ISETC2025

UNIVERSITI TEKNOLOGI MARA

ISETC2025

2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

ORGANIZED BY:
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA
PERAK BRANCH, TAPAH CAMPUS
MALAYSIA

CO-ORGANIZED BY:

三重大学
MIE UNIVERSITY

2nd International Science, Engineering and Technology Colloquium

(ISETC 2025)

Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch, Tapah Campus,
35400 Tapah Road, Perak, Malaysia.

Colloquium date: 9th July 2025
Publication date: 9th September 2025

Proceedings of Extended Abstracts

EDITORS

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

e-ISBN: 978-629-97630-5-5

Copyright © 2025 ISETC
Published by Faculty of Applied Sciences, Universiti Teknologi MARA,
Perak Branch, Tapah Campus, 35400 Tapah Road, Perak, Malaysia.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, 35400 Tapah Road, Perak, Malaysia.

PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

QUALITY OF LATENT FINGERMARK ON CONTAMINATED POROUS SURFACE OVER 1 MONTH EXPOSURE

Syarmilla Ezza Ismail, Ezlan Elias

Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

**Corresponding authors: 2023185387@student.uitm.edu.my, ezlan@uitm.edu.my*

Abstract: Recovering latent fingerprints at crime scenes is essential for establishing links between suspects and crime scenes. However, their quality and recoverability depend on various influencing factors, including sweat composition, substrate type, and environmental conditions. While much research has focused on how environmental factors affect fingermark aging, limited attention has been given to how pre-fingermark deposition substrate contaminants (hereafter referred to as pre-deposition substrate contamination) influences degradation over time. This study aims to address this gap by investigating the effect of pre-deposition soil contamination on porous substrates, specifically paper, and how this influences fingermark quality over a 28-day aging period. Paper samples were buried in soil for varying durations (1 day to 2 months) before fingermark deposition. All 90 fingermarks were developed with ninhydrin. Fingermark quality was assessed using the Centre for Applied Science and Technology (CAST) scoring system. Non-parametric statistical analyses, like Kruskal-Wallis and Friedman tests were performed to evaluate the significance of overall differences in fingermark quality between different substrate conditions and across time, respectively. The results show that while fingermarks on contaminated porous surfaces may initially appear of acceptable quality, their quality declines more significantly over time compared to clean porous surfaces. This progressive degradation suggests a synergistic effect between substrate contamination and fingermark aging, with the most severe quality loss observed on surfaces heavily contaminated prior to deposition. In contrast, control samples showed minimal changes throughout the aging period. These findings offer new insights into how a substrate's history can influence fingermark preservation, highlighting an often-overlooked factor in evidence interpretation. The study contributes to a more detailed understanding of latent fingermark aging and has practical implications for crime scene recovery protocols and future development of fingermark aging models.

Keywords: *Latent Fingermarks, fingermark quality, contaminated porous surfaces, soil burial, degradation, forensic evidence*

INTRODUCTION

Recovering latent fingermarks at crime scenes is crucial for establishing links between individuals and locations, a fundamental principle of forensic science, consistent with Locard's Exchange Principle, which states that "every contact leaves a trace." However, the quality and recoverability of these trace marks are influenced by a complex interplay of factors, including the composition of the fingermark residue, the nature of the substrate it is deposited on, and the surrounding environmental conditions. This dynamic interaction between the three elements determines the initial visibility, persistence, and ultimately, the successful recovery of latent fingermarks. While much research has focused on how environmental factors affect fingermark recovery, less attention has been given to how contamination of the substrate before deposition affects degradation over time. This overlooks a critical real-world scenario where items of evidential value may have been exposed to contaminants prior to the transfer of a crucial fingermark. This study investigates the impact of pre-deposition substrate contamination on the quality of latent fingermarks. The objectives were to (i) determine the effect of varying durations of soil contamination on the subsequent quality of latent fingermarks deposited on A4 paper and developed with ninhydrin, (ii) compare the degradation patterns of fingermarks on contaminated versus clean paper substrates over a 28-day aging period, and (iii) assess time-dependent changes in fingermark quality at specific post-deposition intervals (0, 7, 14, 21, and 28 days).

MATERIALS AND METHODS

This study employed a controlled experimental design using paper substrates that were buried in soil for varying durations (1 day, 3 days, 1 week, 1 month, and 2 months) prior to fingermark deposition. A single donor deposited natural latent fingermarks under standardized conditions, with controlled pressure and contact time to minimize variability. After deposition, 90 fingermark samples were aged under laboratory conditions for up to 28 days. Fingermarks were developed at five post-deposition intervals (Day 0, Day 7, Day 14, Day 21, and Day 28) using ninhydrin via the dipping method, followed by oven heat treatment at 100 °C to accelerate development. The quality of each fingermark was then evaluated using the CAST (Centre for Applied Science and Technology) scoring system, and images were captured for documentation. After the final development interval (Day 28), all data were compiled and analysed using non-parametric statistical tests, including the Kruskal-Wallis and Friedman tests, to assess differences in fingermark quality across substrate contamination levels and aging times.

RESULTS AND DISCUSSION

Non-parametric statistical analysis showed that both pre-deposition substrate contamination and aging time had a significant effect on latent fingermark quality. Interestingly, the initial quality of fingermarks on contaminated paper often appeared similar to those on clean (control) surfaces, challenging the assumption that degradation begins immediately. However, over time, fingermarks on contaminated substrates showed a clear pattern of increasing degradation, which was not observed in the control samples. This suggests that the negative effect of substrate contamination does not happen right away but builds up and worsens over time, working together with natural aging. The level of contamination also played a key role. Substrates buried for 3 days or 1 week showed the most noticeable and rapid drop in fingermark quality. This indicates that the interaction between the fingermark residue and the contaminated substrate possibly involving changes in moisture, pH, or microbial growth can become a major factor in how much the fingermark degrades over time. These findings are important for forensic practice. They show that a fingermark on a contaminated surface may look usable at first but can quickly deteriorate, making recovery more difficult. Therefore, forensic protocols should consider the pre-deposition condition of the substrate, as it plays a critical role in fingermark degradation. Additionally, fingermark aging models may require revision to incorporate pre-existing surface contamination as a key variable in estimating the time since deposition.

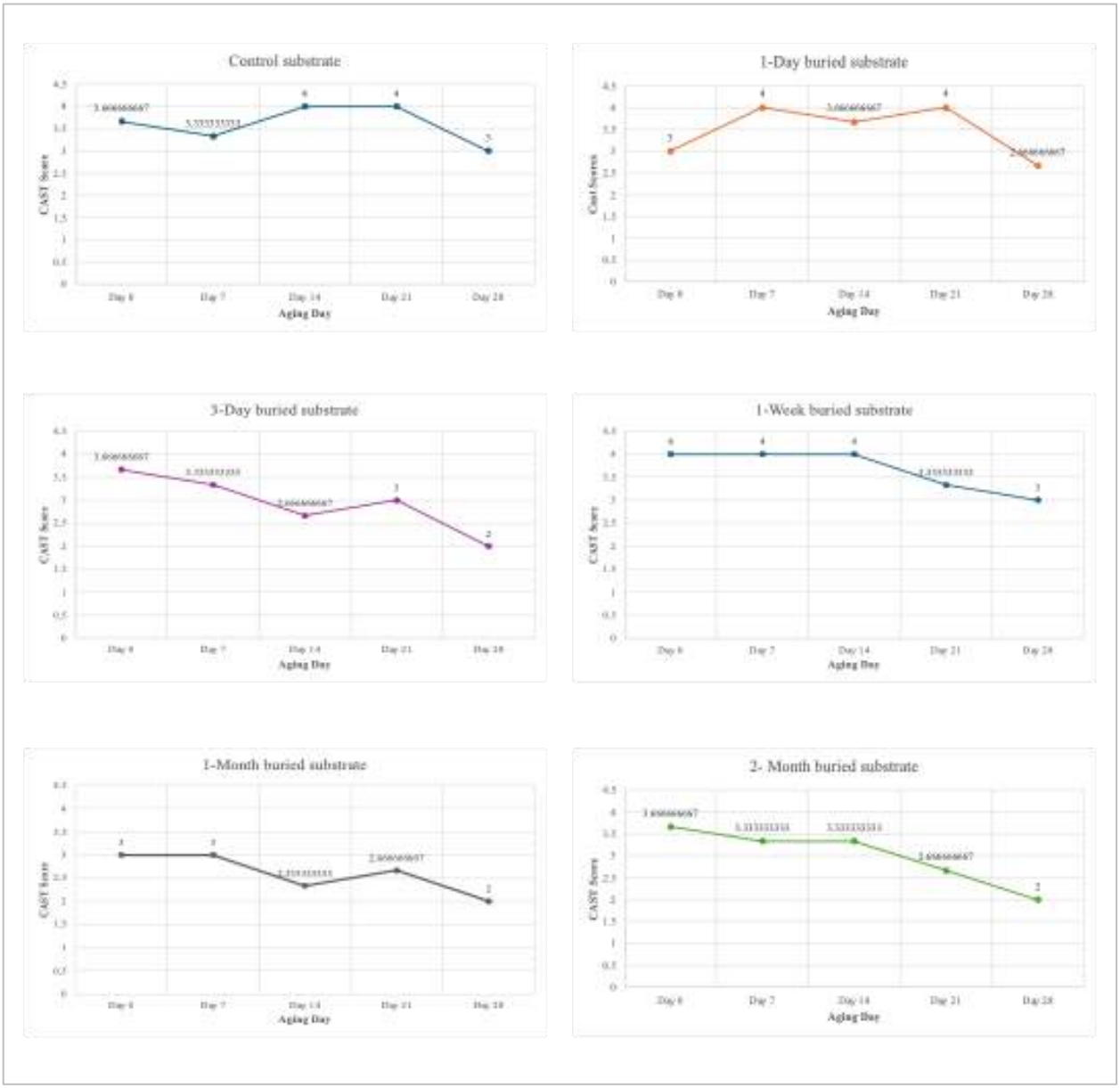


Figure 1. Median CAST Scores of Latent Fingermarks on Various Substrates Over a 28-Day Aging Period

This line plot illustrates the time-dependent degradation of fingermark quality on clean paper (Control) compared to paper pre-contaminated by soil for different durations (1-Day, 3-Day, 1-Week, 1-Month, 2-Month burial). CAST scores range from 0 (undetectable) to 4 (excellent quality).

Table 1. Kruskal-Wallis H Test Statistics for Differences in Overall Latent Fingermark Quality Between Substrate Conditions at Specific Time Points

Sample Interval	Statistic (H)	p-value	Significant ($p < 0.05$)
Day 0	9.444	0.093	False
Day 7	7.886	0.163	False
Day 14	12.719	0.026	True
Day 21	13.437	0.02	True
Day 28	14.45	0.013	True

This table summarizes the Kruskal-Wallis H-statistics and p-values for comparisons of median CAST scores between the Control and various pre-contaminated paper substrates (1-Day, 3-Day, 1-Week, 1-Month, 2-Month burial) at each post-deposition aging interval (Day 0, Day 7, Day 14, Day 21, Day 28). A p-value less than 0.05 indicates a significant difference between groups at that time point.

Table 2. Friedman Test Statistics for the Effect of Aging Time on Latent Fingermark Quality Across Different Substrate Conditions

Substrate Condition	Statistic	p-value	Significant ($p < 0.05$)
Control	8.5	0.075	False
1D	10.087	0.039	True
3D	9.959	0.041	True
1W	10	0.04	True
1M	8.5	0.075	False
2M	6.519	0.164	False

This table presents the chi-squared (χ^2) and p-values from Friedman tests conducted for each substrate condition (Control, 1-Day, 3-Day, 1-Week, 1-Month, 2-Month pre-contaminated paper). Significant p-values ($p < 0.05$) indicate a statistically significant change in fingermark quality over the 28-day aging period within that specific substrate group.

CONCLUSIONS

This study clearly demonstrates that pre-deposition substrate contamination has a significant and progressive impact on the quality of latent fingermarks, with the negative effects becoming more pronounced over time. These findings highlight the importance of considering the environmental history of the substrate when evaluating fingermark evidence, especially in cases involving buried or exposed items. To build upon these findings, future research should consider extending the aging period to observe fingermark degradation over longer durations, beyond the current 28-day timeframe, to gain a clearer understanding of long-term persistence. Additionally, studies should investigate a broader range of environmental contaminants, including various soil types and chemical compositions, while also varying key contamination parameters such as burial depth, exposure duration, and moisture content. Expanding the scope to include a wider variety of porous substrates, such as different paper types, textures, and thicknesses would further reflect the diversity of materials encountered in real forensic scenarios and help determine how substrate properties influence degradation patterns. These future directions will aid in the development of more robust and realistic fingermark aging models and contribute to the refinement of forensic recovery protocols, leading to more accurate evidence interpretation in complex or environmentally compromised conditions.

REFERENCES

Bandey, H. (2022). *Fingermark Visualisation Manual Second Edition 2022* (2nd ed.). Defence Science and Technology Laboratory.

Cadd, S., Islam, M., Manson, P., & Bleay, S. (2015). Fingerprint composition and aging: A literature review. *Science and Justice*, *55*(4), 219–238. https://doi.org/10.1016/j.scijus.2015.02.004

Champod, C., Lennard, C. J., Margot, P., & Stoilovic, M. (2004). *Fingerprints and Other Ridge Skin Impressions*. CRC Press. https://doi.org/10.1201/9780203485040

Girod, A., Ramotowski, R., Lambrechts, S., Misrielal, P., Aalders, M., & Weyermann, C. (2016). Fingermark age determinations: Legal considerations, review of the literature and practical propositions. *Forensic Science International*, *262*, 212–226. https://doi.org/10.1016/j.forsciint.2016.03.021

Girod, A., Ramotowski, R., & Weyermann, C. (2012). Composition of fingermark residue: A qualitative and quantitative review. *Forensic Science International*, *223*, 10–24. https://doi.org/10.1016/j.forsciint.2012.05.018

Gomes, F. M., de Pereira, C. M. P., de Cássia Mariotti, K., Magaiver Pereira, T., dos Santos, N. A., & Romão, W. (2023). Study of latent fingerprints – A review. *Forensic Chemistry*, *35*, 1. https://doi.org/10.1016/j.forc.2023.100525

International Fingerprint Research Group. (2014). Guidelines for the Assessment of Fingermark Detection Techniques. *Journal of Forensic Identification*, *64*.

Jasuja, O. P., Toofany, M. A., Singh, G., & Sodhi, G. S. (2009). Dynamics of latent fingerprints: The effect of physical factors on quality of ninhydrin developed prints - A preliminary study. *Science and Justice*, *49*(1), 8–11. https://doi.org/10.1016/j.scijus.2008.08.001

Yamashita, B., French, M., Bleay, S., Cantu, A., Inlow, V., Ramotowski, R., Sears, V., & Wakefield, M. (2010). Latent Print Development. In *Fingerprint Sourcebook*. National Institute of Justice.

Yong, Y. T., Zakaria, Y., & Nik Hassan, N. F. (2020). Recovery of latent fingermarks from burial environments. *Egyptian Journal of Forensic Sciences*, *10*(31). https://doi.org/10.1186/s41935-020-00206-2

Pejabat Perpustakaan
Library Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023



Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Powered by CamScanner