Technical Note

New Technique for Revealing Latent Fingerprints on Wet, Porous Surfaces: Oil Red O

Alexandre Beaudoin

Service de l'Identité Judiciaire
Sûreté du Québec
Québec, Canada

Abstract: Oil red O (ORO) can be used to reveal latent fingerprints on porous surfaces that have been wet. Tests were carried out on various types of paper and cardboard. Compared with a physical developer, the ORO technique is much less complex and gives results of impressive clarity and intensity.

Introduction

Developing latent fingerprints on porous surfaces that have been wet poses a number of problems. First, ninhydrin and DFO are of no use in revealing these latent prints because the mineral salts and amino acids left by the fingers are dissolved on contact with water [1, 2]. The only other means of finding latent prints is the utilization of lipidic prints left on the surface. To date, the standard technique used to reveal prints on a document that has been wet or soiled has been physical developer. This technique includes repeated soaking in various solutions. In addition to being a very long and laborious procedure, it is necessary to be meticulous to avoid the presence of chloride ions and to control the development reaction. Thus, the complexity of applying physical developer often discourages its use. During training on the physical developer technique, the author observed that even when applied on very high-quality samples, the results remained uneven and often poor. Other lipophic reagents were considered (e.g., Menzel's europium ortho-phenanthroline complex) [1]. Unfortunately, an ultraviolet light source is required for visualization and our research was being directed toward nonfluorescent detection methods. We therefore find ourselves facing a major weakness in revealing prints on wet, porous surfaces. It was following this observation that the search for a more efficient technique for developing fingerprints on wet porous surfaces began.

This is where oil red O (ORO) comes into its own. Oil red O is a lysochrome (soluble lipid stain) suitable in biology for coloring lipoproteins separated by electrophoresis of cellulose acetate. Oil red O is a lipophilic stain (Appendix I) that permits efficient and selective coloration of lipidic prints. In addition, the application is very simple, having just three stages: coloration, neutralization, and drying.

This results in well-defined red ridges on a pink background that are observable in daylight, and the preservation of the traces on the object seems very stable.

The first tests were attempted with different stains that are used for coloring lipids and lipoproteins. Finally, following the convincing preliminary tests of ORO on dry and wet documents, an efficient procedure for an appropriate treatment for revealing latent fingerprints was determined. A buffer was identified to neutralize the base side of the coloring solution to make the treated objects secure and stable. Several tests were carried out on various samples.

Oil red O may be used as the physical developer in certain situations [3]:

- when the prints are "poor" in amino acids, because of the constitution of the individual

- when a porous surface has been wet or subjected to a high level of humidity

Materials and Methods

Preparation of Solutions

Stain Solution

1. Weigh out 1.54 g of ORO and dissolve it in 770 ml of methanol.
2. Dissolve 9.2 g of NaOH (sodium hydroxide) in 230 ml of water and add it to the above solution.
3. Mix and filter, then store in a brown bottle away from light.

pH 7 Buffer Solution

1. Add 26.5 g of Na2CO3 (sodium carbonate) to 2 L of water and shake until it is dissolved.
2. Carefully add 18.3 ml of concentrated HNO3 (nitric acid), shaking constantly.
3. Add enough water to increase volume to 2.5 L.

Procedure

1. The document is first immersed in the stain solution and shaken (using a titer plate shaker) for 90 minutes.
2. It is then removed and drained, then immersed in the buffer solution to adjust the pH of the document.
3. The document is then rinsed in a container of distilled water and dried.
4. Drying can take place in the open air or in an oven at 50 ºC to accelerate the process.

Test Procedures

The fingers were washed to remove extraneous contaminants and were allowed to secrete natural perspiration. The fingerprints were made by carefully pressing the finger onto the surface. After a few days, the samples were moistened in clear tap water. [Further research will be carried out with older fingerprints as well as with contaminated moistening solutions (e.g., salt, calcium, sand, etc.).]

Sample Identifier	Substrate and Exposure Description
A1	Kraft brown paper bag immersed in water and immediately dried (Figure 1).
A2	Kraft brown paper bag immersed in water for two hours and dried (Figure 2).
B1	White cardboard immersed in water and dried immediately.
B2	White cardboard immersed in water for two hours and dried.
C1	Standard white paper immersed in water and dried immediately (Figure 3).
C2	Standard white paper immersed in water for two hours and dried.
D1	Brown corrugated cardboard immersed in water and dried immediately.
D2	Brown corrugated cardboard immersed in water for two hours and dried (Figure 4).
E1	Cardboard with one glossy side and one rough side immersed in water and dried immediately.
E2	Cardboard with one glossy side and one rough side immersed in water for two hours and dried.
F1	Piece of glass immersed in water and dried immediately.
F2	Piece of glass immersed in water for two hours and dried.

Table 1

Substrate on which prints were placed.

Results and Discussion

Observing the results obtained following coloring with ORO, we note that the quality of the fingerprint is directly proportional to the type of the substrate tested. It is obvious that prints revealed on a Kraft brown paper bag are of good quality (A1 and A2), whether merely immersed in water or having remained there for more than two hours.

We can say the same for white cardboard (B1 and B2) and white paper (C1 and C2).

Figure 1

Fingerprint on a Kraft brown paper bag immersed in water and dried immediately (A1).

Figure 2

Fingerprint on a Kraft brown paper bag immersed in water for two hours and dried (A2).

Figure 3

Print on standard white paper immersed in water and dried immediately (C1).

Thanks to the results obtained on corrugated cardboard (D1 and D2), we can observe that the red prints are well-defined on the dark brown background of the cardboard. On the other hand, when we observe black and white photos, it sometimes happens that the background is more of a problem, because the contrast is less obvious without the color. However, this problem can be reduced through the use of a green filter when taking black and white photos.

Samples E1 and E2 were on cardboard with one glossy side and one rough side. We note that no matter which side the print was on, the results are surprising and the prints have a definition that is more than satisfactory. Unfortunately, we cannot say the same for the pieces of glass (F1 and F2), which gave very poor results. In the case of nonporous surfaces, prints do not seem to show up well. We can conclude that the stain gives superior results when applied on porous or semiporous surfaces.

Figure 4

Print on brown corrugated cardboard immersed in water for two hours and dried (D2).

Conclusion

Oil red O's physical properties allow this stain to reveal the water-insoluble traces of grease left by the skin's friction ridges on porous surfaces. When this stain is used on porous objects that have been exposed to water after contact with fingers, the fingerprint is effectively revealed, and the ridges appear red.

The development method using ORO has the advantage of applying both to dry documents and those exposed to water. It even seems to apply to semiporous or soiled paper, but more experiments are required. We can conclude that using this technique can be useful in some truly problematic situations.

Acknowledgments

The author would like to thank latent print development technician Mario Gagnon of the Sûreté du Québec for his assistance in developing an appropriate buffer solution as well as for the tests done with ORO. I would also like to thank latent print development technician Christian Brown for assistance in revising this document.

For further information, please contact:

Alexandre Beaudoin
Conseiller Scientifique en Identité Judiciaire
Sûreté du Québec
Service de l'Identité Judiciaire
1701 Parthenais, Montréal, Québec, Canada H2K 3S7
514-598-4513
alexandre.beaudoin@surete.qc.ca

References

1. Menzel, E. R. *Fingerprint Detection with Lasers*, 2nd ed.; Marcel Dekker: Lubbock, TX, 1999; pp 139-153, 230-241.
2. Kent, T., Ed. *Manual of Fingerprint Development Techniques*, 2nd ed.; Home Office, Police Scientific Development Branch: Sandridge, UK, 1998.
3. Bellemarre, J. F.; Beaudoin, A. Révélateur Physique. In *Manuel de Techniques en Identité Judiciaire Interactif*; Sûreté du Québec: Montréal, Québec, Canada, 2003.
4. Horobin, R. W.; Kiernan, J. A., Eds. *Conn's Biological Stains*, 10th ed.; Springer-Verlag: New York, 2002.

Appendix

Physical Properties of Oil Red O [4]

Ionization	Lysochrome
Water solubility	Insoluble
Solubility in ethanol	Moderate
Color	Red
Molecular weight	408.510
Empiric formula	$C26H24N4O$