



8<sup>TH</sup> EUROPEAN ACADEMY OF  
FORENSIC SCIENCE CONFERENCE  
LYON CONVENTION CENTER - FRANCE

2020 THE FORENSIC ODYSSEY  
AUGUST 27<sup>TH</sup> - 31<sup>ST</sup> 2018

# OPTIMIZATION OF THE REVELATION SEQUENCE OF LATENT FINGERPRINTS ON THERMAL PAPERS

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## Context and target

Thermal papers are often difficult to analyze because of the darkening of the glassy side due to heat application or polar solvents used in classical processing techniques, such as ninhydrin or 1,2-indanedione/ZnCl<sub>2</sub>.

The aim of this study was to develop a revelation sequence that combines at best adequate detection methods so as to maximize the chances to reveal prints on these substrates with current methods and equipments.

## Methodology

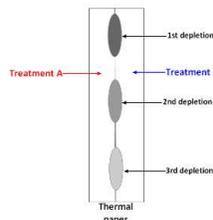
Tested treatments:

- ninhydrin
- 1,2-indanedione/ZnCl<sub>2</sub>
- thermal revelation using heat press
- magnetic powder
- Lumicyano®
- whitening step

Score from 0 to 3

### 1. Conditions of the orientation tests

- 2 study substrates
- 5 donors, 3 depletions
- Hands washed 30min prior to donation
- Age of fingerprints : 1 day, 1 week, 1 month and 2 months



### 2. Conditions of the pseudo-operational tests

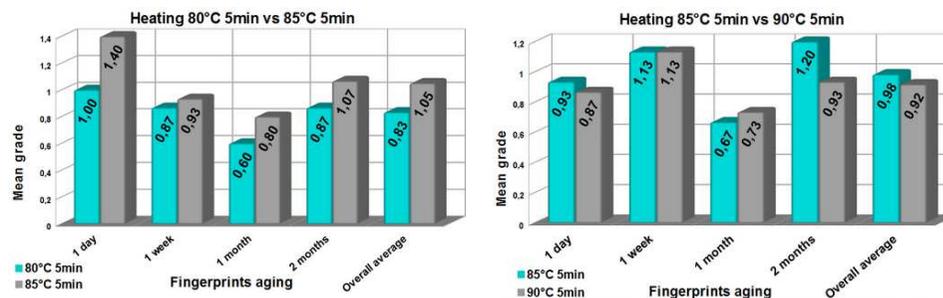
- 200 substrates per sequence
- Fingerprint deposits and aging not controlled
- Substrates homogenized before treatments

## References

- Bond, J. W. *J. Forensic Sci.* **2015**, *60* (5), 1331–1336.  
 Bond, J. W. *J. Forensic Sci.* **2014**, *59* (2), 485–489.  
 Fitz, T. *J. Forensic Ident.*, **2014**, *64* (4), 329-350.  
 Bond, J. W. *J. Forensic Sci.* **2013**, *58* (3), 767–771.  
 Scott, M. J. *Forensic Ident.* **2008**, *58* (4), 424-428.  
 Wakefield, M.; Armitage, S. *J. Forensic Ident.* **2005**, *55* (2), 202-213.

## Results

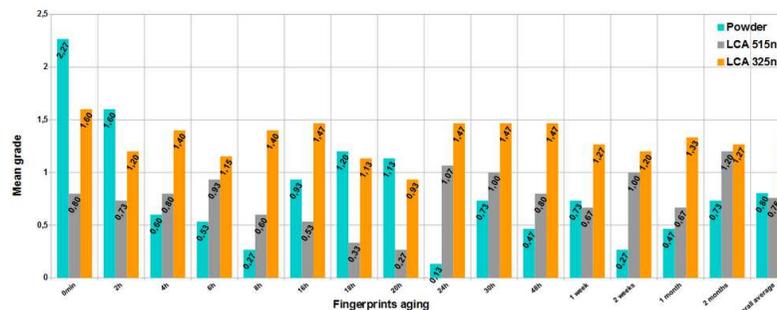
### Determination of the optimal temperature for thermal revelation



### Optimal thermal revelation of the prints by heating at 85°C during 3-5 min

It has been noted that the temperature is highly dependent on the substrate. Heating before at 54°C may reveal other fingerprints.

### Comparison of magnetic powder and Lumicyano®



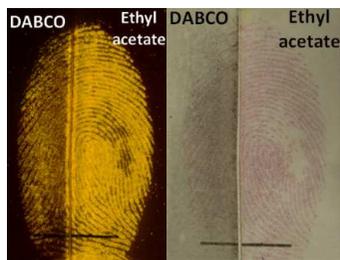
**Lumicyano® is statistically more efficient than magnetic powder**

The optical detection in UV-A seems to lead to more detailed fingerprints.



## Results

### Determination of the best whitening agent

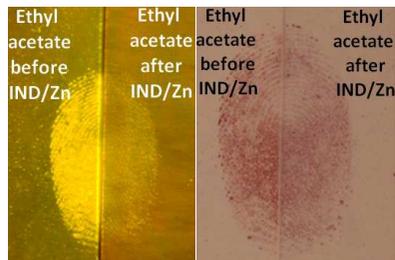


Among DABCO, ethyl acetate, acetone and bleach, **the best whitening agent is ethyl acetate.**

The prints exhibit a more intense luminescence with ethyl acetate than with other whitening agents and their visibility is increased after being treated with ninhydrin.

A 1-day aged fingerprint revealed with 1,2-indanedione/ZnCl<sub>2</sub> (left) and ninhydrin (right) after whitening of the substrate with DABCO or ethyl acetate.

### Position of the whitening step in the processing sequence

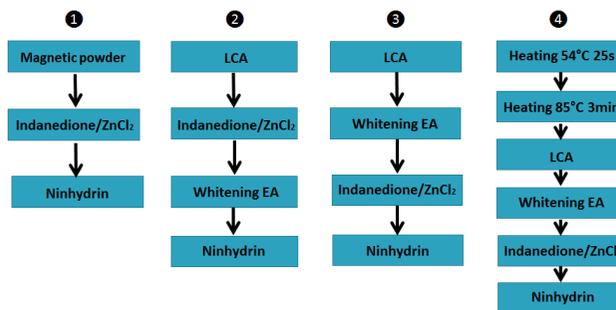


**The whitening gives better results if it occurs before the 1,2-indanedione/ZnCl<sub>2</sub> step**

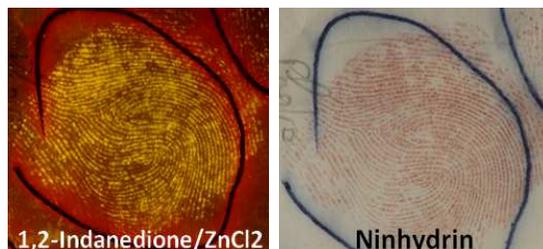
The prints luminescence is much higher and their visibility in white light after the ninhydrin step is not deteriorated if the whitening step takes place before the IND/Zn one.

A 5-day aged latent print revealed with 1,2-indanedione/ZnCl<sub>2</sub> (left) and ninhydrin (right) after whitening of the substrate with ethyl acetate before the IND/Zn step.

## Determination of the best revelation sequence (pseudo operational tests)



	Sequence 1	Sequence 2	Sequence 3	Sequence 4
Total number of fingerprints detected	786	849	903	1072
Fingerprints average grade	1,39	1,32	1,34	1,32
Number of papers containing fingerprints	168 (84%)	173 (86,5%)	176 (88%)	180 (90%)
Number of exploitable fingerprints	259	234	248	301



Latent print enhanced during the processing sequences.

**The sequence 4 is retained as the best sequence (more prints revealed with higher grades)**

## Conclusions

Based on orientation tests on blank papers, this study has enabled the development of a new revelation sequence composed of six steps (thermal development (54°C and 85°C), Lumicyano, Whitening, Indanedione/ZnCl<sub>2</sub> and ninhydrine). This sequence gives satisfying results without any additional equipment or special formulation.

