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Research Paper

Development of Latent Finger Prints on Nonporous Surfaces Recovered from Water Samples of Abaya & Chamo Lakes, Forty Springs and Rain Water of Arba Minch Region

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ABSTRACT
Fingerprints have a key role in criminal investigations and are the most commonly used form of evidence in world- wide. Criminal offenders have a fundamental goal not to leave any traces at the crime scene. Some may suppose that items recovered under water will have no forensic value, therefore, they try to destroy the traces by throwing items in water. These traces are subjected to the destructive environmental effects. This can represent a challenge for forensic experts investigating fingerprints. 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 non-porous materials disposed in water samples of Forty Spring, Chamo lake, Abaya Lake and Rain Water. Fingerprints are one of the most important forms of physical evidence in criminal investigations and the most commonly used forensic evidence in world- wide. Fingerprint examination cases typically match or out-number all other forensic case work combined, with approximately ten times as many cases solved using fingerprint evidence compared toDNA.
Keywords: *Fingerprints, black powder, crime, water surface*

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I. INTRODUCTION

In Ethiopia Criminal offenders have two basic goals, i.e., to successfully commit a criminal offence and to remain undetected, in order to avoid responsibility for their illicit conduct. They usually tread carefully and try to not leave any traces at the crime scene. These objects are difficult to detect and traces are subjected to destructive effects of the environment this can represent a difficulty for experts investigating fingermarks. Fingerprint Evidences one of the most reliable and accepted evidence in the court of law when fingerprints are exposed to different atmospheric conditions for example of fingerprints Evidences usually recovered from under water crime scenes have always been a challenge for the forensic researchers or Ethiopian forensic investigation bureaus. Water has a destructive Effect on the Prints and considerably affects the evidential values.

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 weapon's prior disposal in water bodies. The enhancement of the 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 non-porous surfaces disposed in water by using suitable development techniques. This study also assumes that the Salinity of thewater may have an adverse effect on the quality of print developed. The study mainly focused on the use of Black Powder for development of latent finger prints on non-porous surfaces.

The present study was conducted to determine the optimal method for latent fingerprints development on dry non-porous surfaces submerged in aquatic environments at different timeinterval. The quality of the developed fingerprints depending on the used method was assessed. In addition, two factors were analyzed in this study; the effects of the nature of aquatic environment and the length of submerged time. Therefore, latent fingerprints were deposited on metallic, plastic and glass objects and submerged in spring, rain and lake water (abaya and Chamo) for 1, 2, and 5 days. After recovery, the items were processed by black powder and the prints were examined. Each print was evaluated according to fingerprint quality assessment scale.

Criminals usually tread carefully and try not to leave any traces at the scene of the crime. Investigators are frequently faced with the fingerprint detection and their subsequent development tasks. In some cases, offenders try to destroy the traces by throwing items, e.g., bottles, firearm, plastics, foils, etc. in water or by exposing the scene and objects to extreme conditions likewater.

II. MATERIALS and METHODS

In order to make the study, analysis and interpretation of sampling gathered from Arab Minch Region (Water sample from Abaya Lake, Chamo Lake, Rain Water and Forty Springs). The samples were gathered. 12 tubs tanks were prepared and the water distributed to the tank toexamine.

Three surfaces have been chosen for the study. On each surface four latent fingerprints have been collected from five individuals. The subjects were asked to touch his/her forehead and face and then their fingerprints / and prints were taken. Four sets of three surfaces, impinged with latent fingerprint were immersed in water for (one day, two days and five days) and then they are allowed to dry. Four sets for every surface is prepared to study the development of latent prints in various time intervalsi.e. developmentisd one after the printsare one day, two days, and five day sold.

The method used here in the development of latent prints is powder dusting without using the brush as preliminary studies. Application of powder to the print by brushing is a simple and an easy technique but it also has disadvantage like the brush on coming in contact with the surface having the print, destroys the print and hence the ridge characteristics. In order to develop latent fingerprints, the black powder is sprinkled over a surface and then excess of powder is removed by tapping in order to get aclear view of fingerprints.

Materialsused

Non-porous surfacesused:

1. Glass sheets (approx. 20 × 10cm)
2. Compact discs (shinysurface)
3. Knife blades (stainlesssteel)

Fingerprint powder used: Blackpowder

Miscellaneous items used:

1. Tubs/ Plastictank.
2. Alcohol
3. Permanent marker
4. Gloves, face masks and magnifying glass

Procedure

The samples of glass, plastic and metal weretaken. Thesurfaces were cleaned by washing and sterilized by alcohol swabs to make sure no unintentional prints were deposited. After that, all were allowedto dry completely, 24hrs prior to thedeposition of latentfingerprints.12 clean water tubs were taken and were marked Chamo, Abaya Lake, rain and spring water and the tubs were filled with water samples collected from Chamo and Abaya Lake, rain and springwater. Thefingerprints have been deposited by five consent fingerprint donors.The fingerprint donors were informed not to wash their hands before the experiment. They were asked to rub their fingertip against the forehead and around the nose (groomed/ sebum rich fingerprint), then press their fingers in rolling motion against the surface. The samples were not allowed to wash their hands prior to deposition (Figure1). The intention was to initially deposit good quality fingerprints onto the substrate and, where possible, oblique lighting was used to confirm that the quality and clarity of those recently deposited fingerprints were identifiable. The deposited prints were labeled using permanent marker. The latent fingerprint impressions were deposited at the normal roomtemperature. The samples were disposed one hour later into the tubs marked Chamo Lake, Abaya Lake, Rain and spring water (Figure2). The samples were submerged in water for a period of 5 days. The samples were removed from water and enhanced on alternative days i.e. 1, 2, 5,respectively. After the recovery of the samples from the water we were allowed to dry atnormal temperature and then the development techniques were implied (Figure3).On development, the latent print impression was photographed under normal lightingcondition.


Figure 1: **Five fingerprint donors was taken**


Figure 2: Non-porous surfaces were placed in Plastic tank filled with 4 type of water samples after fingerprints deposition

Figure3: Developed latent fingerprints using black powder on knife blade after submersion in spring water for 1 day. (Score 5)

Figure 4: Developed latent fingerprints using black powder on glass after submersion in spring water for 1 day. (Score4)

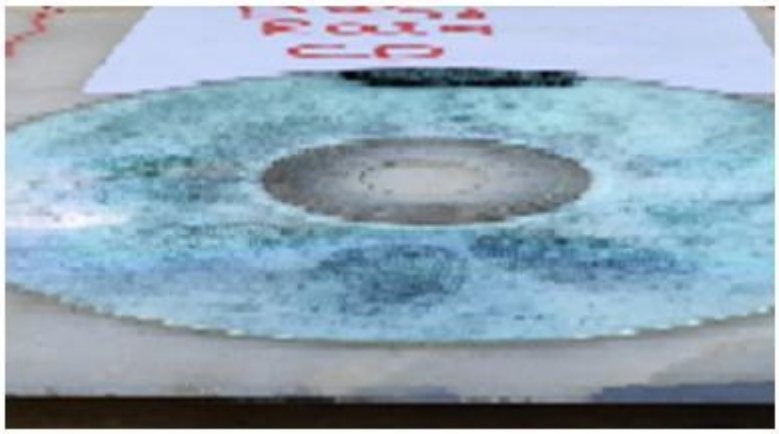


Figure 5: Developed latent fingerprints using black powder on CD after submersion in spring water for 1 day. (Score2)

FingerprintsExamination

The developed latent prints were examined using magnifying glass and photographed. All print marks were examined, assessed and scored according to fingerprint quality assessment scale.

Score 5- Very goodvisibility

Clearly defined friction ridges across entire print. Classifiable as one of the three basic fingerprint patterns (arch, loop, or whorl). Core (center point) and minutiae (individual features,
e.g. bifurcation, ending ridge) are visible.

Score 4- Goodvisibility

Clearly defined friction ridges are visible across majority of print. Classifiable as one of the three basic fingerprint patterns (arch, loop, or whorl).

Score 3- Poorvisibility

Friction ridges are only visible on portion of print. The print cannot be classified into one of the three basic fingerprint patterns. Prints may be smudged.

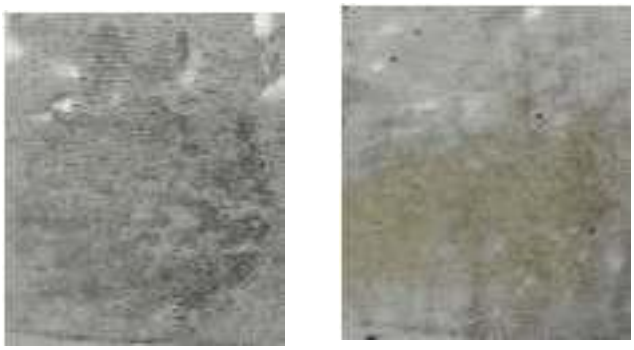
Score 2- Badvisibility

No friction ridges are clearly defined. Print is almost completely smudged or obscured and cannot be classified into one of the three basic fingerprint patterns.

Score 1- Blur/No print

No print is visible or only the outline of print is visible.

5- VeryGoodVisibility **4-GoodVisibility** **3- PoorVisibility**



2- BadVisibility **1- Blur / NoPrint**

Figure 6: Latent fingerprint visibility scoringsystem

Visualization method: The surfaces were left in air for two hours to dry then the black powered dusting methods were used:Little amount of the black powder was sprinkled on the non-porous surface and the excess was removed using the squirrel hair brush with special care to leave the fingerprints intact (Figs. 7 and 8).

Figure 7: Developed latent fingerprints using black powder on knife blade after submersion in spring water for two days. (Score 3)

Figure 8: Developed fingerprint using black powder on glass surface after submersion in Chamo lake water for two days. (Score 3)

III. RESULTS ANDDISCUSSION

Different results are shown when development is done on various substrates depending upon the time of development. Initially after drying the sample the results were good on each surface but later on ridges are not clear depending upon the surface. It is clear from the figures that developed prints are of good quality and can beanalyzed. It had been observed that on all the surfaces fingerprints could be developed after oneday.

Surfaces Disposed on Chamo LakeWater Samples

On the fifth day, 60% of fingerprint were poor and no blurred characteristics appeared. In metal deposition 50% present is bad and in plastic deposition 60% is blurred

Table 1: Chamo Lake Water scores

Fingerprints development scores using black powder techniqueon glass, metal and plastic surfaces submerged in Chamo Lake water at 1, 2- and 5-days' intervals according to fingerprints quality assessment scale

Black powder	Time (days)	Number of deposited marks	Scores									
			5 (very good)		4 (good)		3 (poor)		2 (bad)		1 (blur/no)	
			N	%	N	%	N	%	n	%	n	%
Glass	1	10	2	20%	4	40%	4	40%	0	0%	0	0%
	2	10	1	10%	2	20%	5	50%	2	20%	0	0%
	5	10	0	0%	1	10%	6	60%	3	30%	0	0%
Metal	1	10	1	10%	2	20%	3	30%	4	40%	0	0%
	2	10	0	0%	1	10%	4	40%	5	50%	0	0%
	5	10	0	0%	0	0%	5	50%	5	50%	0	0%
Plastic	1	10	2	20%	3	30%	5	50%	0	0%	0	0%
	2	10	1	10%	2	20%	6	60%	1	10%	0	0%
	5	10	0	0%	0	0%	2	20%	2	20%	6	60%

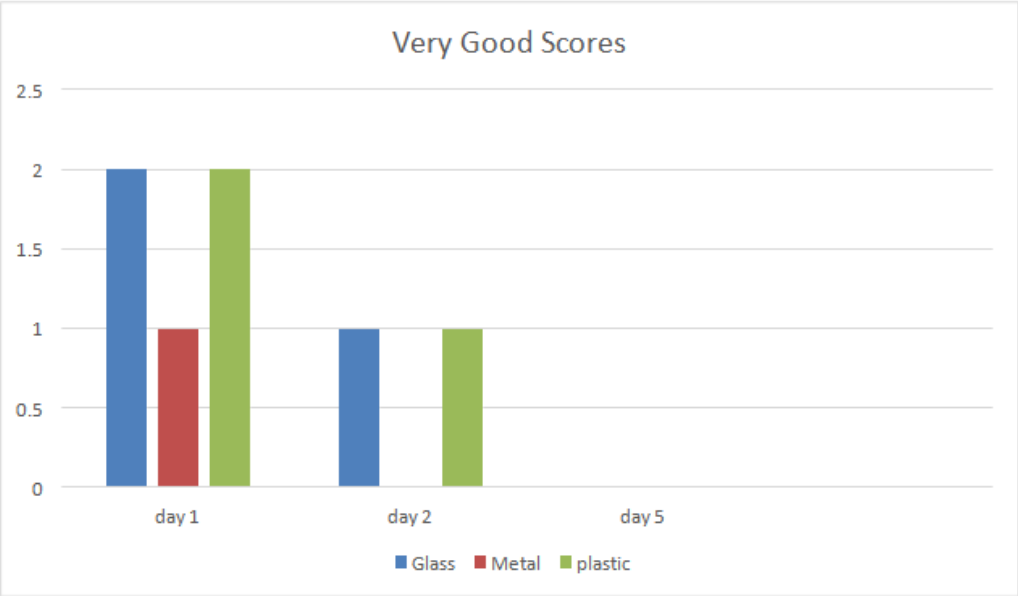


Figure 9: Very good score for Chamo Lake Water

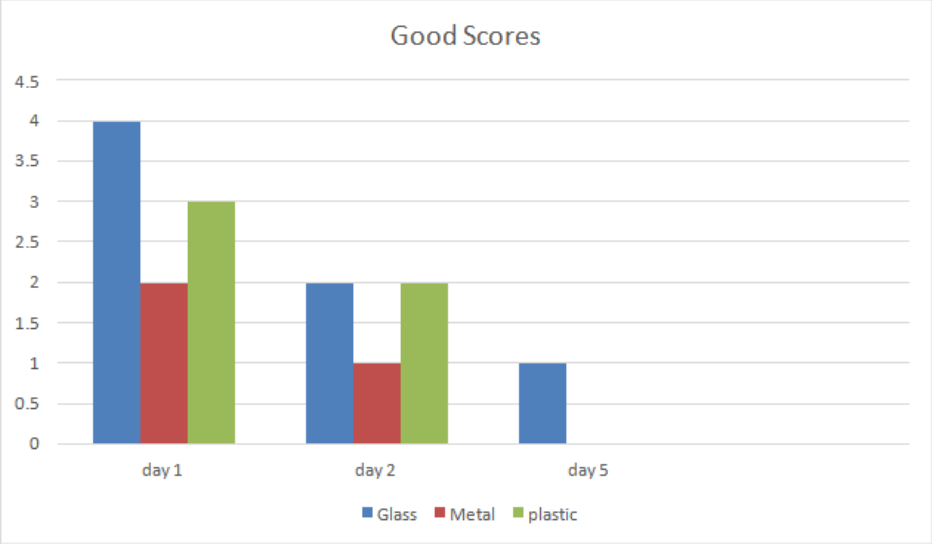


Figure 10: Good scores for Chamo Lake Water

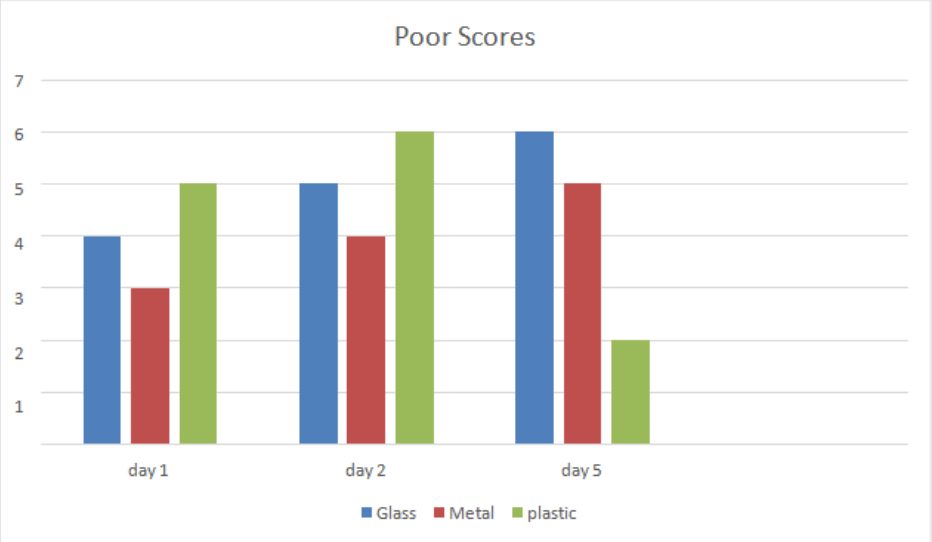


Figure 11: Poor Score for Chamo lake water

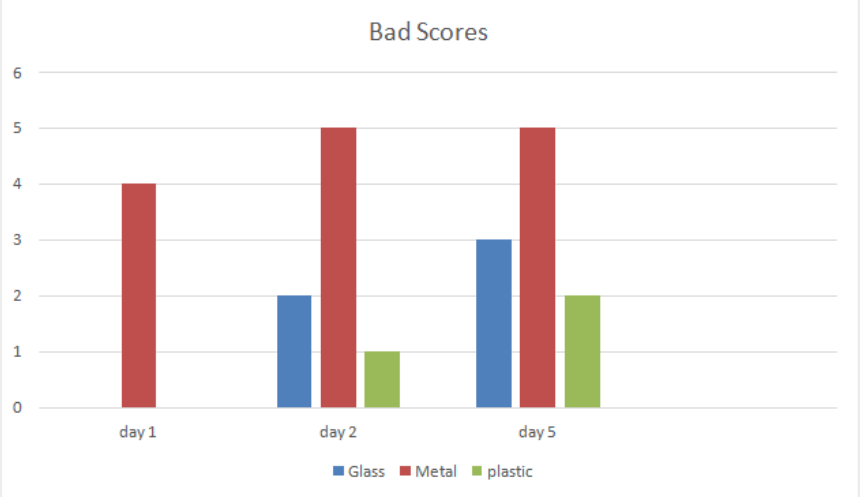


Figure 12: Bad Scores for Chamo Lake Water

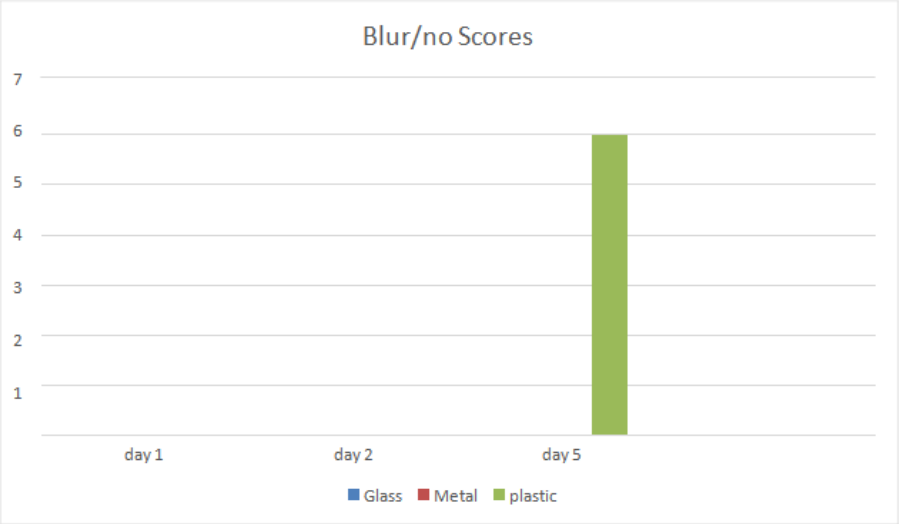


Figure 13: blur/no Scores for Chamo Lake Water

Surfaces Disposed on Abaya Lake Water Samples

No fingerprint was detected during the first day of deposition, indeed the nature of the water samples of lake (muddy water) makes it worsen to recover prints. The visibility of the print almost invisible up to 70%

Table 2: Abaya Lake water scores

Fingerprints development scores using Black powder on glass, metal and plastic surfaces submerged in abaya lake water at 1, 2- and 5-day's intervals according to fingerprints quality assessment scale

Black powder	**Time (days)**	**Number of deposited marks**	**Scores**									
			5 (very good)		**4 (good)**		**3 (poor)**		**2 (bad)**		**1 (blur/no)**	
			N	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Glass	1	10	0	0%	2	20%	3	30%	5	50%	0	0%
	2	10	0	0%	1	10%	3	30%	6	60%	0	0%
	5	10	0	0%	0	0%	0	0%	3	30%	7	70%
Metal	1	10	0	0%	1	10%	4	40%	5	50%	0	0%
	2	10	0	0%	0	0%	4	40%	6	60%	0	0%
	5	10	0	0%	0	0%	5	50%	3	30%	2	20%
Plastic	1	10	0	0%	2	20%	4	40%	4	40%	0	0%
	2	10	0	0%	1	10%	3	30%	2	20%	4	40%
	5	10	0	0%	0	0%	2	20%	3	30%	5	50%

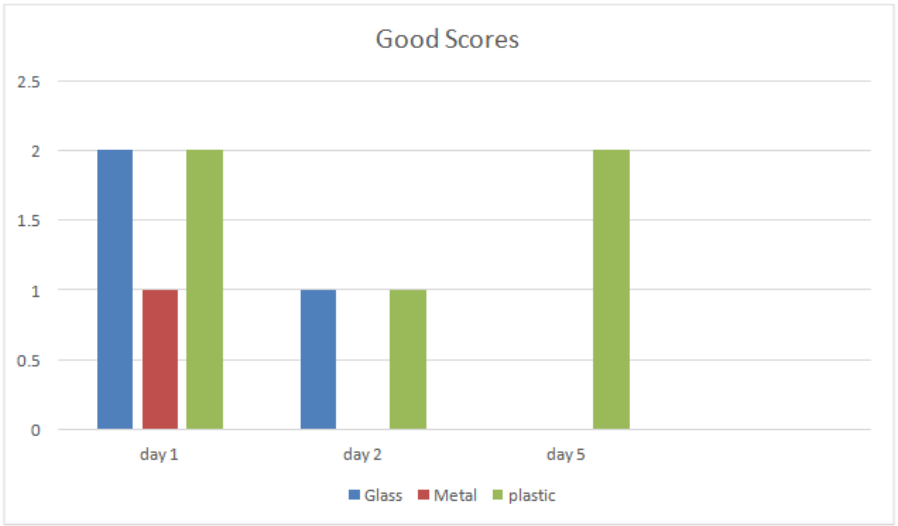


Figure 14: Good Scores for Abaya Lake water

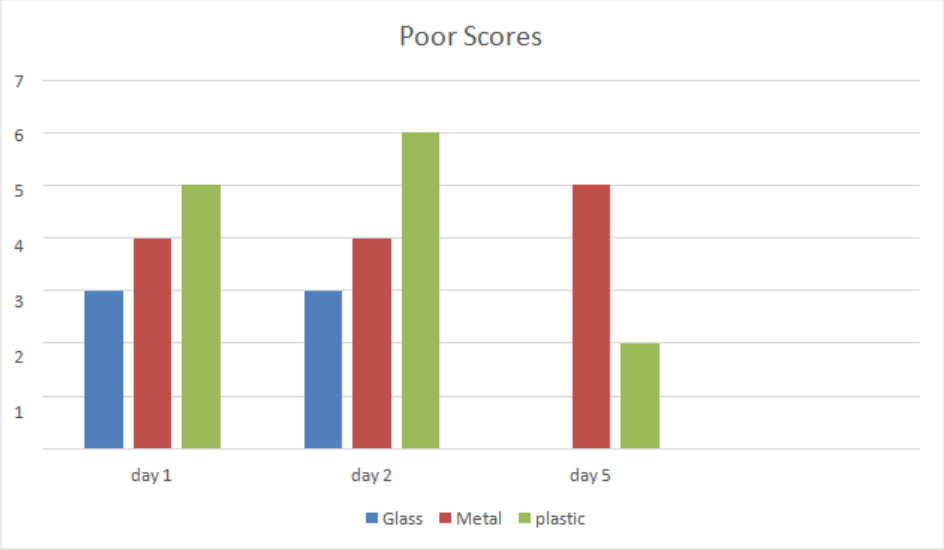


Figure 15: Poor Scores for Abaya Lake water

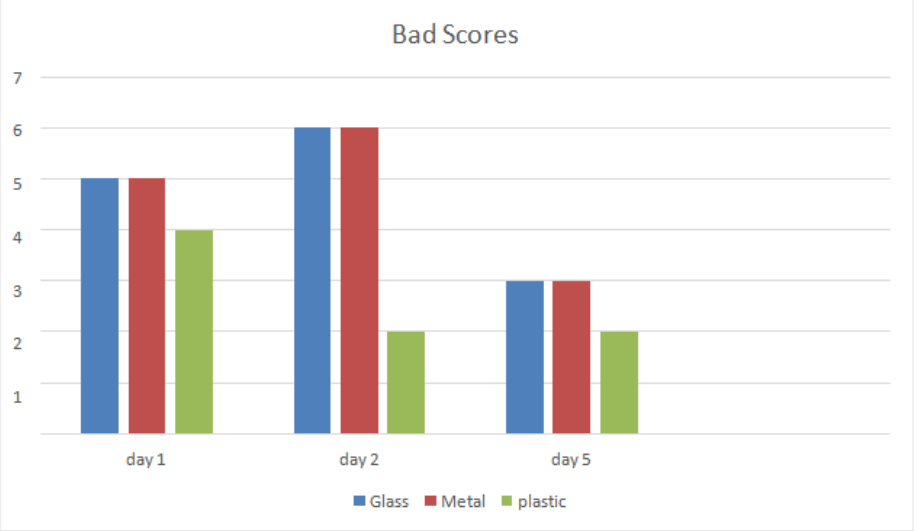


Figure 16: Bad scores for Abaya Lake water

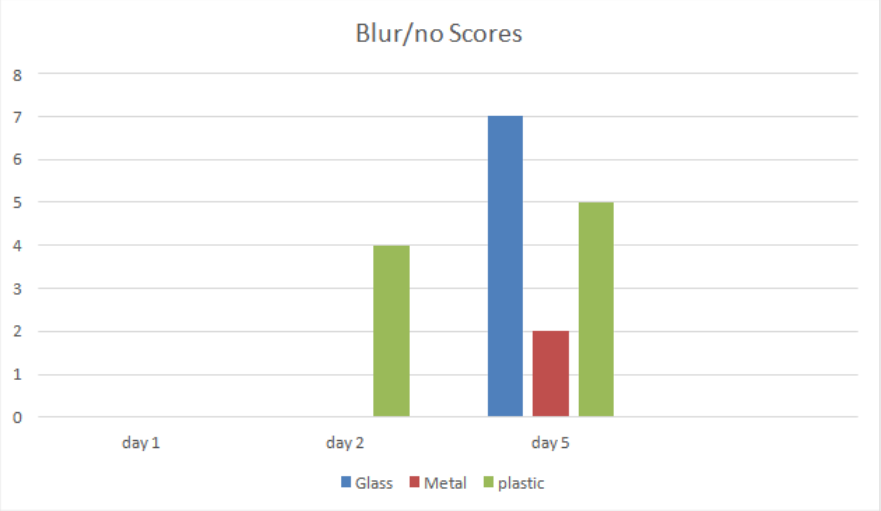


Figure 17: Blur/no Scores Abaya Lake water

Surfaces Disposed on Rainwater

The quality of the developed fingerprints on glass surfaces after 1 day revealed that half ofthem were of badvisibility.

On metal surface, the quality of 40% of the developed marks was with poor visibility andmost of the prints werebad.

Table 3: Rain water scores

Fingerprints development scores using Black powder on glass, metal and plastic surfaces submerged in Rain water at 1, 2- and 5-day's intervals according to fingerprints quality assessment scale

Black powder	Time (days)	Number of deposited marks	Scores									
			5 (very good)		4 (good)		3 (poor)		2 (bad)		1 (blur/no)	
			N	%	n	%	n	%	n	%	n	%
Glass	1	10	0	0%	2	20%	2	20%	5	50%	1	10%
	2	10	0	0%	0	0%	1	10%	5	50%	4	40%
	5	10	0	0%	0	0%	0	0%	5	50%	5	50%
Metal	1	10	0	0%	3	30%	4	40%	3	30%	0	0%
	2	10	0	0%	2	20%	3	30%	5	50%	0	0%
	5	10	0	0%	1	10%	2	20%	4	40%	3	30%
Plastic	1	10	0	0%	2	20%	3	30%	5	50%	0	0%
	2	10	0	0%	1	10%	1	10%	6	60%	2	20%
	5	10	0	0%	0	0%	1	10%	7	70%	2	20%

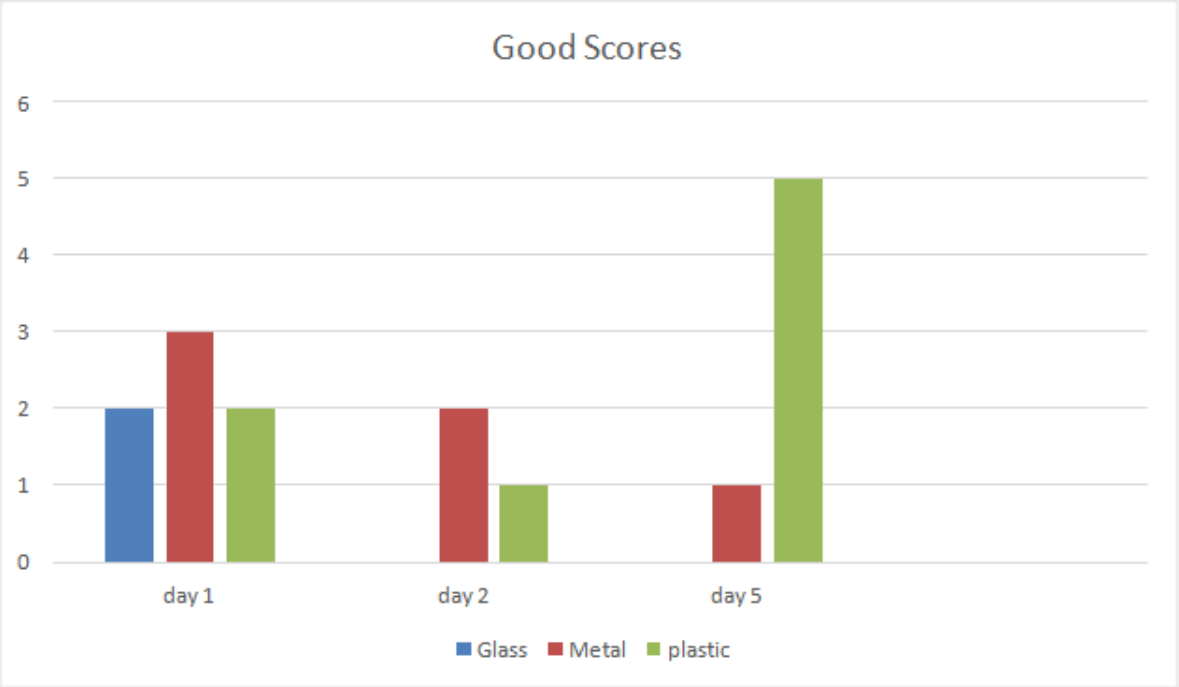


Figure 18: Good Scores for Rain water

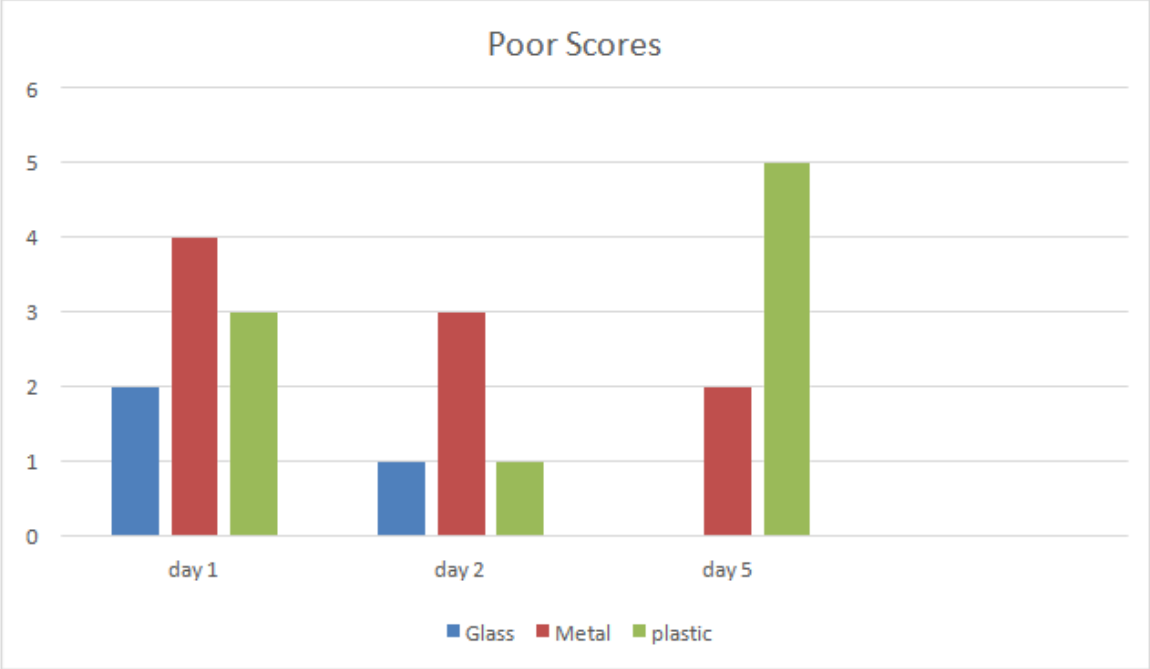


Figure 19: Poor Scores for Rain water

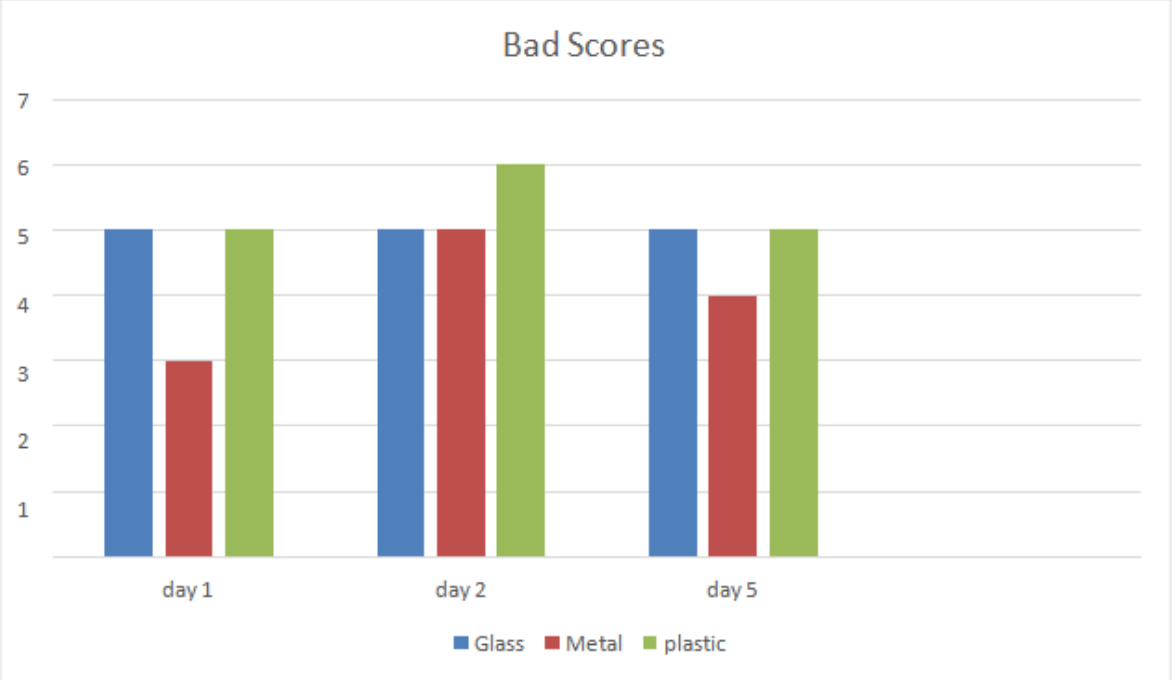


Figure 20: Bad Scores for Rainwater

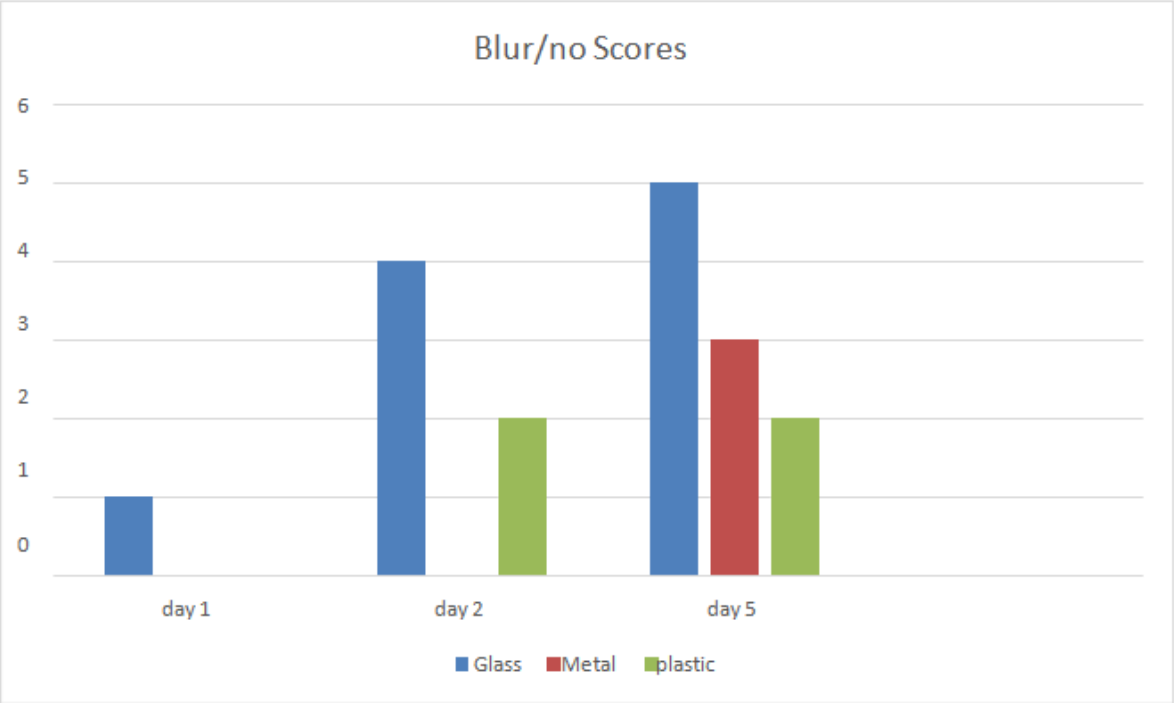


Figure 21: Bad Scores for Rainwater

Surfaces Disposed on Water Samples Forty SpringWater

Half of the developed prints on glass surface were of good visibility (50%). Spring water is better in recovering the finger print the tendency of losing finger print is low. The finger print remain almost near until the fifth day, and no blurred or total appearance wasn't conducted, the least poor is70%

Table 4: Forty spring water scores
Fingerprints development scores using black powder technique on glass, metal and plastic surfaces submerged in forty spring at 1, 2and 5 days' intervals according to fingerprints quality assessment scale

Black powder	**Time (days)**	**Number of deposited marks**	**Scores**									
			5 (very good)		**4 (good)**		**3 (poor)**		**2 (bad)**		**1 (blur/no)**	
			n	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
Glass	1	1	4	40%	5	50%	1	10%	0	0%	0	0%
	2	1	3	30%	5	50%	2	20%	0	0%	0	0%
	5	1	2	20%	3	30%	5	50%	0	0%	0	0%
Metal	1	1	5	50%	4	40%	1	10%	0	0%	0	0%
	2	1	4	40%	3	30%	3	30%	0	0%	0	0%
	5	1	2	20%	2	20%	6	60%	0	0%	0	0%
Plastic	1	1	3	30%	4	40%	3	30%	0	0%	0	0%
	2	1	2	20%	3	30%	5	50%	0	0%	0	0%
	5	1	1	10%	2	20%	7	70%	0	0%	0	0%

Table 5 shows that on plastic surface, 40% of prints were of good visibility on the first day.

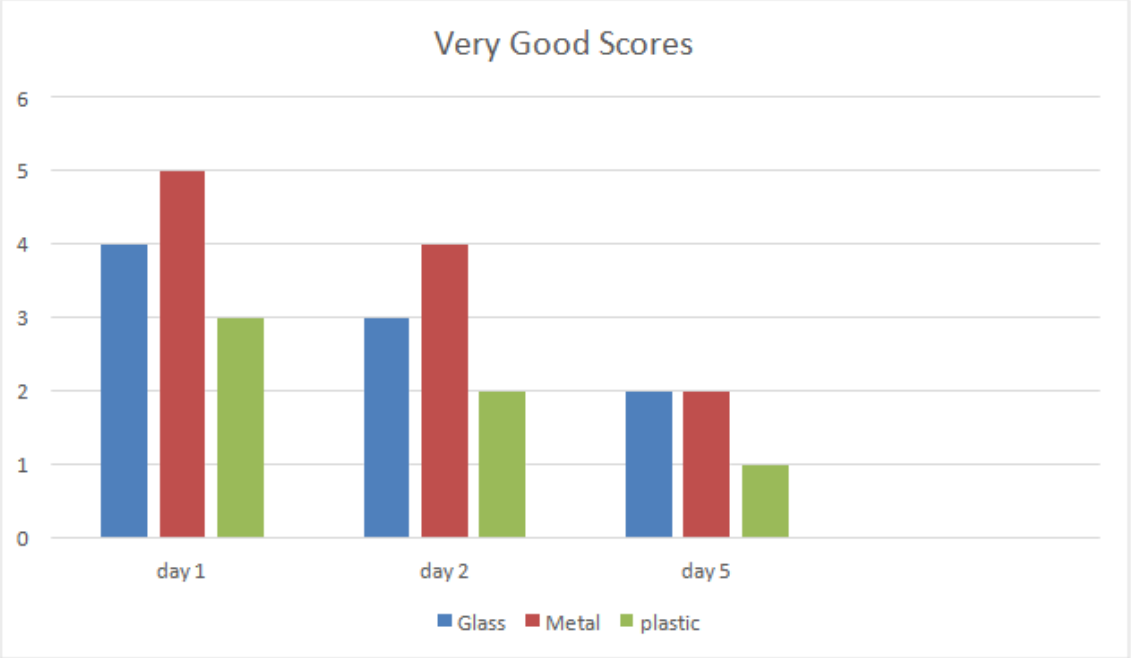


Figure 22: Very Good Scores for Forty Spring water

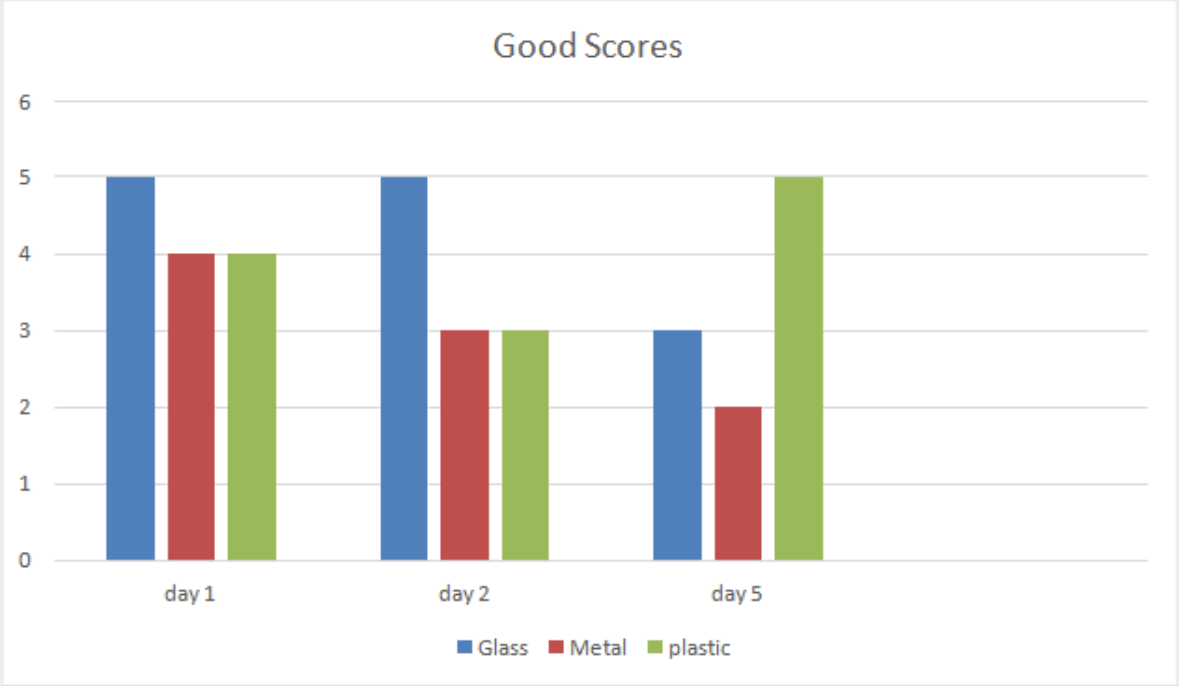


Figure 23: Good scores for forty spring water

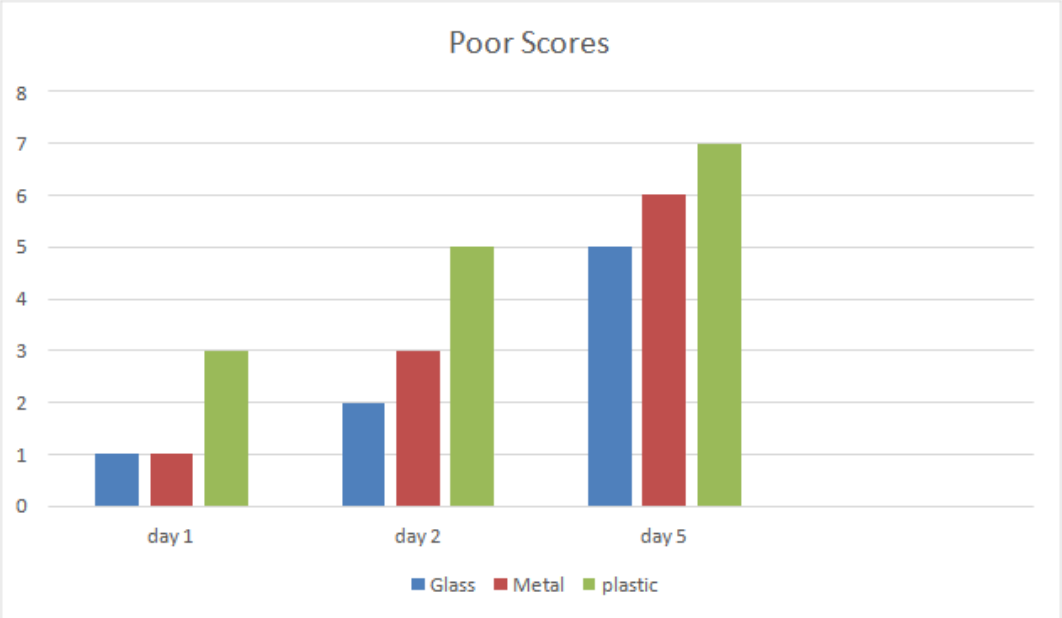


Figure 24: Poor scores for forty spring water

IV. CONCLUSION

The study demonstrated that it is possible to develop latent prints from non-porous material disposed in water. It was concluded that black powder was considered to be the one of the conventional and regular visualization methods for development of latent prints on non-porous materials disposed in fresh water and lake water. The duration of disposal affects the quality of fingerprints developed i.e. the longerthe duration of disposal, the lower the quality of prints developed. This study also concludes that black powder proves to be an effective technique for the development of latent prints on non-porous surfaces disposed in water. In addition, this study has revealed that the exposure to salinity and water containing mud i.e. rain and abaya lake 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. Fingerprint development on different objects submerged in water at different interval of time. One should be aware that in real cases it will be difficult to find out whether the fingerprint on a submerged object were deposited before or during submersion. Consequently, it will be necessary to find out which reagent and procedures is the most effective in respective crime cases.

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