

# Development of Latent Finger Prints from Porous and Non-Porous Substances Disposed In Water



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Submission: July 06, 2018; Published: July 24, 2018

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## Abstract

Evidences usually recovered from under water crime scenes have always been a challenge for the forensic researchers, as water has a destructive effect on the prints and considerably affects the evidential values. The aim of this study is to develop latent fingerprints from porous and non-porous materials disposed in fresh water and salt water. For this purpose, two porous (i.e. cardboard and untreated wood) and two non-porous (i.e. glass and plastic) were deposited with latent finger prints 1 hour prior to disposal. The samples were disposed in containers containing salt water and fresh water for one to fifteen days before drying and development. Different techniques were used for development of latent fingerprints and the method depends on the types of surface- porous: Ninhydrin and Iodine Fuming and non-porous: Cyanoacrylate and Black Powder were used and the effectiveness of each of them on this particular type of evidences was evaluated. The result concluded that it is still possible to develop latent finger prints from non-porous substances like glass and plastics by using black powder and Cyanoacrylate. It was also found that using Iodine fuming can develop prints on substances like wood and cardboard initially and yields negative results after prolonged disposal in water and Ninhydrin (ether based) proves to be ineffective in development of latent finger prints from porous surfaces disposed in water (Figure 1). The study in addition proves that the salinity of water has a destructive effect on the quality of print developed.



**Figure 1:** Development of Finger print from Glass Unexposed to Water.

**Keywords:** Evidences; Cyanoacrylate; Iodine fuming; Ninhydrin and black powder

## Introduction



**Figure 2:** Development Using black Powder after 24 hrs in fresh water.

Water bodies are considered to be the best place to dispose the evidences after commission of the crime. The evidences

retrieved from these water bodies may contain latent fingerprints deposited on the weapons prior disposal in water bodies. The enhancement of these prints becomes a real challenge for the examiner since this impression tends to become more malleable. This study was conducted to determine whether it is possible to develop latent fingerprints from surfaces disposed in water. The study assumes that latent fingerprints can be developed from porous and nonporous surfaces disposed in water by using suitable development technique. This study also assumes that the salinity of the water may have an adverse effect on the quality of print developed (Figure 2). The study mainly focused on the use of Oil Red O for development of latent finger prints on wet and porous surfaces. The study was conducted on porous surfaces

by immersing them in water for a short time interval of an hour or two and were dried immediately and treated with Oil Red O solution [1]. The results proved that the latent fingerprints were developed successfully by the use of Oil Red O solution and has yielded a better enhanced image when compared to the other physical developers (Figure 3).



Figure 3: Development Using black Powder after 3 days in fresh water.



Figure 4: Development Using black Powder after 5 days in fresh water.

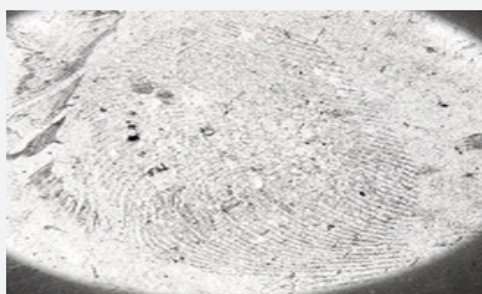


Figure 5: Development Using black Powder after 7 days in fresh water.

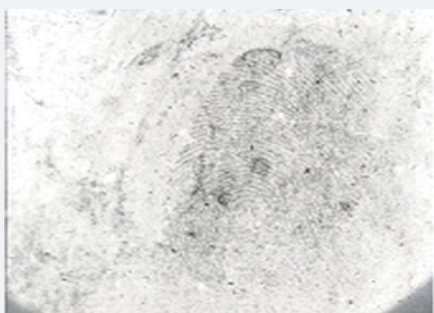


Figure 6: Development Using black Powder after 9 days in fresh water.

The study conducted in the University of Valencia was based on the development of latent finger prints submerged in water [2]. The study was performed on non-porous substances like plastic and glass. The reagents used for the enhancement of latent finger prints were black powder, silver metallic powder, fluorescent powder, Sudan black (powder & solution) and Small Particle Reagent. The study was conducted for different time interval (1, 3,5,7,10,15 days) respectively. The result proved that it is possible to develop latent fingerprints from substances submerged in water (Figure 4) for different time interval. The study states that Small Particle Reagent and some lipochromes (oil red-O and Sudan black) are best methods for enhancement of latent finger prints. The study conducted in Graduate Faculty of George Mason University was based on the development of latent finger prints on non-porous metals surface immersed in various aquatic conditions. The aim of the study was to determine the effect of stream current and the length of time submerged on the quality of print developed [3]. The samples were submerged for a time interval of 24hrs, 48hrs & 72hrs at varying stream current (Figure 5).



Figure 7: Development Using black Powder after 11 days in fresh water.

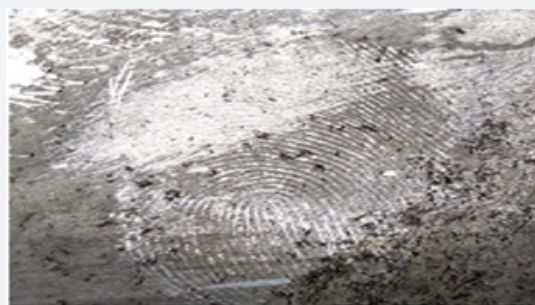
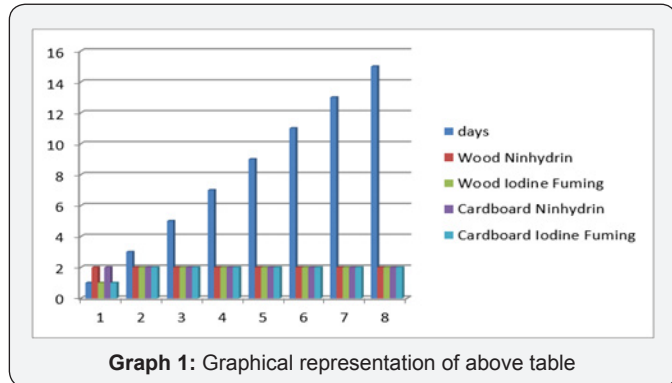


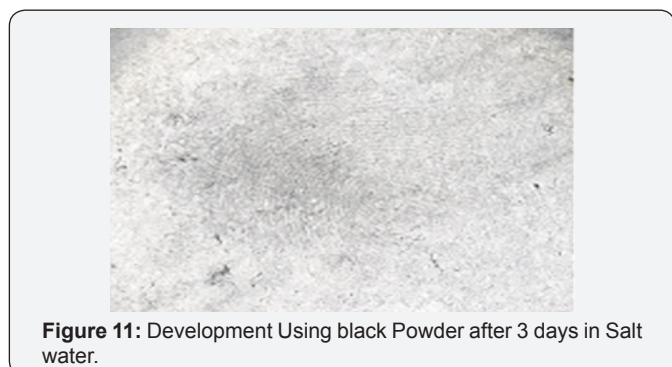
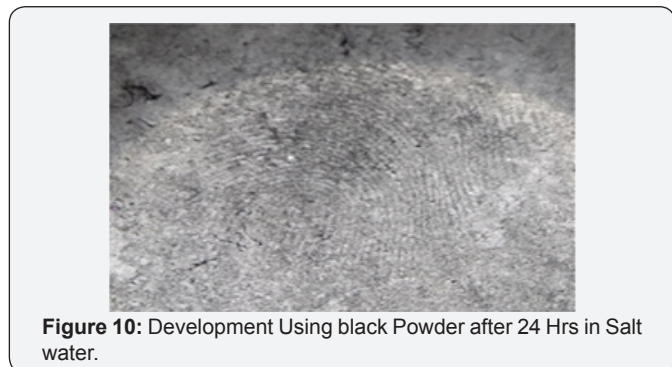
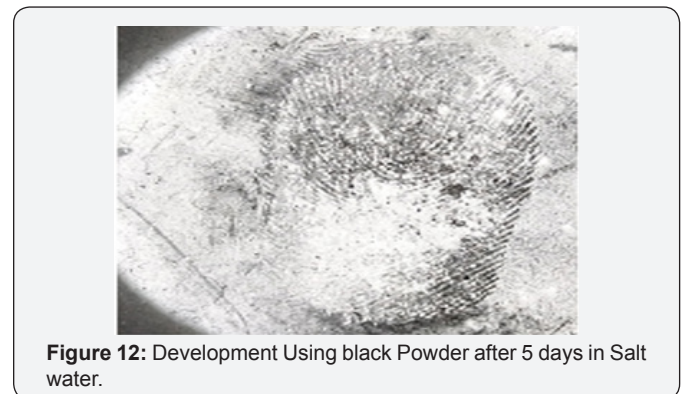
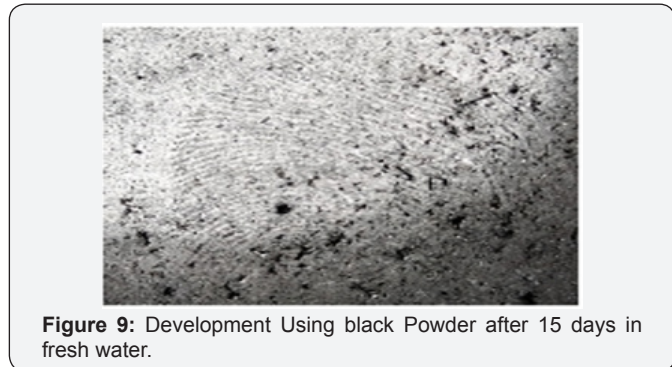
Figure 8: Development Using black Powder after 13 days in fresh water.

The techniques used for enhancement of latent fingerprints were cyanoacrylate and black powder. The study proved that latent finger prints can be developed from non-porous surfaces submerged in water and the water current effects the clarity of the prints developed. The study was conducted by the department of Forensic Sciences, Kho Kaen University were based on the development of latent fingerprints from non-porous wet surface using Small Particle Reagent [4]. The materials like stainless steel, mirror and plastics were immersed

in clean water and dirty water for an extended period of 30 days. Every day three materials were treated with the SPR and prints were enhanced. The results concluded that SPR yielded results on stainless steel followed by glass & plastic (Figures 6-8). The aim of the study was to develop the latent fingerprints from non-porous surfaces submerged in water at different interval of time. The enhancement technique used for development of latent fingerprints was small particle reagent black and white [5].

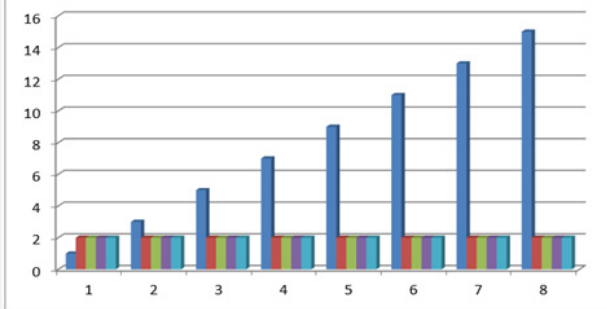


The samples of plastic, metal (aluminum) & glass were submerged in water for 15, 30, 45 and 60 days (Graph 1). The study concluded that with the use of small particle reagent the prints were developed with great clarity. The study also suggests that black powder and small particle reagent black and white can develop latent finger prints submerged in water (Figures 9-11). The study states that the no. of day's submersion is inversely proportional to the clarity of prints developed. This study mainly focused on visualization of Latent fingerprints immersed in water on different porous and non-porous surfaces using Rhodamine B reagent [6]. The non-porous substrates used in this work are plastic sheet, glass slide, and tacky side of transparent electrical tape, ceramic tile and stainless steel disc. The porous substrates used in this work are A4 size paper and glossy paper. The non-porous surfaces are immersed in water for a period of 96hrs and the other set of nonporous surfaces are kept in freezer at -50 degrees Celsius. The results conclude that SPR with Rhodamine B is a best technique of development of latent fingerprints on multicolored non-porous surfaces (Figure 12).



The study was conducted in the department of forensic medicine and clinical toxicology, faculty of medicine, university of Alexandria and is based on the various methods used to enhance the latent fingerprints on non-porous surfaces submerged under fresh water and sea water [7]. The study was performed for a period of 10 days (Figure 13). The techniques used for enhancement of latent fingerprints were black powder, small particle reagent and cyanoacrylate. The results have shown that cyanoacrylate was best technique for enhancement of

fingerprints submerged in water and the duration of submersion affect the clarity of print (Graph 2). In addition, this study has also revealed that the exposure of samples to saline water influence the quality of print developed (Figure 14). The study was conducted by the department of anthropology, University of Delhi were based on the use of Small Particle Reagent based on basic fuchsin dye for development of latent fingerprints on wet non-porous surfaces [8].



Graph 2: Graphical representation of above table

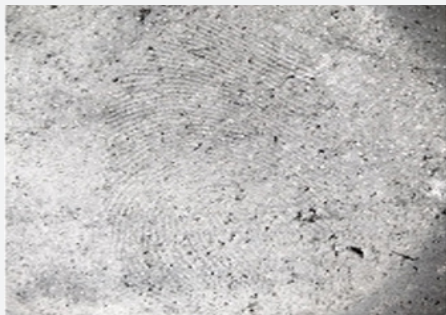


Figure 14: Development Using black Powder after 9 days in Salt water.

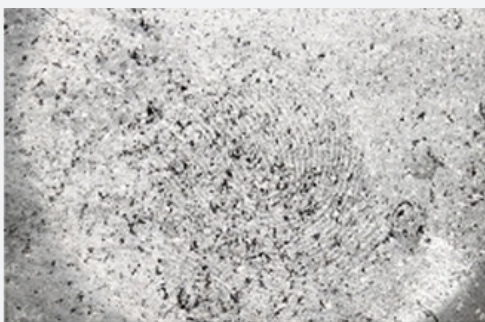


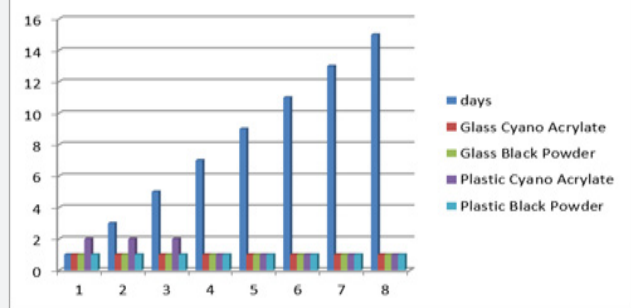
Figure 15: Development Using black Powder after 11 days in Salt water.

The latent prints were deposited on the substances like metallic spoon, aluminum foil and glass slide and were submerged in water for a varying period of time (5, 10, 15, 20, 25, 30, 35, 40, 45 days). The samples were treated with different formulations of SPR (Figures 15-17). The result shows that for the first 20 days, both the formulations yield excellent prints and later the quality of print decreases. The study conducted in the University of Delhi is based on the development of latent finger prints from crime scene by using Brilliant Blue R. The surfaces on which the prints were developed are plastic sheet, wooden ply, glossy

paper, metal surfaces and sticky slides (Graph 3). The chemicals used for enhancement of fingerprints were composition based on Brilliant Blue R and the samples were immersed for 30 days under clean and dirty water [9]. The result concluded that the use of this composition produces a fluorescent and is effective for enhancing weak prints also. The study also states that the quality of the developed prints is not compromised even after a lapse of 90 days (Figures 18).



Figure 16: Development Using black Powder after 13 days in Salt water.



Graph 3: Graphical representation of above table.

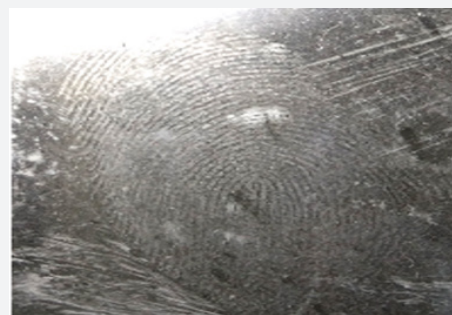


Figure 17: Development Using Cyanoacrylate after 4 hrs in fresh water.



Figure 18: Development Using Cyanoacrylate after 3 days in fresh water.



**Figure 19:** Development Using Cyanoacrylate after 5 days in fresh water.



**Figure 20:** Development Using Cyanoacrylate after 7 days in fresh water.



**Figure 21:** Development Using Cyanoacrylate after 9 days in fresh water.



**Figure 22:** Development Using Cyanoacrylate after 11 days in fresh water.

A study conducted in national forensic laboratory, Police Ministry of the interior, Stefanova, Slovenia is based on finger prints developed on glass and metal surfaces submerged in stagnant water [10]. The latent fingerprints were deposited on the glass and metal surface and the samples were submerged in

water for different time intervals i.e. (1hr, 24hr, 48hr, 168hr) on glass and (4hr, 24hr, 48hr, 168hr) on metal surfaces. The (Figures 19-21). techniques used for enhancement of finger prints were cyanoacrylate and small particle reagent (black). The result has shown that cyanoacrylate has been proved as the best technique for development of fingerprints submerged in water. The study also proved that latent fingerprints can be developed on metal and glass surface submerged under water even after 168hrs. The study conducted in the University of Teesside is based on the persistence and development of latent fingerprints on non-porous wet surfaces (Figure 22). The materials used for deposition of fingerprints were paper and plastic surfaces and these substances were submerged in water for an hour, 24 hours and a week [11]. The chemicals used for the enhancement of latent fingerprints are Oil Red O and Small Particle Reagent. The results proved that Oil Red O is best for developing prints on paper while Small Particle Reagent yields best on plastics (Figures 23-25).



**Figure 23:** Development Using Cyanoacrylate after 13 days in fresh water.



**Figure 24:** Development Using Cyanoacrylate after 15 days in fresh water.



**Figure 25:** Development Using Cyanoacrylate after 24 hrs in salt water.

## Materials Required

### Chemicals used for enhancement

- a) Porous surfaces: Ninhydrin and Iodine fuming.
- b) Non porous surfaces: Black powder and Cyanoacrylate fuming.

### Other materials

- a) Ostrich hair brush
- b) Water tubs
- c) Fresh water
- d) Sea water
- e) Gloves and face masks
- f) Iodine fuming chamber and cyanoacrylate fuming chamber
- g) Coffee cup warmer
- h) Watch glass

### Samples

- a) Glass pieces (6\*4\*1) cms.
- b) Plastic pieces (6\*4\*1) cms.
- c) Untreated wood pieces (7\*4\*1.5) cms.
- d) Cardboard (6\*4\*1.5) cms.

## Protocol for chemicals used in development of latent finger prints

### Cyanoacrylate fuming



Figure 26: Development Using Cyanoacrylate after 3 days in salt water.

Cyanoacrylate fuming is a development technique used to develop fingerprints on non-porous surfaces.

Equipment: heater, aluminum foil, fuming chamber and super glue Processing Procedure:

- a) Place the aluminum foil in a dish and place it on the heating surface to the highest setting.
- b) When the dish is hot place enough liquid of cyanoacrylate in the dish (Figure 26).

- c) When the cyanoacrylate begins to fume place the specimen in the chamber and secure the chamber door.
- d) Expose the specimen to the fumes for a period of 30 seconds to 4 minutes.
- e) After the procedure is completed, remove the specimen from the chamber to view the latent prints and if necessary the fuming process can be repeated.

### Black Powder



Figure 27: Development Using Cyanoacrylate after 5 days in salt water.



Figure 28: Development Using Cyanoacrylate after 7 days in salt water.



Figure 29: Development Using Cyanoacrylate after 9 days in salt water.

Powdering is the application of finely ground colored powder to a non-porous object to make latent prints visible. Powder adheres to moisture, oil and other residues (Figures 27-30).

- a) Equipment: camel hair brush, feather duster, black powder.
- b) Processing Procedure:

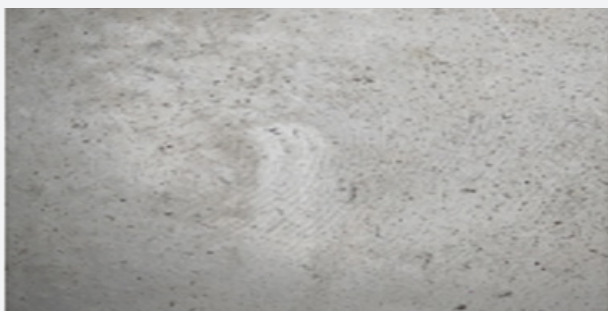
- i. Pour needed amount of powder into a small pile.
- ii. Dip the brush gently into the powder.
- iii. Apply small amount of powder onto the surface and begin to brush.
- iv. Apply in the direction of any ridges that appears.
- v. Build powder onto the ridges and stop when latent print reaches point of sufficient clarity.
- vi. Clean excess powder deposited on the specimen.



**Figure 30:** Development Using Cyanoacrylate after 11 days in salt water.

#### Iodine fuming

Iodine fumes adhere to grease or oil on porous surfaces and appear as yellow stains.



**Figure 31:** Development Using Cyanoacrylate after 13 days in salt water.

- a) Equipment: fuming chamber, ceramic or glass dish, heat source (Figure 31).
- b) Processing Procedure:
  - i. Place iodine crystals in the ceramic or glass dish and place the specimen to be processed in the fuming chamber. Apply heat to the crystals and observe development. Remove the specimens from the chamber when sufficient development has occurred.

#### Ninhydrin (Petroleum Ether Based)

Ninhydrin is used to develop prints in porous surfaces. Ninhydrin reacts with the amino acids present in perspiration (Figure 32).

- a) Equipment: scales, beakers, graduated cylinder, brush,

glass tray, stirring rod, humidity chamber, iron, sprayer, dark storage bottle.



**Figure 32:** Development Using Cyanoacrylate after 15 days in salt water.

#### b) Mixing Procedure:

- i. Ninhydrin ..... 5g
- ii. Methanol ..... 30ml
- iii. Isopropanol ..... 40ml
- iv. Petroleum ether ..... 930ml



**Figure 33:** Development Using Black powder after 24 hrs in fresh water.



**Figure 34:** Development Using Black powder after 3 days in fresh water.

The Ninhydrin crystals are dissolved in methanol followed by the addition of Isopropanol and then add petroleum ether. Processing Procedure: (Figures 33-35) The ninhydrin solution can be applied to a specimen by spraying, dipping or painting. Once the solution has been applied, it must be dried before any attempt is made to accelerate the development process using a humidified environment. if the humid chamber is available, set humidity chamber 60% and 70% for best results (Figures 36-39).



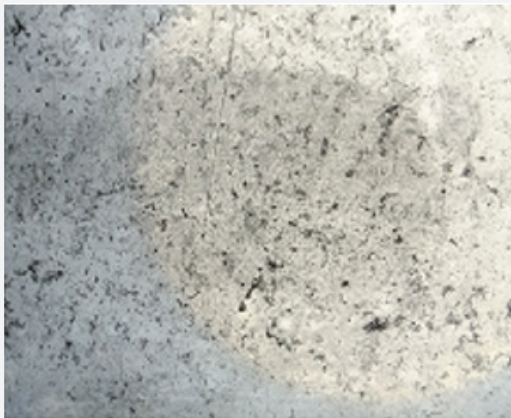
**Figure 35:** Development Using Black powder after 5 days in fresh water.



**Figure 39:** Development Using Black powder after 13 days in fresh water.



**Figure 36:** Development Using Black powder after 7 days in fresh water.



**Figure 37:** Development Using Black powder after 9 days in fresh water.



**Figure 38:** Development Using Black powder after 11 days in fresh water.

### Procedure

- The samples of glass, plastic, wood and cardboard were taken.
- The samples were sterilized by washing and were allowed to dry completely, 24hrs prior to the deposition of latent fingerprints.
- Two clean water tubs were taken and were marked 'A' and 'B'. The tub marked 'A' was filled with normal fresh water and the tub marked 'B' was filled with sea water.



**Figure 40:** Development Using Black powder after 15 days in fresh water.

- The fingerprints were deposited by 3 females and 1 male on the samples. The samples were not allowed to wash their hands prior to deposition (Figure 40).
- The latent fingerprint impressions were deposited at the normal room temperature.

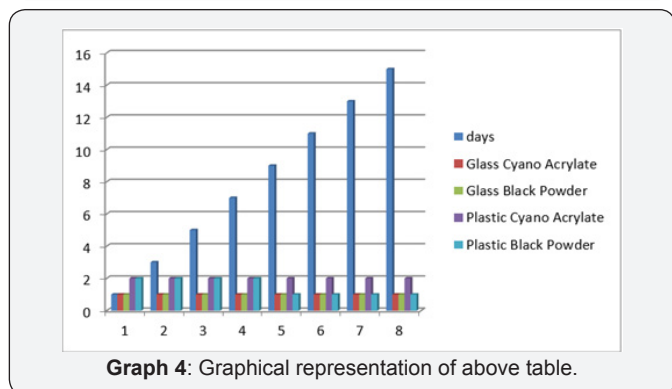


**Figure 41:** Development Using Black powder after 9 days Salt Water



- f) The samples were immediately disposed into the tubs marked 'A' and 'B'.
- g) The samples were submerged in water for a period of 15 days. The samples were removed from water and enhanced on alternative days i.e. 1, 3, 5, 7, 9, 11, 13, 15 respectively.
- h) After the recovery of the samples from the water they were allowed to dry at normal temperature and then the development techniques were implied (Figure 41).
- i) On development, the latent print impression was photographed under normal lighting condition.

**Results & Discussion**



The aim of the research was to develop latent prints from non-porous and porous surface materials disposed in fresh water and saltwater and to determine the effect of salinity of water on the latent prints. The materials used for this research included non-porous materials like glass and plastic pieces and porous substances like untreated wood and cardboard (Figure 42). Both the materials were deposited with latent fingerprints at room temperature. The samples were disposed in fresh water and salt water for a period of 15 days. The samples were removed in a set of odd day's i.e. 1, 3, 5, 7, 9, 11, 13 and 15 days from water and were allowed to dry over a period of 24 hours (Graph 4). Once the samples were completely dried the development techniques were used to develop fingerprints and the use of technique depended upon the type of surfaces (porous: iodine fuming and Ninhydrin, non-porous: black powder and cyanoacrylate). The developed prints were photographed immediately after the process of development (Figure 43).



**Table 1:** showing the presence and absence of prints developed on porous surfaces disposed in fresh water 1= present; 2= absent.

Days	Salt water			
	Porous			
	Wood		Cardboard	
	Ninhydrin	Iodine Fuming	Ninhydrin	Iodine Fuming
1	2	2	2	2
3	2	2	2	2
5	2	2	2	2
7	2	2	2	2
9	2	2	2	2
11	2	2	2	2
13	2	2	2	2
15	2	2	2	2

**Table 2:** showing the presence and absence of prints developed on porous surfaces disposed in salt water 1= present; 2= absent.

Days	Salt water			
	Porous			
	Wood		Cardboard	
	Ninhydrin	Iodine Fuming	Ninhydrin	Iodine Fuming
1	2	2	2	2
3	2	2	2	2
5	2	2	2	2
7	2	2	2	2
9	2	2	2	2
11	2	2	2	2
13	2	2	2	2
15	2	2	2	2

On referring to Table 1, it was found that the partial prints on wood and cardboard were developed using iodine fuming after 24 hours of disposal in fresh water and no latent prints were developed for the later days. Hence it can be concluded that latent fingerprints can be developed from porous substances like untreated wood and cardboard using Iodine fuming for the early days of exposure to fresh water. And the possibility of print development becomes impossible for prolonged days in water.

On referring to Table 1. it was also found that no latent prints were developed on untreated wood and cardboard by the use of Ninhydrin solution after disposal in fresh water. Hence, it can be concluded that Ninhydrin is not an effective technique for development of latent fingerprints from porous materials exposed to fresh water. On referring to Table 2. it was found that no latent fingerprints were developed on wood and cardboard using Iodine fuming and Ninhydrin method disposed in salt water. Hence, it can be concluded that Iodine fuming and Ninhydrin are not effective methods to develop latent fingerprints from porous materials disposed in salt water.

**Table 3:** showing the presence and absence of prints developed on non-porous surfaces disposed in fresh water. 1= present; 2= absent.

Days	Fresh water			
	Non-Porous			
	Glass	Plastic		
	Cyano Acrylate	Black Powder	Cyano Acrylate	Black Powder
1	1	1	2	1
3	1	1	2	1
5	1	1	2	1
7	1	1	1	1
9	1	1	1	1
11	1	1	1	1
13	1	1	1	1
15	1	1	1	1

**Table 4:** showing the presence and absence of prints developed on porous surfaces disposed in salt water. 1= present; 2= absent.

Days	salt water			
	Non-Porous			
	Glass	Plastic		
	Cyano Acrylate	Black Powder	Cyano Acrylate	Black Powder
1	1	1	2	2
3	1	1	2	2
5	1	1	2	2
7	1	1	2	2
9	1	1	2	1
11	1	1	2	1
13	1	1	2	1
15	1	1	2	1

On referring to Table 3. it was found that latent finger prints were developed on glass after 15 days of exposure in fresh water using black powder. As the days of exposure to water prolonged, the quality of print degraded. It was also found that the variation in the rate of deposition of sweat affects the quality of prints developed. On referring to Table 4. it was found that latent finger prints were developed on glass after 15 days of exposure in salt water using black powder technique. As the days of exposure to water prolonged, the quality of print degraded. The prints

developed from glass was disposed in fresh water and salt water were compared and it was found that the print developed on glass recovered from fresh water yielded a better quality print when compared to that recovered from salt water. Hence, it can be concluded that black powder can be used for development of fingerprints on glass evidences disposed in fresh water and salt water. The quality of print developed degrades with time of exposure to water and salt water has a predominant effect on the quality of prints and degrades prints at a faster rate compared to fresh water (Figure 44).



**Figure 44:** Development Using Black powder after 15 days Salt Water



**Figure 45:** Development Using Cyanoacrylate after 7 days in fresh water.

On referring to Table 3. it was found that the latent prints were developed on glass for 15 days after exposure to fresh water using cyanoacrylate fuming. The quality of prints gets degrades as a result of prolonged exposure to the water. On referring to Table 4. it was found that the prints were developed on glass for 15 days of exposure to salt water by the use of cyanoacrylate fuming. The glass produced faded light prints by the end of 13 day due to the deposition salt particles over the surface which interferes with the fumes and prevents fumes to be deposited on the surface (Figure 45). Hence on comparing the prints it can be concluded that Cyanoacrylate fuming proves to be an effective technique for development of finger prints from surfaces exposed to water. And the salt water has a predominant effect on the quality of prints and degrades prints at a faster rate compared to freshwater. On referring to Table 3. it was found that the latent prints were not developed for the first three consecutive days and this may be due to the deposition of low quality prints prior to disposal. The prints were developed after 7 days of exposure to fresh water using black powder.



**Figure 46:** Development Using Cyanoacrylate after 11 days in fresh water.



**Figure 47:** Development Using Cyanoacrylate after 13 days in fresh water



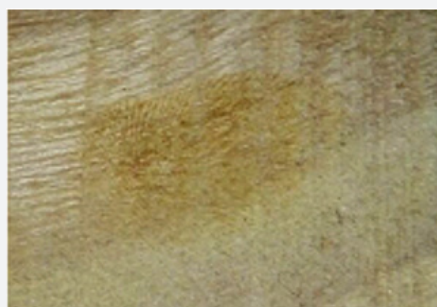
**Figure 48:** Development Using Cyanoacrylate after 15 days in fresh water.

On referring to Table 4. it was found that the latent were not developed for the first three consecutive days and this may be due to the deposition of low quality prints prior to disposal. On comparing both the prints developed on plastic disposed in fresh water and salt water (Figure 46). It was found that the prints developed on plastic disposed in fresh water yielded a much better quality prints when compared to that disposed in salt water (Figure 47). Hence, it was concluded that black powder is an effective technique used for the development of latent prints on plastic disposed in water (Figure 48). And the salinity of water has a predominant effect on the quality of print developed. On referring to Table 3, it was found that latent finger prints were not developed for the first three consecutive days and this may be due to deposition of low quality prints prior to disposal. The prints were developed after 7 days of exposure to fresh water using cyanoacrylate fuming technique (Figure 49). On referring

to Table 4. it was found that latent prints were not developed for any days on plastic surface using cyanoacrylate disposed in salt water. Hence, it can be concluded that cyanoacrylate may prove to be an effective technique for development of latent print on plastic disposed in fresh water but proves to be less reliable to plastic surfaces disposed in salt water (Figure 50).



**Figure 49:** Development Using Iodine fuming after 24 hrs in fresh water.



**Figure 50:** Development Using Iodine fuming after 24 hrs in fresh water.

## Conclusion

The aim of the study was to develop latent fingerprints from non-porous and porous surface materials disposed in fresh water and sea water. The study demonstrated that it is possible to develop latent prints from porous and non-porous material disposed in water. It was concluded that black powder was considered to be the best visualization method for development of latent prints on non-porous materials disposed in fresh water and salt water. The duration of disposal affects the quality of fingerprints developed i.e. the longer the duration of disposal, the lower the quality of prints developed. This study also conclude that iodine fuming method can develop prints on porous materials at the early days of disposal and no latent prints can be developed for later days. Ninhydrin proves to be a non-effective technique for the development of latent prints on porous surfaces disposed in water. In addition, this study has revealed that the exposure to salinity i.e. salt water has a more damaging consequence on the quality of the detected latent finger print. Hence it can be concluded that any piece of evidences recovered from water bodies must be examined for the presence of latent prints irrespective of the time since disposal.

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DOI: [10.19080/JFSCI.2018.10.555779](https://doi.org/10.19080/JFSCI.2018.10.555779)

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