

Determination of the Consistency and Persistency of Developed Latent Prints Using Factors of Exposure: Experimental Research

Queen Heneylour S. Relatorres, Rosalie T. Navarro, Rose Jane Mae A. Nepangue

College of Criminal Justice Education, University of the Visayas

DOI: <https://doi.org/10.51244/IJRSI.2026.1308000322>

Received: 09 September 2026; Accepted: 14 September 2026; Published: 24 September 2026

ABSTRACT

This study investigates the longevity of latent fingerprints on products exposed to extreme heat and water such as in a fire scene. This study is a pre-experimental design over latent development -using black powder reagent (PS27A). The latent print development was conducted using various household items, which are non-porous and porous materials subjected to high temperatures using butane torch and high-velocity water from a fire truck. Results showed that non-porous materials, such as glass and metal, retained usable latent prints even after high heat and water pressure exposure, with significant retention for up to 30 days. Though a porous material like clothing demonstrates rapid degradation of latent prints, it still yields a positive result. This study highlighted the importance of latent print development process as immediate as possible to maximize the recovery of latent prints with in the fire scene incident. The findings of this study yield a 95% confidence which suggests a high level of reliability in the findings from the sample of 10 trials. This finding also underscores the need for forensic investigators to focus on non-porous materials during evidence collection and follow protocols on evidence recovery in relation to latent prints. Finally, this study recommends that latent print development using powder reagents can be practice or applied during arson/fire scene investigations.

Keywords: Latent Prints, Exposure Factors, Experimental Research and Forensic Analysis

INTRODUCTION

Fingerprints have been used for the purpose of criminal identification for years because of their individual characteristics which do not change. These characteristics form before birth and can remain identifiable throughout one's life and after death. Upon our hands and feet, we have friction skin. Friction skin is comprised of several ridges that have sweat pores which constantly exude perspiration. Aside from the natural exude from the friction skin, the ridges may also become contaminated with other mediums (paint, blood). When an object is touched, the perspiration or other matter upon the raised ridges may transfer to the item. The outline of these ridges leaves what is referred to as a latent fingerprint impression. The question regarding how long a fingerprint can survive has been a common inquiry in criminal cases especially on fire scenes.

According to (Spawn, 2000) arson presents itself as one of the most expensive crimes in terms of monetary loss. The crime of arson, however, seems to attract a lesser degree of attention when it comes to examining a scene for fingerprints. This is likely due to the destructive forces which are present at fire scenes: intense heat and excessive black soot. The investigator may not entertain the possibility of a scene fingerprint examination because of the destructive nature of fire. On the study of Midkiff, (2006) from all of the studies and cases examined, it is apparent that wide variations exist in the ability of a latent print to survive, even under rather harsh conditions. Development of a latent print at a crime scene is no guarantee of its having been recently placed. Merkel (2011) works, however, employs a different approach, counting binary pixel for the approximation of a mathematical ageing function. Holyst (2010) describes analyzing changes in the preparatory-adipose substance to determine a presumable time on smooth and absorptive surfaces within the limits from 24 hours to a few years. It is unclear, however, whether these tests would be satisfactorily accurate when dealing with crime scene marks that could contain other contaminants.

Across the International countries, the development of improving the means and the techniques of fingerprint identification has come to its excellent phase, yet there are still areas that has been taken for granted which fingerprint is found essential in cases such as arson, which perceived by the many as a weak kind of evidence to convict criminals. A lack of information concerning the potential recovery of fingerprints from the fire scenes and related evidence creates the gap in solving cases of arson.

Thus, the researchers prompted conduct a study that will fill the gap regarding the longevity of latent prints when exposed to fire. The researcher also considered on how the resultant findings could be put in to the practice of fingerprint or arson examiners.

Methodical` Framework

This research is anchored on the procedure of Spawn (2000) in his study in testing the effects of fire in latent prints. As part of this research, four separate incendiary fires will be set as part of the experiment. A kerosene, gasoline mixture was used in each fire. Ordinary household items will be placed in each scene. Flammable liquid containers will also place in these settings, such as those which may be left behind by an arsonist. Fires will be set and burn. The fire will result in the kind of intense heat and thick black smoke that would be encountered in the field. The fires will be extinguished through ordinary suppression efforts, and examined.

Longevity status of latent prints – No scientific methods can determine the length of time for which a fingerprint lasts on an object. There are many factors that determine how long a fingerprint lasts on any surface or object, with environmental conditions being the primary influence of the longevity of the prints. In some instances, fingerprints have been discovered on objects that have not been disturbed for more than 40 years. Sometimes prints cannot be found on an object or surface that was recently tampered with as most prints are removed when the surface is cleaned. According to (South Dakota Division of Criminal Investigation, 2014) it is also not possible to determine the age of a latent print with scientific methods without knowing when a surface was last completely cleaned.

Intensity of Fire- for some surfaces, there are temperatures beyond which latent prints can be recovered thus making it impossible to get an impression. According to

(Iten, 2012) the longer the latent print is exposed to heat, the maximum temperature to visualize that impression decreases. These maximum temperatures may vary depending on the surface they are tested on, but were the same in this study.

Degree Celsius- refers to a specific temperature on the Celsius scale as well as a unit to indicate a temperature interval. This measurement will be used in the study to measure the intensity of fire where latent prints will be exposed to it.

Water pressure- Water pressure refers to the force that allows water to go through pipes and reach people's homes. Some factors that affect water pressure are the height of the water reservoir, the elevation of a property and the water usage of consumers.

Per cubic tons- The cubic ton is a measure of volume

Possible areas to be found- these areas are referring to the surfaces where the latent prints will be discovered. Possible areas of the experiment will cover the origin of fire and distance from the origin of fire.

Origin of the fire is the place within the fire scene where the fire started before it escalates. Dehaan (2011) best describes the physical feature of the origin of fire where state, process, or instance of combustion in which fuel or other material is ignited and combined with oxygen, giving off light, heat, and flame.

Distances from the origin of the fire- these are the spaces surrounding the origin of fire, these spaces are within the 5 feet distance from the source of ignition. According to (Spawn, 2000) latent prints may not be found on the origin of fire where the production of soot is to strong however with 5 feet away from the origin fire latent print may be recovered because the soot effect from the fire has the same procedure to a camphor

method of developing a latent print. The use of camphor is a fuming type of method in developing latent print where the soot of the chemical will allow the latent prints to be visible to see.

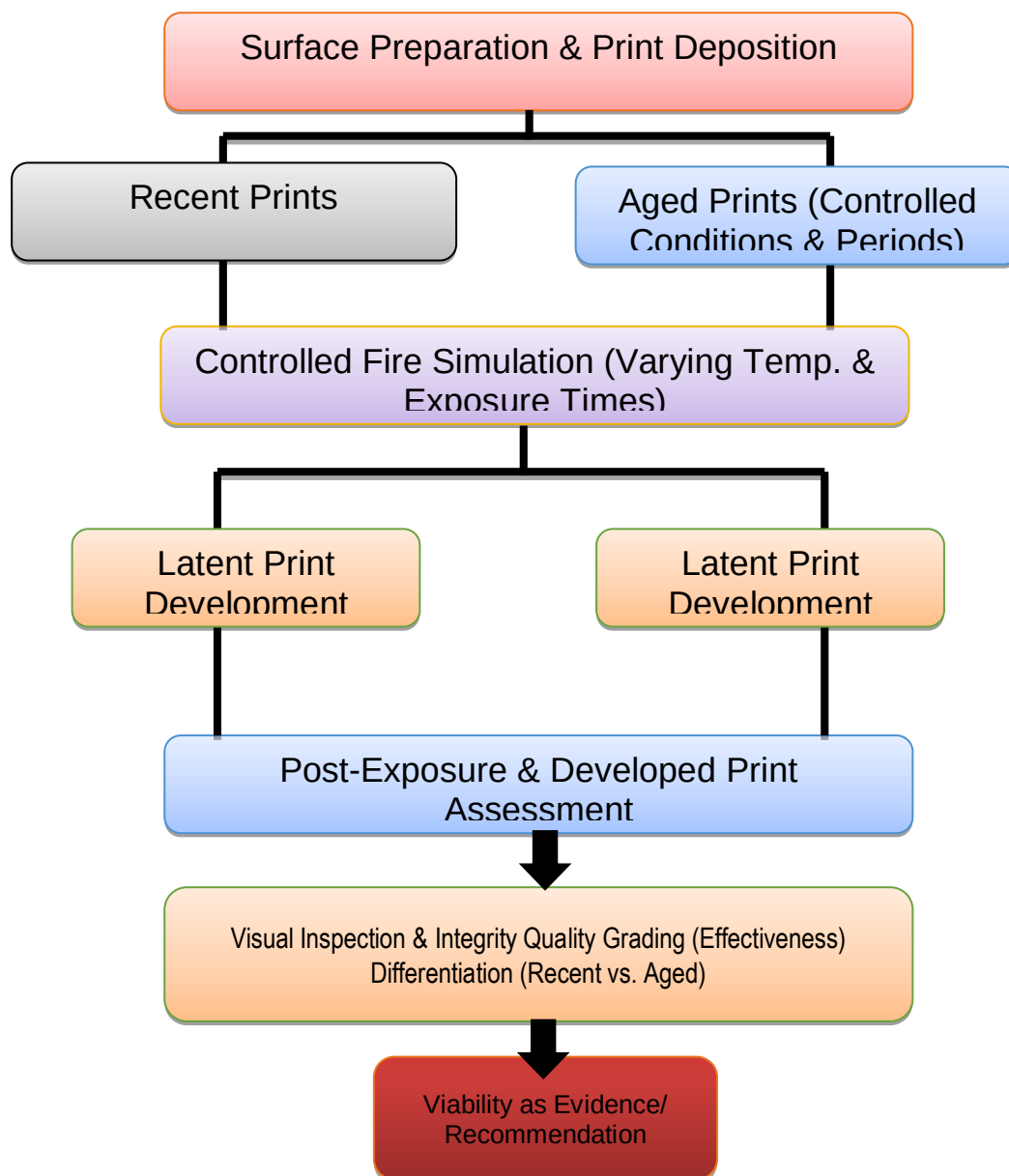


Figure 1: Schematic Diagram

Possible items to be found- both porous and non-porous surfaces were considered in the study get a possible reliable result. The two surfaces have differences in the exposure of water and fire, this aspect necessitates the researcher to consider since, the exposures of the one surface vary from the others.

Non-Porous Surfaces – these types of surfaces do not absorb the sweat. The fingerprint deposits can remain on the surface for a very long time. Examples: Glass, certain type plastics, polythene bags, metal surfaces, and glazed ceramics, glossy paints, etc. The probability of getting usable prints is high.

Steel products- steel product obtained by rolling ingots on a rolling mill or processed through a continuous caster and cut into various lengths.

Problems encountered must be duly noted by the researchers during the conduct of the experiment as it will serve as precursory to the effectiveness of the result

Objectives of the Study

To investigate the longevity and survival of latent fingerprints exposed to fire conditions, thereby enhancing the understanding of their viability as evidence in arson cases.

Specific Objectives

1. To examine the impact of temperature and exposure times on the integrity of latent fingerprints on various surfaces unexposed to high heat and water pressure.
2. To evaluate the effectiveness of latent print development using powder reagent in extracting latent fingerprints from fire-damaged materials.
3. To assess the ability to differentiate between recent and aged latent fingerprints on surfaces exposed to fire.

Null hypothesis

1. There is no significant difference in the Completeness Scores measured after 3 days and after 30 days.

Significance of the Study

The study will be beneficial to the following:

Criminology Student acknowledges the importance of fingerprint in terms arson cases in which evidences may be collected with latent prints on the object. With the knowledge they learn from the expert investigator and adapt the things that they get from them, someday these knowledge that the student acquired can be a good opportunity in making a legal basis in determining the cause and possible effect in arson cases.

Criminology Faculty allows the students in doing research with the agenda of crime investigation as they find interesting in the field of arson investigation. Guidance and moral support have been thrown to the students in pursuing such activity in order to build a good better way of disciplining the matters to them.

The University of the Visayas has proven its own standard in the field of making the school to be one of the top of having well educated students. By letting the school in reaching the highest peak of learning, they introduced the research with the agendum and the given topic. The school helps the student by challenging the individual with its mental capabilities, thus, as students would become a better fruit along the citizens that surround us.

Researchers the result of the study will be beneficial to the fund of knowledge among criminology students and among investigators of fire scene cases. The researchers on the other hand will can utilize these learning when they somehow become aspiring investigators. They're acquired capability after doing the research study will become their competency as criminology students.

Future Researchers would benefit from the reviews of related literature, related studies and conclusion of the study. The ideas that would be deduced for the reviews would help them create another implication that could serve as an opportunity or foreseen problem.

RESEARCH METHODOLOGY AND PROCEDURES

This chapter presents the research methodology and procedure of the study.

Methods

Pre-experimental research design is a systematic approach used to observe the effects of certain variables on a specified outcome without employing a true experimental framework that includes random assignment or control groups. This type of study can provide useful insights, especially in fields like latent print development and identification where it might not be feasible to establish rigorous control conditions.

Setting

The laboratory experiment will be conducted in the Criminology Laboratory of the University of the Visayas. This will be done in the presence of the Laboratory technician, Dactyloscopy specialist and researchers.

Materials

Materials to be use in the study during the laboratory experiments.

1. Fire
2. Water
3. Non-Porous Aluminum Products
4. Latent Prints
5. Developing Reagents to develop latent print

Date Collection and Measurement

The researchers will utilize cutting torch and fire truck in the conduct of the experiments. Cutting torch will serve as the pressuring device to increase or control the intensity of the fire as intended by the researchers. The cutting torch must have a pressure gauge to control the hotness of the fire to be use. This equipment will be applied on both porous and non-porous products which latent prints are suspected. Another instrument will be the fire truck which is equipped with control panel to control or release the pressure of the water that is needed to the experiment. The same with fire, porous and non-porous materials will also be exposed to the water with the intended pressure needed.

A laboratory procedure will be utilized by the researchers in order that they will be guided on what things must be recorded during the conduct of the laboratory experiments. In every result recording on its varieties will be duly noted by the researchers. There will be no ethical consideration to be undertaken for the study, since this is purely experimental which do not involve a participant, informant or respondents.

Ethical Discussion

There will be no human participants involve in the study and that the researchers will do the experiment with the guidance of the College of Criminal Justice Education laboratory technician.

The researcher has no conflict of interest of the study. If the study will published in the future the researchers fully submits to the decision of the University of the Visayas College of Criminal Justice Education regarding the progress of the study.

RESULTS AND DISCUSSIONS

Table1: The longevity status of latent prints against fire incidents with out the reagent.

Table 1: The longevity status of latent prints against heat exposure water using the black powder reagent (PS27A).

Exposure to	Materials	Qty	Duration of Exposure	Duration before it was process for Latent Print development			
				Completeness Score	3 days after	Completeness Score	After 30 days
1. Butane Torch (1,970 °C - 2,000 °C)			30 min	5		5	
2. Fire Truck water	Doorknob	4			Positive		Positive

	bs				e		
a. Fire hose 11.7 diameter	Spoon	2	30 min	5	Positive	0	Negative
b. Nozzle- 20 cm in diameter	Fork	2	30 min	5	Positive	0	Negative
c. Water velocity is 20 meters per sec.	Broken bottles	2	30 min	5	Positive	5	Positive

As presented in Table is the result of the experiment ant where the 10 samples (doorknobs, spoon, fork and broken bottles. Which are exposed to heat and water pressure for about 30 minutes then 1 set was process for latent print development 3 days after exposure to heat and water. While the other set was after 30 days.

Results shows that those samples that were process using black powder reagent (PS27A after 3days were found to have a positive latent finger print s with completeness score of 5 which means that such latent print impression focal points and rid characteristics is identifiable, while only 2 samples was found with positive latent print impression with identifiable focal points and ridge characteristics .

Butane Torch Exposure (1,430 °C)

The results indicate that while unfunctional doorknobs and broken bottles retained positive results for latent print development both immediately and after 30 days, utensils like spoons and forks showed positive results only immediately after exposure. The high temperature of the butane torch likely causes significant alteration to the surface characteristics of materials like metal utensils, possibly leading to degradation of the oils and residues required for latent print visibility (Miller, 2017). In contrast, the surfaces of the doorknobs and broken bottles seem less affected by the thermal exposure, maintaining their ability to retain prints longer.

Fire Truck Water Exposure

The results demonstrate that unfunctional doorknobs and broken bottles again showed positive developments both immediately and 30 days later, while utensils performed poorly after a month. The high-velocity water from a fire truck (20 meters per second) could wash away or dilute the latent prints on more porous materials or those with non-smooth surfaces, such as utensils. The hydrophobic nature of some surfaces (like glass and smooth metals) might better retain latent prints compared to materials prone to absorption or physical alteration from high-pressure water (Holland et al., 2019).

Table 2: Fixed areas to be found in the fire scene.

Fixed Areas	Materials	Duration before it was process for Latent Print development	
		Right After	After 30 days
Kitchen	Used Bottles	+	-
	Spoon	+	-
	Forks	+	-
Point of Entry and Exits	Doorknobs	+	-

The table provided outlines observations related to certain fixed areas—specifically the kitchen and points of entry and exit—over two-time intervals: immediately after a certain intervention or event and after 30 days. The materials assessed include used bottles, spoons, forks, and doorknobs, with corresponding positive (+) or negative (-) evaluations.

Kitchen Observations

1. Used Bottles: The positive rating immediately after suggests that the used bottles were suitable for latent print development right after the event. However, the subsequent negative indication after 30 days signals degradation or loss of potential for latent print recovery, possibly due to environmental factors or handling. This suggests that materials may need to be processed promptly to ensure the best chance for fingerprint recovery.

2. Spoon: Like the used bottles, spoons were deemed suitable for fingerprint analysis immediately. The transition to a negative after 30 days could imply that oils, moisture, or contamination may have degraded the latent prints. This emphasizes the importance of immediate processing to capture useful evidence, as delays can severely affect the quality and recoverability of prints.

3. Forks: The forks exhibit the same pattern as the other kitchen items, reinforcing the idea that immediate processing is essential. The deterioration in condition of potential latent prints again raises concerns about the environmental influences over time, underscoring that utensil, if not processed quickly, may lose key evidence.

Point of Entry and Exits Observations

1. Doorknobs: The findings regarding doorknobs mirror those of the kitchen items. The initial suitability for print development suggests that doorknobs were recently accessed and had observable prints. However, the eventual negative assessment highlights the risk of contamination and wear over time. This demonstrates that entrance and exit points should also be processed immediately after an event, particularly in high-traffic areas.

The data reveals a consistent trend across all materials indicating a critical decline in the potential for latent print development from a positive to a negative assessment within a relatively short span of 30 days. This raises important questions regarding evidence preservation and highlights the need for prompt action in forensic investigations.

Items Where Latent Prints Can Possibly Be Found During Extreme Exposure of Heat and Water

Based from the conducted experiments, the researchers only utilized samples of non-porous products as it is expected that porous materials such as cotton, cloth, paper can be easily burned to ash when exposed to heat and easy to deteriorate when exposed to water.

In forensic science, latent prints can be critical pieces of evidence. However, their recovery can be significantly influenced by environmental factors, particularly heat and water exposure. While non-porous materials, such as glass, metal, and some plastics, tend to retain latent prints better under harsh conditions, porous materials like cotton, cloth, and paper are more vulnerable to destruction by fire and water damage.

Studies indicate that non-porous surfaces, even when subjected to high temperatures, may still retain viable latent prints if the exposure time is limited. For example, a study by K. W. B. F. G. Adair et al. (2021) found that latent prints on non-porous materials could sometimes survive temperatures up to 200°C for short durations, particularly when coated with certain barriers designed to protect the prints.

Conversely, porous materials often suffer irreparable damage from extreme heat, as they tend to combust, turning to ash, or degrading substantially when wet. According to a 2020 study by H. J. Bell and T. K. Walsh, prints from porous substrates are more likely to deteriorate rapidly once exposed to water, thereby complicating recovery efforts in fire-related incidents involving textiles or paper products.

To further illustrate the persistence of latent prints on non-porous materials, A. Davies and M. F. Omni (2019) explored the effectiveness of various recovery techniques and found that, even after exposure to flames, some prints could be visualized using specific chemical reagents designed for non-porous surfaces. This shows the importance of material selection during an investigation, particularly in environmental extremes such as fires or floods.

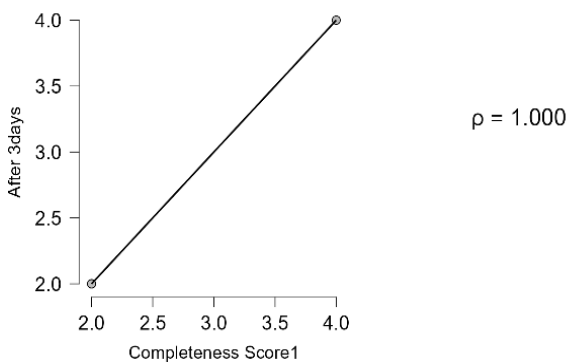
Table 3: Spearman's Correlations

		Spearman's ρ	p-value
Completeness Score 1	After 3 days	1.000***	< .001
Completeness Score 1	Completeness Score 2	0.333	0.667
Completeness Score 1	After 30 days	1.000***	< .001
After 3 days	Completeness Score 2	0.333	0.667
After 3 days	After 30 days	1.000***	< .001
Completeness Score 2	After 30 days	0.333	0.667

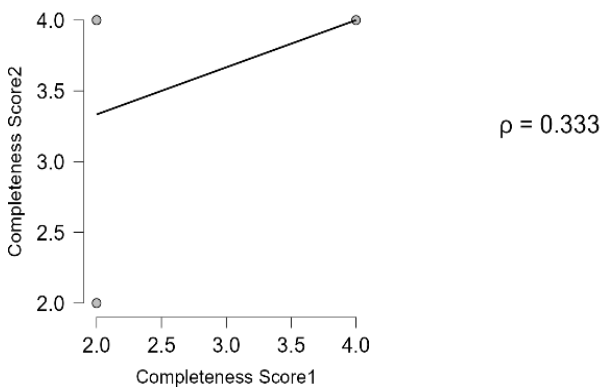
Note. $p < .05$, * $p < .01$, ** $p < .001$.

Scatter Plot

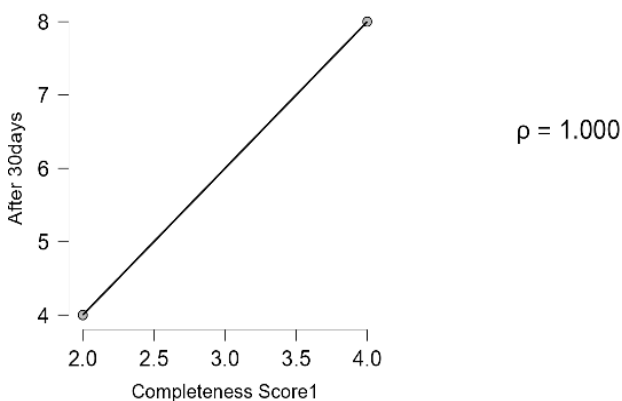
Completeness Score1 vs. After 3days



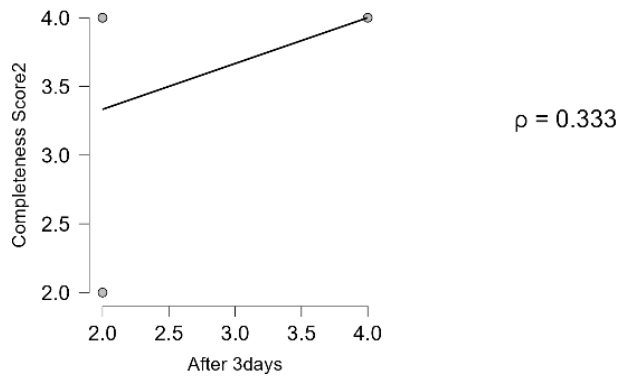
Completeness Score1 vs. Completeness Score2



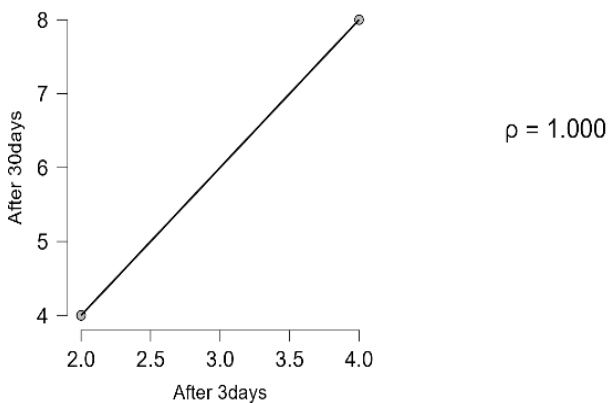
Completeness Score1 vs. After 30days



After 3days vs. Completeness Score2



After 3days vs. After 30days



Completeness Score2 vs. After 30days

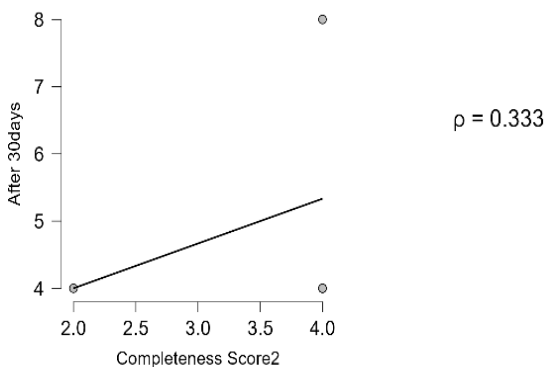


Table 4: SUMMARY OF CORRELATIONS

Variables	Spearman's ρ	p-value	Decision	Interpretation
Completeness Score1 - After 3 Days	1	*** < .001	Significant	Strong positive correlation, meaning scores remain stable over 3 days.
Completeness Score1 - Completeness Score2	0.333	0.667	Not Significant	Weak correlation, indicating little to no consistent relationship.
Completeness Score1 - After 30 Days	1	*** < .001	Significant	Strong positive correlation, meaning scores remain stable over 30 days.
After 3 Days - Completeness Score2	0.333	0.667	Not Significant	Weak correlation, no strong relationship between these scores.

After 3 Days - After 30 Days	1	*** < .001	Significant	Perfect correlation, indicating stability over time.
Completeness Score2 - After 30 Days	0.333	0.667	Not Significant	Weak correlation, suggesting inconsistency in Completeness Score2.

Table 3 and 4 presents the analysis of Completeness Scores reveals important implications for arson investigations and forensic evidence collection. Strong positive correlations (Spearman's ρ of 1) between scores measured after three days and thirty days suggest that the quality of forensic evidence remains reliable over time, providing reassurance in the context of potential evidence degradation.

However, weak correlations related to Completeness Score2 highlight inconsistencies that warrant a reassessment of measurement methods to ensure reliability in analyses. This emphasizes the necessity of systematic investigative protocols and training for forensic teams to maintain a coherent body of evidence, ultimately supporting prosecution efforts. Consequently, policy development focused on thorough initial evidence collection, alongside standardized protocols, can enhance the reliability and effectiveness of forensic practices in arson cases, leading to improved investigative outcomes.

FINDINGS

Impact of Extreme Heat on Latent Print Retention

The results indicate that non-porous materials like unfunctional doorknobs and broken bottles exhibit a greater resilience to high temperatures from sources like a butane torch. Both items retained positive results for latent print development immediately and even after a 30-day period. In contrast, metal utensils such as spoons and forks showed positive results only immediately after exposure. This suggests that the structural integrity of certain non-porous materials helps them withstand thermal alteration, preserving the essential oils and residues required for latent print visibility.

Effect of Water Exposure on Recovery Potential

The high-velocity water from fire truck hoses proved relatively effective at washing away latent prints from porous materials like utensils. The samples retained positive results immediately after exposure but turned negative after 30 days. This highlights that high-pressure water can dilute or remove latent prints, particularly on items prone to absorption or physical alterations. In contrast, smoother surfaces such as doorknobs and broken bottles maintained their ability to retain prints longer, indicating that surface texture and material composition play crucial roles in print recovery post-water exposure.

Time Sensitivity of Evidence Processing

The findings across all tested materials consistently underscore the critical importance of immediate processing for latent print development. For kitchen items such as spoons and forks, along with used bottles, the ability to recover prints diminished significantly after 30 days, leading to a negative assessment. Similarly, doorknobs indicated a positive development right after exposure but turned negative over time. This emphasizes the need for timely forensic intervention to capture and preserve potential evidence before environmental factors degrade print viability. Delays in processing can have serious implications for the integrity of forensic investigations. These findings collectively stress the importance of material selection and timing when attempting to recover latent prints in scenarios involving exposure to extreme conditions.

CONCLUSION

In conclusion, the analysis of latent print longevity under high heat and water exposure offers valuable insights for forensic investigations, especially in arson cases. The consistent Completeness Scores indicate that timely evidence collection is crucial, as early assessments of fingerprint quality remain reliable over time. However,

discrepancies in certain measurements highlight the need for critical evaluation of methodologies, urging investigators to refine classification systems for coherent forensic analysis.

Moreover, establishing systematic protocols for evidence collection and emphasizing training on rapid processing and surface type influence will better equip forensic teams for unpredictable conditions. Thus, we recommend, future research should focus on factors affecting latent fingerprint degradation and explore varied development techniques to enhance forensic effectiveness. By continuously improving practices and training, the field can better support justice outcomes in complex cases like arson.

RECOMMENDATIONS

Based on the findings regarding the longevity and recovery of latent prints under extreme conditions of heat and water exposure, several recommendations can be made to optimize forensic practices:

Prioritize Immediate Evidence Processing:

Prompt processing of potential latent print evidence is crucial, particularly within the first 24 to 48 hours after an incident. Forensic teams should establish protocols that emphasize immediate assessment and collection of samples from critical areas, such as points of entry/exit and high-traffic areas like kitchens, to maximize the recovery of latent prints.

Focus on Non-Porous Material Recovery

Given the demonstrated resilience of non-porous materials, forensic investigators should prioritize the collection of evidence from items such as glass, metal, and certain plastics. Efforts should be concentrated on surfaces that exhibit lower susceptibility to degradation from heat and water, thus increasing the potential for successful latent print recovery.

Utilize Protective Coatings

Research suggests that certain barriers may preserve latent prints on non-porous surfaces when exposed to high temperatures. Forensic practitioners should explore the application of protective coatings or treatments that enhance the viability of latent prints during and after exposure to extreme conditions.

Implement Controlled Water Exposure Methods

In incidents involving fire suppression with high-velocity water, procedures should be developed to minimize potential damage to latent prints. For example, using controlled water application techniques or employing absorbent materials to contain water flow may prevent the dilution and removal of latent prints in the scene.

Conduct Regular Training and Simulation Drills

Forensic teams should engage in regular training sessions that involve simulations of fire and water exposure scenarios to enhance their skills in identifying and recovering latent prints under extreme circumstances. Continuous education on the latest research findings and methodologies will ensure that investigators are equipped with updated knowledge and techniques.

Invest in Advanced Recovery Technologies

Forensic laboratories should consider investing in advanced methodologies and technologies, such as chemical enhancement techniques specifically designed for non-porous surfaces. This includes studies into new reagents and recovery methods that can effectively visualize latent prints even after exposure to challenging conditions.

Document and Analyze Environmental Effects

Ongoing research and documentation of how various environmental factors affect different materials will

bolster the understanding of latent print longevity. Regularly updating forensic databases with findings related to environmental influences on print recovery will help inform best practices.

By adhering to these recommendations, the efficacy of latent print recovery in forensic investigations can be significantly enhanced, leading to improved outcomes in solving cases that involve extreme heat and water exposure.

LIST OF REFERENCES

1. Archer, N.E., (2005). Changes in the Lipid Composition of Latent Fingerprint Residue with Time after Deposition on a Surface, 154 (2-3) 25, Retrieved January 23, 2017 from <http://cseye.com/content/2014/april/research/fmark%20longevity>
2. Barcikowski, S.,(2004). Contribution to the Age Determination of Fingerprint Constituents Using Laser Fluorescence Spectroscopy and Confocal Laser Scanning Microscope, Optical Materials in Defence Systems Technology, Retrieved January 17, 2017 from [http://www.scienceandjusticejournal.com/article/S1355-0306\(06\)71589-1/abstract](http://www.scienceandjusticejournal.com/article/S1355-0306(06)71589-1/abstract)
3. Baniuk, K., (1990). Determination of the Age of Fingerprints, Forensic Science International, 46(1-2), 133-137, Retrieved January 21, 2017 from [ww.forensicmag.com/article/2012/06/optimal-temperatures-latent-print-recovery](http://www.forensicmag.com/article/2012/06/optimal-temperatures-latent-print-recovery)
4. De Paoli, G., (2010). Photo- and Thermal-Degradation Studies of Select Eccrine Fingerprint Constituents, J Forensic Sci, Vol. 55, No. 4, 962-969, Retrieved January 13, 2017 from <https://www.ncbi.nlm.nih.gov/pubmed/20487155>
5. Dikshitulu, Y. S., (1986). Aging Studies on Fingerprint Residues Using Thin-layer and High Performance Liquid Chromatography, Forensic Science International, 1986, 31(4) 261-266, Retrieved January 5, 2017 from <http://cseye.com/content/2014/april/research/fmark%20longevity>
6. Ricci, C., (2007). Chemical Imaging of Latent Fingerprint Residues, Applied Spectroscopy 61(5): 514-522. Retrieved January 5, 2017 from <http://cseye.com/content/2014/april/research/fmark%20longevity>
7. Simon, B.B., (2014). How Long Can an Identifiable Fingerprint Persist on an Exterior Surface? Retrieved December 13, 2017 from <http://www.keithborer.co.uk/uploads/assets/files/SB%20CS%20Eye%20FP%20Longevity%20Paper.pdf>
8. Weyermann, C., (2011) Initial Results on the Composition of Fingerprints and its Evolution as a Function of Time by GC/MS Analysis, Vol 56, Issue 1, 102-108, Retrieved January 15 2017 from <http://cseye.com/content/2014/april/research/fmark%20longevity>
9. Merkel, R., (2011). Approximation of a Mathematical Aging Function for Latent Fingerprint Traces Based on First Experiments Using a Chromatic White Light (CWL) Sensor and the Binary Pixel Aging Feature, Communications and Multimedia Security. Retrieved January 21, 2017 from [http://www.scienceandjusticejournal.com/article/S1355-0306\(06\)71589-1/abstract](http://www.scienceandjusticejournal.com/article/S1355-0306(06)71589-1/abstract)