D_D0003: EFFECT OF CONDENSED WATER ON LATENT FINGERPRINTS ON NON POROUS SURFACES

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Abstract: Fingerprint is one of the most important evidences in forensic science. A common method used to develop the latent fingerprints on non-porous wet surfaces is a Small Particle Reagent (SPR). In fact, wet latent fingerprints are not only occurred by soaking in water but also by forming condensed water on the surface. When the evidences were sent to the lab, it had been dried and black powder dusting was a common method used. Latent fingerprints were impressed on the sample surfaces (glass, color metal and plastic) both before (E.I) and after (E.II) condensed water was formed. Six developed methods (black powder dusting, fluorescent powder followed by Alternative Light Source (ALS), Black SPR, white SPR, cyanoacrylate fuming (CA) followed by black powder or fluorescent powder dusting and ALS) were applied and repeated 5 times. The number of minutia (24 points) of an inked print was done as a reference, and the developed latent fingerprints were calculated as percentage. On glass samples, fluorescent powder followed by ALS, and CA followed by fluorescent powder and ALS, were the effective methods for developing the fingerprints deposited before (E.I) condensed water was formed on their surfaces. (99.17%); and black and white SPR were the most successful methods for developing the fingerprints deposited after (E.II) condensed water was formed (85%). On metal surface, black powder and black SPR were the appropriate methods for developing the fingerprints deposited before (99.17%) and after (93.33%) condensed water was formed. On plastic surface, CA followed by fluorescent powder and ALS, and black SPR were the effective method for fingerprint development before (100%) and after (89.17%) condensed water was formed.

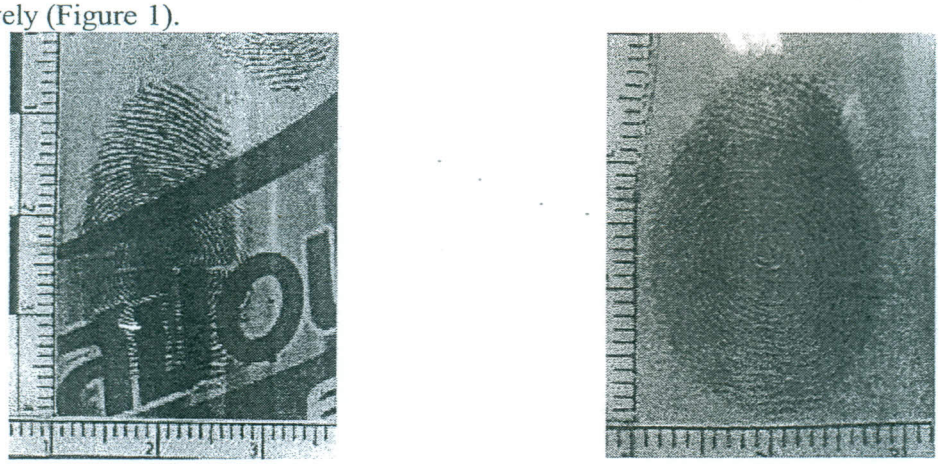
Introduction: Latent fingerprints found at the crime scene cannot be seen by naked eye. Several methods have been used to develop the latent fingerprints on dry or wet surface. For non-porous wet surfaces, the SPR was used.[1] Latent fingerprints left on nonporous surfaces and exposed to water up to 30 days could be developed by SPR.[2] CA was the best method for developing latent fingerprints deposited on glass and metal surfaces which placed in stagnant water.[3] However, surfaces can be wet by condensed water in the atmosphere. The aim of the present study was to find the appropriate method to visualize the latent fingerprint deposited on various non-porous surfaces wet by condensed water.

Methodology: A cleaned author's right thumb was touched on an oily area such as forehead, and then pressed on non-porous surface samples (glass, color metal, and plastic, PET). Latent fingerprints were created on the sample surfaces both before (E.I) and after (E.II) condensed water was formed. Condensed water was formed on the sample surface by mixing ice and drinking water. The temperature of cold water was controlled at 0-3°C, and the relative humidity was controlled at 65-75%. Six methods were used to develop the latent fingerprints:

1). Black powder dusting (Lynn Peavey Co. Ltd.)
2). Fluorescent powder dusting (Lynn Peavey Co. Ltd.) followed by ALS
3). Black SPR (BVDA Co. Ltd.)
4). White SPR (BVDA Co. Ltd.)
5). CA (BVDA Co. Ltd.) followed by black powder dusting
6). CA followed by fluorescent powder dusting and ALS

All methods, except SPR used for wet surfaces, were used to develop fingerprints on the surfaces where the condensed water had already dried, and repeated 5 times. In the present study, 90 latent fingerprint samples each were impressed before (E.I) and after (E.II) condensed water was formed. The developed prints were collected by photography with a digital camera (Sony, alpha 230). The minutiae of the developed prints were observed and calculated as percentage by comparing to a reference inked print (24 points). ALS 470 nm wavelength and orange filter were used to observe the visible prints.

Results, Discussion and Conclusion: Black powder dusting could be used to develop latent fingerprints on both dry and wet surface samples (condense water formed after and before fingerprint impression, respectively). The developed latent fingerprints achieved from this study had a very good quality for identification. The quality of minutiae obtained from E.I (97.50-99.17%) was better than those from E.II (73.33-84.17%). The best developed fingerprints in the E.I and E.II were gained from the color metal and plastic surfaces, respectively (Figure 1).



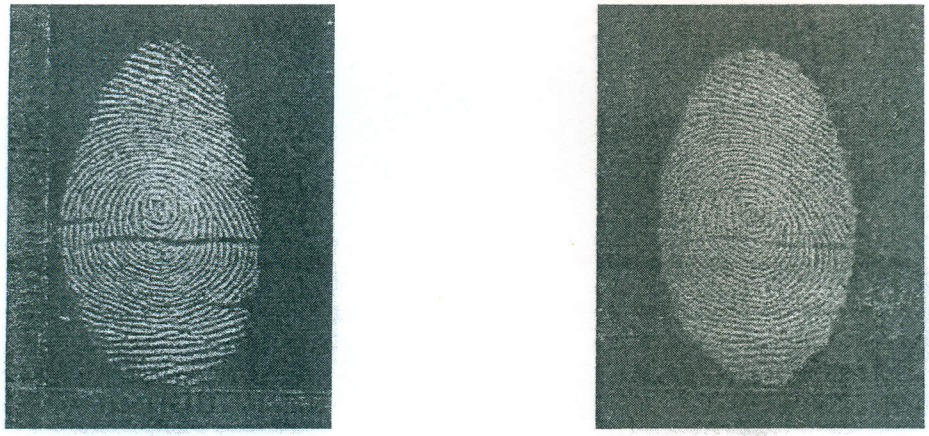
(A) (B)

Figure 1. Fingerprint images developed by black powder dusting (A) Color metal surface (E.I) (B) Plastic surface (E.II)

Fluorescence powder dusting followed by ALS could achieve a very good quality of minutiae both in the E.I (98.33-99.17%) and E.II (66.67-86.67%). The best results were obtained from glass surface and plastic surfaces, respectively (Figure 2).

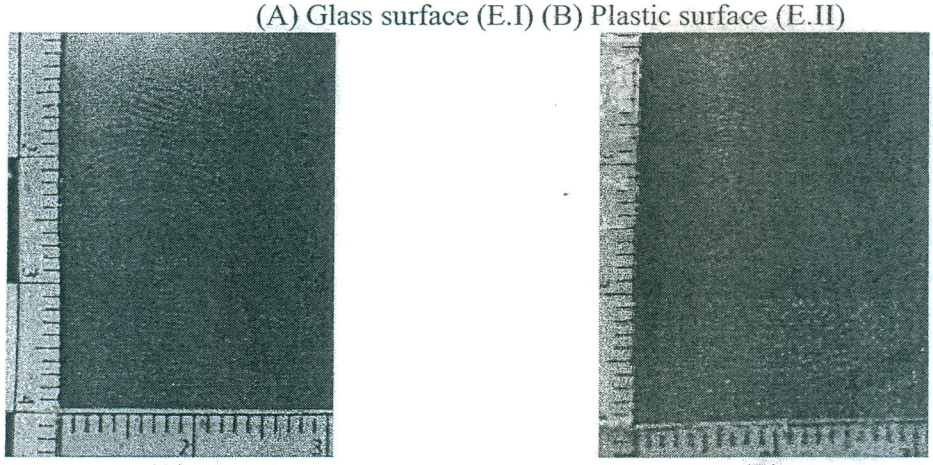
Black SPR could be used both in the E.I and E.II. The results from the former were better than those from the latter. The quality of developed prints was good enough for identification. The quality of minutiae in the E.I (97.50-99.17%) was better than those from the E.II (85.00-93.33%). The best method was found on plastic and color metal surfaces, respectively (Figure 3).

A good quality of minutiae could be obtained from White SPR in both E.I (85.00-95.00%) and E.II (80.00-85.00%). White SPR was the most successful method found on glass surface in both experiments. Both black and white SPR could be used on glass surface in the E.I (Figure 4).



(A) (B)

Figure 2. Fingerprint image developed by fluorescent powder dusting and followed by ALS (A) Glass surface (E.I) (B) Plastic surface (E.II)



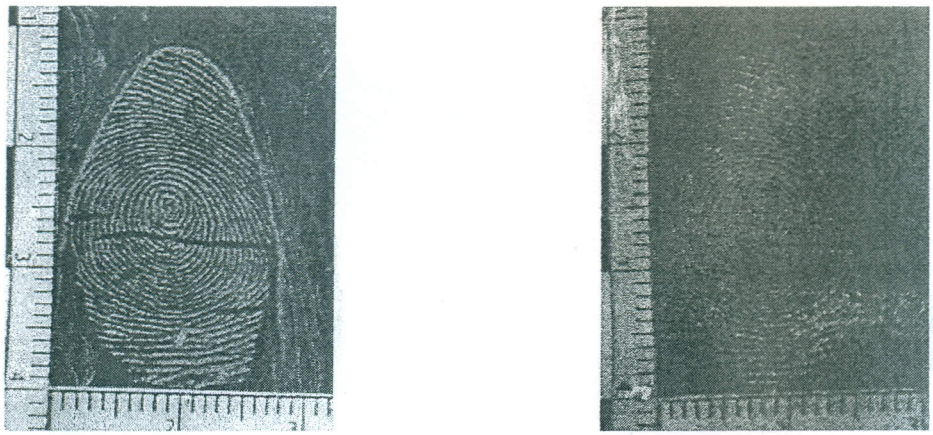
(A) (B)

Figure 3. Fingerprint images developed by black SPR (A) Plastic surface (E.I) (B) Color metal surface (E.II)

CA followed by black powder dusting used in the E. I (98.33-99.17%) could obtain better quality of minutiae than that from the E. II (75.83-88.33%). The best results were obtained from plastic surface both in E.I and E.II. In the E.I, the percentage of developed prints on plastic surface was not so different from glass and colored metal surfaces; but in the E.II the percentage of developed prints from different kinds of sample surfaces were quite different (Figure 5).

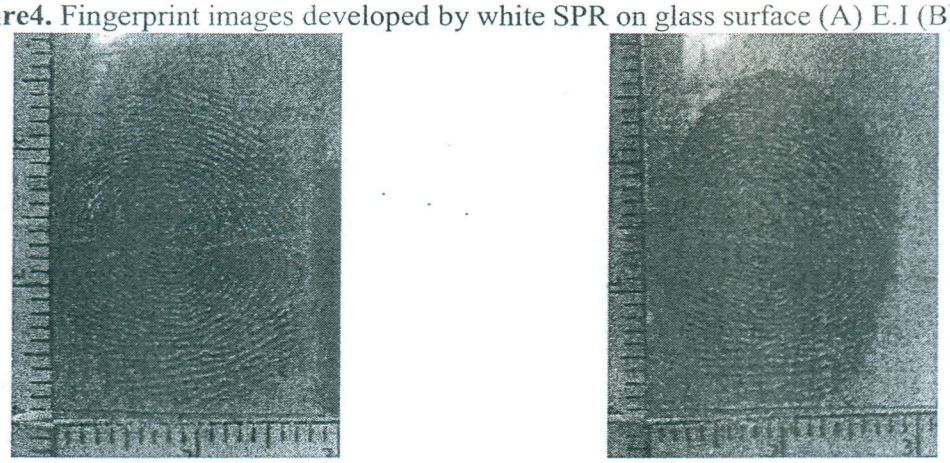
CA followed by fluorescence powder dusting and ALS could be used in both E.I and E.II. The percentage of minutiae obtained from E.I (97.50-100.00%) was more than that from the E.II (69.17-75.83%). The best results of the E.I and E.II were obtained from plastic surface (Figure 6).

Cold water (0-3°C) simulated the condition when drinking water in bottles or cans was taken out from the refrigerator. Condensed water was formed on the surfaces within a minute after cold water had been poured into the sample containers, and stayed for 50 to 70 minutes depended on the humidity of the environment (60-75%), temperature of environment was 27-30°C. Condensed water were stayed on color metal surface longer than on plastic and glass surfaces. The time of condensed water formed on the surfaces was not so different and did not affect the methods used in the present study.



(A) (B)

Figure4. Fingerprint images developed by white SPR on glass surface (A) E.I (B) E.II



(A) (B)

Figure 5. Fingerprint images developed by CA followed by black powder dusting on plastic surface (A) E.I (B) E.II

The developed latent fingerprints were examined by counting the minutiae. The minutia of reference fingerprint was counted as 24 points. To identify fingerprint, at least 12 points of minutiae were required. In the present study, more than 12 points could be obtained from all developed techniques.

(A) (B)

Figure 6. Fingerprint images developed by CA followed by fluorescent powder dusting and ALS on plastic surface (A) E.I (B) E.II

The results from the E.I showed that condensed water presented on the surfaces had slightly effect on the latent fingerprints. Most techniques gave good results in identifying the minutia. The average number of minutia found in all developed fingerprints was 20.40-24.00 (85-100%). The effective methods for glass surface were fluorescent powder dusting followed by ALS, and CA followed by fluorescent powder dusting and ALS. The best method for color metal surface and plastic surface was black powder dusting and CA followed by fluorescent powder dusting and ALS (Table 1).

Table 1. The average percentage of developed fingerprints obtained from six methods from the E.I and compared with different surfaces.

Methods	% Developed Prints		
	Glass	Color metal	Plastic
1. Black powder dusting	97.50	99.17	97.50
2. Fluor. powder+ALS	99.17	98.33	98.33
3. Black SPR	98.33	97.50	99.17
4. White SPR	95.00	90.00	85.00
5. CA + Black powder	98.33	98.33	99.17
6. CA+Fluor.Powder+ALS	99.17	97.50	100.00

The E.II revealed that condensed water had been formed on the surface samples before the latent fingerprints were deposited could affect fingerprints deposition because of the presence of thin film of condensed water. The amount of finger residues deposited on the wet surfaces was less than those on the dry ones. Good results were obtained from all development techniques. The average number of the point of minutia found in the developed prints was 16.00-22.40 (66.67-93.33%). The best methods found on glass surface were black and white SPR. For color metal and plastic surfaces, the best method was black SPR (Table 2).

Table 2. The average percentage of developed fingerprints obtained from six methods from the E.II and compared with different surfaces.

Methods	% Developed Prints		
	Glass	Colored metal	Plastic
1. Black powder dusting	79.17	73.33	84.17
2. Fluor. powder + ALS	73.33	66.67	86.67
3. Black SPR	85.00	93.33	89.17
4. White SPR	85.00	85.00	80.00
5. CA + Black powder	75.83	75.83	88.33
6. CA+Fluor.Powder+ALS	69.17	73.33	75.83

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