities of blood supported by a nonporous surface. It is recommended that the impregnated membranes be used within 2–3 months of being made for optimum lifting and enhancing capabilities. Enhanced and/or lifted impressions should be photographed shortly after processing.

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