Fingermark Visualisation Newsletter

March 2019

IN THIS ISSUE

INTRODUCTION

CAST/Dstl integration

In April 2018, the Home Office Centre for Applied Science and Technology (CAST) integrated with the Defence Science and Technology Laboratory (Dstl), to become a single science and technology organisation. We are in the first stage of the CAST/Dstl Integration programme, whose vision statement describes "*a single organisation, working as one, drawing on integrated and sustained capabilities and processes to deliver cutting edge challenges, solutions and advice to support and shape government security, defence and resilience*". The final stage of the programme will be the physical relocation of staff and facilities from the formerly-CAST sites in Sandridge and Langhurst, to Porton Down by April 2020.

Forensics and Identity team

The fingerprints team now sit within a broader Forensics and Identity team, which is part of the Policing and Security Group (PSG) in Dstl. This new team brings together two previously discrete teams with a shared aim to support UK and international law enforcement and the Home Office by the provision of advice, support, and research and development. The integration into Dstl is giving us the opportunity, not only to continue with our core work, but to expand our remit and knowledge to tackle wider forensics and identity issues. We are also looking forward to working more collaboratively across new sectors by identifying new opportunities for novel and innovative work.

New commissioning function

As part of Dstl, we will continue to deliver science against Home Office and policing requirements, but the process through which this work is agreed and commissioned has changed. A new Science & Technology (S&T) Commissioning Hub based in

the Home Office has been created to capture customer needs and formally task Dstl to address requests for S&T support. Home Office Commissioning is funding our fingermark visualisation research within a broader Future Forensics project. See back page for contact details.

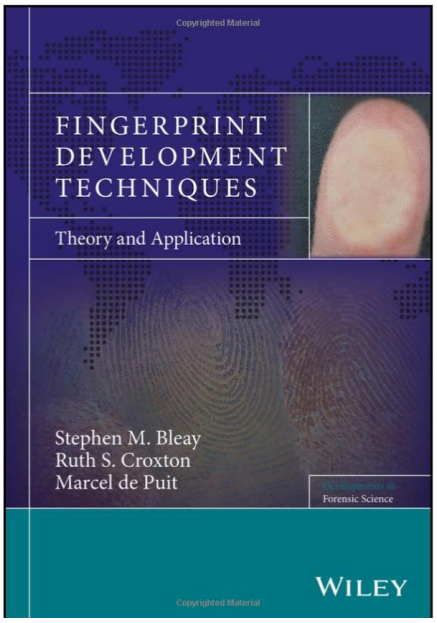
Farewell to colleagues

Due to retirement and the upcoming relocation to Porton Down, three staff members within the fingerprints team have moved on to pastures new.

Vaughn Sears retired from CAST in March 2018 after 38 years' service in the field of fingermark visualisation. Notable achievements include contributing to all of the fingerprint manuals produced by the Home Office from 1986 – 2014. He was responsible for identifying and introducing several of the mainstream chemical processes including Basic Yellow 40 as a superglue dye, Acid Yellow 7 and Acid Violet 17 as blood dyes, and also significantly contributing to the optimisation of amino acid reagents, Physical Developer, Powder Suspension, to name a few.

Vaughn Sears and Steve Bleay receiving the Henry Medal from the Fingerprint Society in 2013 on behalf of CAST for their contribution to the advancement of fingerprints in the field of forensic investigation

Dr Steve Bleay has taken up a position in academia. During his 15-year career at the Home Office/Dstl he has been instrumental in engaging with and steering research within academia and industry towards solving operational problems, whilst recognising future potential applications for novel ideas. He also established the CAST Industry and Academia group. His breadth of knowledge, like Vaughn's, is vast and he has made significant contributions to many areas including fingermark imaging, arson, VMD, novel methods such as disulphur dinitride (now known commercially as RECOVER: LFT), to name a few. In 2018 Steve published a book titled 'Fingerprint Development Techniques: Theory and Application'. This draws together his wealth of knowledge on the subject and is a must read for visualisation enthusiasts!



Steve Bleay's book on 'Fingerprint Development Techniques'

Last but not least, we also said goodbye to Rory Downham who has worked in the team for 10 years. He will also be venturing into academia and aiming to study for a PhD in environmental sciences. He strove to further our scientific and practical understanding of the Powder Suspension process and was instrumental in it becoming mainstream. He is also responsible for the recent guidelines (and underpinning research) on the recovery of marks from the UK polymer banknotes.

We wish all three colleagues the very best in their future endeavours.

A new start!

We're glad to say that staffing isn't all going one way, and we are in the process of rebuilding the team so that we can provide the level of service required by the customer. This has started with an influx of keen graduates and this will be followed by recruitment of more experienced staff to key roles.

FINGERMARK VISUALISATION MANUAL (FVM)

It has been five years since the FVM was published back in 2014 and there is now a significant body of information that needs to be incorporated into a future edition. Some of this was identified in the last newsletter (March 2017) and the information has continued to grow.

The team are currently exploring options for a future version of the manual.

Maintaining a chart

There are many challenges to keeping sequential processing charts up-to-date and relevant (and thus maximising mark recovery rates). Time does not stand still and changes to substrates, chemical and equipment supply, environmental laws etc., in addition to advances in science and technology, mean that guidance has to be continually monitored and changed where appropriate. This inevitably requires horizon scanning, collaboration with industry, academia and international colleagues, innovation and often significant research, development and validation. Without this intervention, processes would gradually become unusable or ineffective and standards would drop.

To demonstrate the value of maintaining a chart, let's look at Chart 2 (Porous) as presented in the FVM first Edition and how it may look in an updated version. The warning symbols identify where CAST/Dstl have focussed recent research efforts which have led to either changes in the chart, or changes to the particular process instruction. The thought bubbles add more detail. In one case, we are simply providing data to showcase a currently under-utilised process. Further information on each particular study can be found later in this newsletter or in referenced publications. Without recognising challenges (imminent or future) and acting upon them, this chart would soon become obsolete.

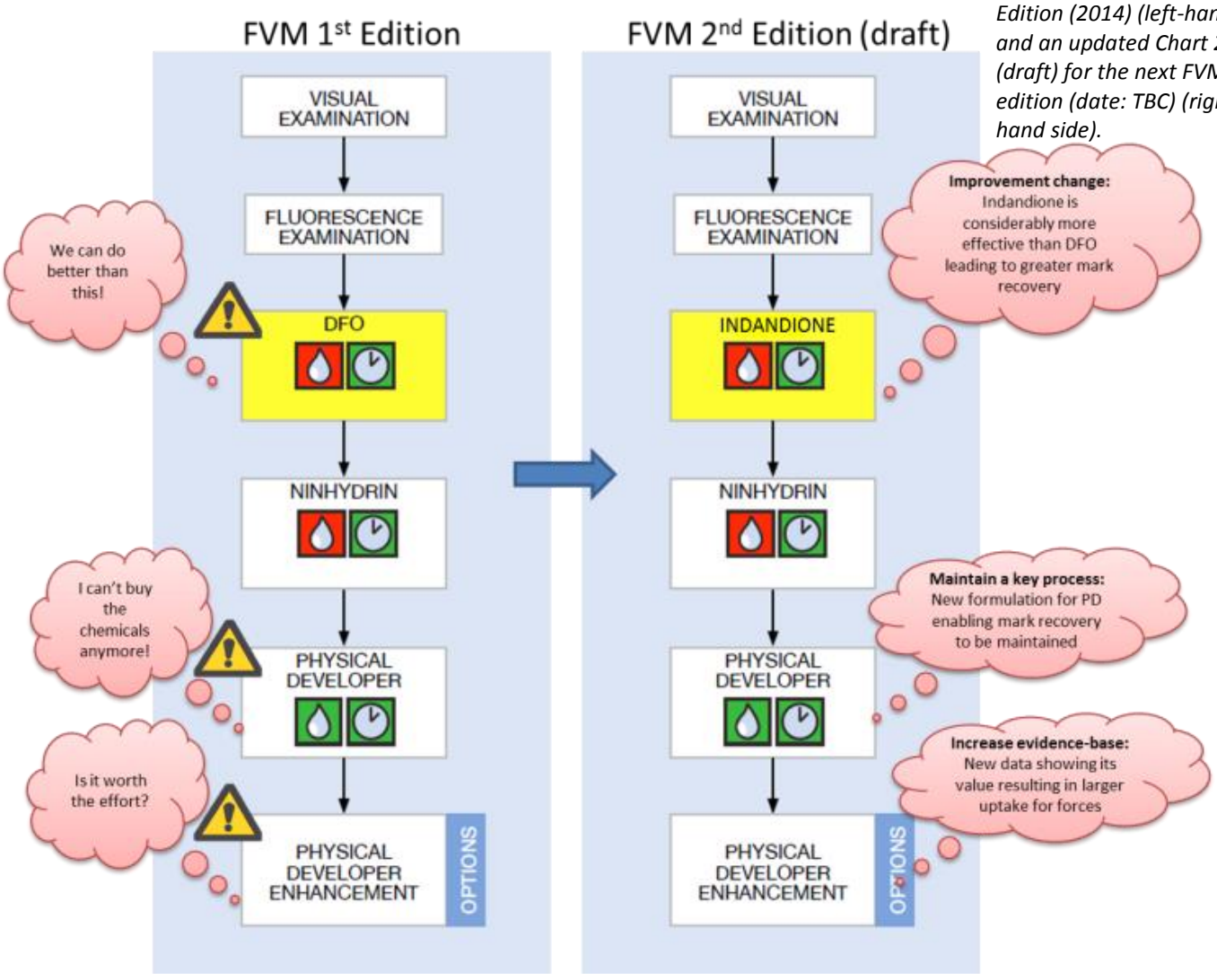


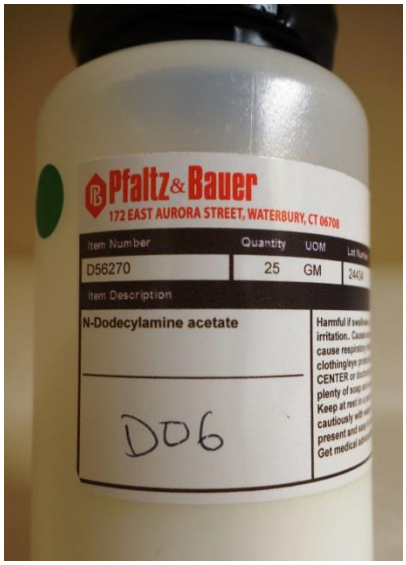
Chart 2 from the FVM 1st Edition (2014) (left-hand side) and an updated Chart 2 (draft) for the next FVM edition (date: TBC) (right-hand side).

RESEARCH AND DEVELOPMENT

Physical Developer reformulation

Physical Developer stock detergent solution continues to be made and supplied to UK law enforcement agencies by Dstl, using remaining stocks of hard-to-purchase detergents n-Dodecylamine acetate and Synperonic N. Stocks are depleting so Home Office-funded research has been conducted to identify suitable alternatives.

N-Dodecylamine acetate was bought in bulk by CAST in order to ensure a consistent purity is used (key for the success of Physical Developer). After evaluating solutions from a number of suppliers the team will be purchasing from Pfaltz and Bauer (although a US chemical company, its products can be bought via UK distributors). For further detail about why we have made this choice please contact the team.

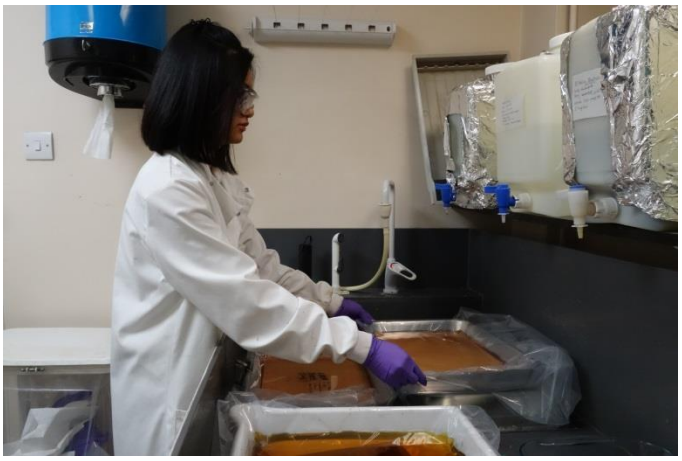


Pfaltz and Bauer n-dodecylamine acetate

Synperonic N has been banned for use over a certain concentration. Although its use in Physical Developer is below this concentration, the supply of the reagent will eventually cease. Other countries have switched to using Tween 20 as an alternative to Synperonic N. This was tested in-house but, after many attempts, we were unable to create a consistent solution (see photo) and so investigated other options. An alternative detergent**,** Decaethylene glycol mono-dodecyl ether (DGME), proved effective during planted mark trials in the laboratory. A pseudo-operational trial is in progress to test this detergent further and the results to date are promising.

Stock detergent solutions made with Tween 20 (left) and Synperonic N (right) showing differences in solubility and thus cloudiness of the solution.

It is anticipated that a new, fully tested, Physical Developer process using the reformulated stock detergent solution, using the chemicals outlined above, will be ready for inclusion in the next FVM update. In the meantime, the stock detergent will continue to be supplied until mid-2019 by Dstl until our research is complete; at this time, you will be informed to begin purchasing reagents for the new formulation direct from the suppliers at an estimated cost of approximately £40 per litre.



Undergraduate placement student, Zi Ying, from Loughborough University, processing items with Physical Developer

Old documents

The results of this work have been accepted for publication and listed by Science and Justice as being 'in press'. A full reference will be provided in the next newsletter.

A specific aspect of the validation studies for the new DGME-based Physical Developer formulation has been to establish if it gives comparable performance to the existing formulation under some of the more challenging conditions that fingermarks can be exposed to. In pseudo-operational studies of sequential processing options conducted in 2003, the team found that Physical Developer could develop fingermarks up on aged documents up to 57 years old (the oldest tested), whilst DFO and Ninhydrin appeared to be mostly ineffective for documents of this age.

This pseudo-operational study has now been extended, with documents up to 90 years old included in the evaluation as well as batches of cheques dating between 1986 and 1997. Cheques and documents were processed using the sequences: DFO/Ninhydrin/Physical Developer and Indandione/Ninhydrin/Physical Developer. Although the focus of the study was fingermark visualisation on old documents in general, this was the perfect opportunity to include both DGME-based and Synperonic N-based Physical Developer at the end of the sequence. The number of marks developed at each stage of the processing sequence was recorded and used to monitor the effectiveness of each process.

The results of this exercise indicate:

- There is no discernible difference between the performances of the two Physical Developer formulations on documents older than 21 years;
- Both formulations of Physical Developer are capable of developing fingermarks of identifiable quality on documents 90 years old;
- Physical Developer continues to produce an appreciable proportion of additional marks (typically 15-30%) regardless of which sequence (DFO - Ninhydrin or Indandione - Ninhydrin) has been used before it.
- Indandione, DFO and Ninhydrin remain effective on documents 32 years old and stored under controlled conditions, but were mostly ineffective on older documents.

The outcomes of this study provide additional supporting evidence that the new DGME-based Physical Developer formulation gives equivalent performance to the existing Synperonic N-based formulation that will be phased out from use as stocks deplete.

The results also have significant implications for cold case reviews, reiterating the point that it may be possible to obtain fingermarks from document much older than previously thought.

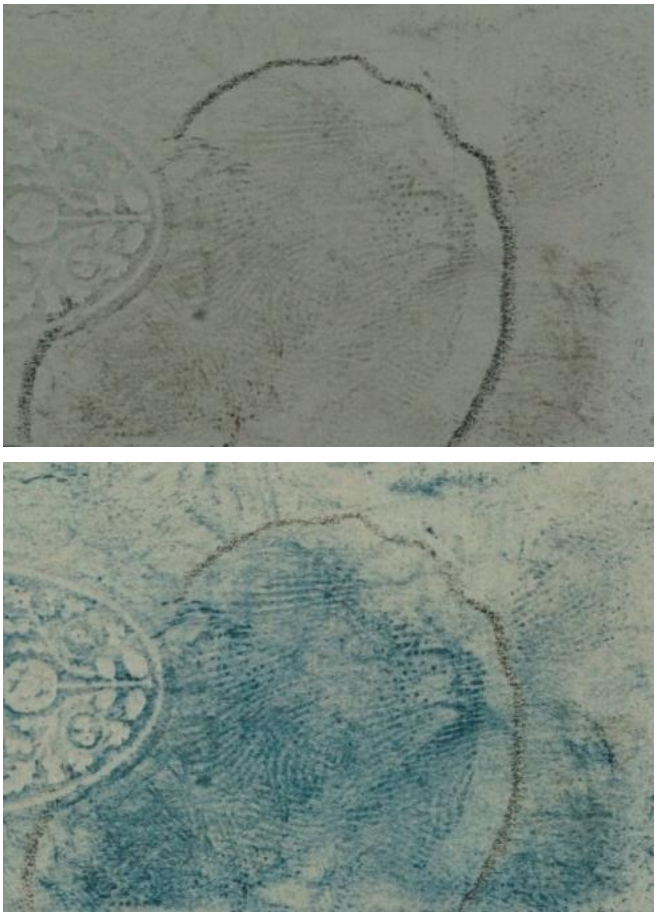

The Progress of a Great Store

Twenty-six years ago

A 1920s document processed using DGME-based Physical Developer (left) and Synperonic N-based Physical Developer (right) showing no perceptible difference in level of development between the two sides.

Added value from Physical Developer Enhancement

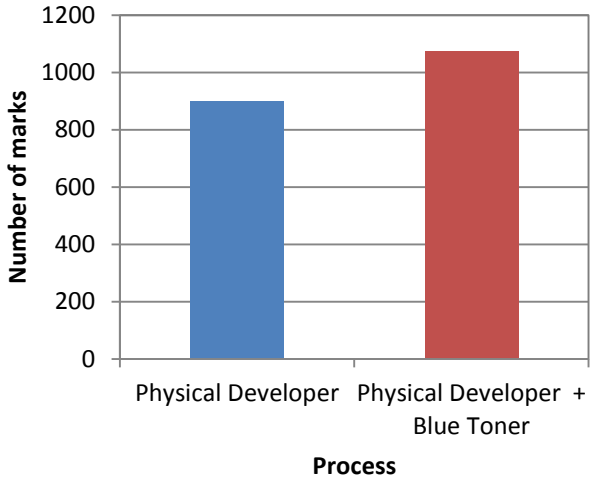
During the study into old documents, the opportunity was also taken to explore the potential benefits of using a further enhancement process after Physical Developer. Although Physical Developer Enhancement is included in the FVM, it is not thought that any UK police force currently includes it within the scope of their UKAS ISO 17025 accreditation. However in this study we have shown there are clear advantages to using this technique.



Fingermarks visualised by blue toning on old documents. A Physical Developer mark on a 1940s document (a) before toning, and (b) after toning showing increase in contrast

The Physical Developer Enhancement process used in this study was blue toning (BT20 Blue Toner, Fotospeed, Corsham, UK). This is the simplest and most widely applicable of the three processes described in the FVM, and requires making a toning solution by mixing three pre-prepared solutions with water. Articles to be treated with the toner are pre-wetted, immersed in toner solution for approximately 2 minutes, and then washed in a water bath or print washer until excess toner is removed from the background. The toning process is quick and easy to carry out, and approximately 25 A4 sheets can be treated with the 1.2 L of the solution made from the chemicals supplied in each pack.

The results of adding blue toning as an additional process for all of the aged documents previously processed using Physical Developer are shown in the graph below.

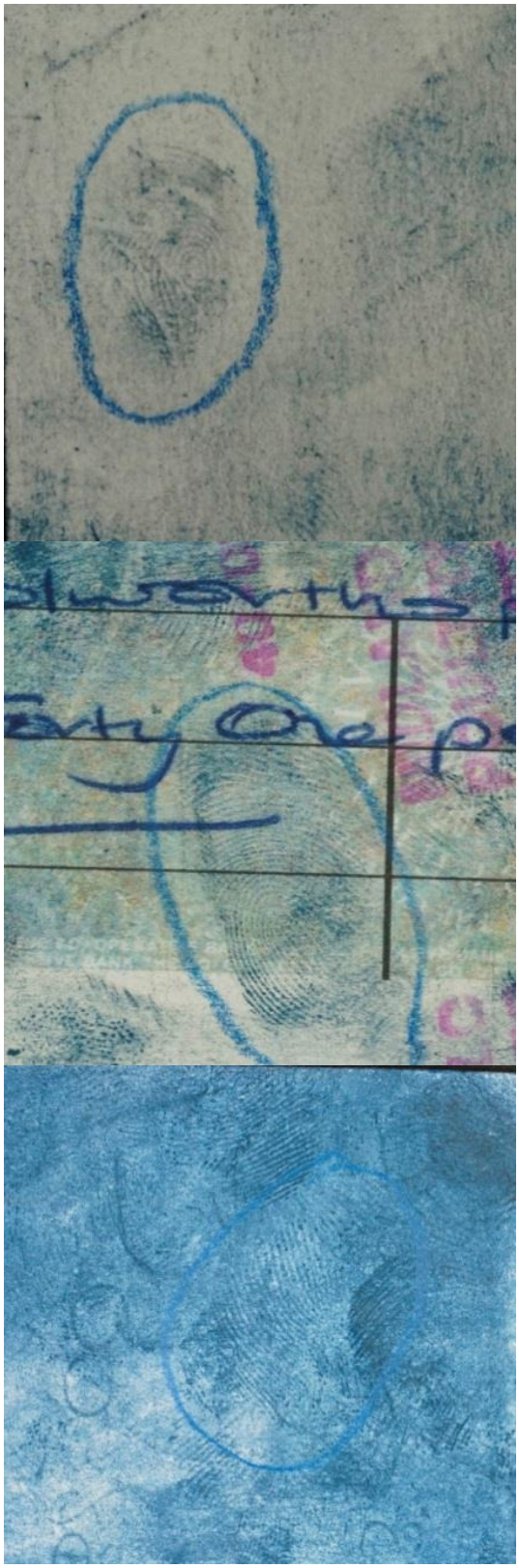


A graph showing the number of additional marks visualised on cheques using blue toner. The data is collated from studies carried out from 2003-2018 on 296 cheques from 1988-1997.

The study showed that blue toning can develop an additional 10–20% of marks if used sequentially after Physical Developer. The additional identifiable marks obtained using blue toning typically arose from one of three sources:

- Marks initially only faintly developed using Physical Developer becoming visible because of an increased contrast between the ridges and the background;
- Marks running across coloured or patterned backgrounds becoming visible because the toned blue ridges are more readily distinguished than the initial pale grey colour;
- Certain marks in regions of heavy, overlaid fingermark deposition being more heavily stained than others, making their ridge flow easier to discern.

Example images of the three points identified about are shown on the next page.



Examples of fingermarks visualised on cheques using blue toner showing: a faint mark increased in contrast (top); a mark running across a coloured background (middle); and selective staining of marks in a region of heavy, overlaid deposition (bottom)

It is hoped that the favourable results obtained from this short study will encourage users of Physical Developer to consider blue toning as an additional means of boosting fingermark recovery.

The results of this study have been incorporated into the submitted journal paper mentioned at the start of the 'Old documents' article.

Category C Process - S_2N_2: An update

The S_2N_2 (disulphur dinitride) process is already included in the FVM as a Category C process, based on the promise of work conducted by Loughborough University prior to 2010. At that time, the process involved sublimation of S_2N_2 crystals in a vacuum resulting in selective deposition of $(SN)_x$ polymer to reveal the fingermarks, and has similarities to VMD, superglue and iodine fuming. Following demonstrations of the effectiveness of the small scale laboratory process on washed, heated and mechanically distorted metal, Dstl funded further research to simplify the chemistry and make the potentially friction sensitive materials safe to handle, to scale up the process and make it reproducible. A patent application to the new process was filed by Dstl, and subsequently licensed to Foster + Freeman through Ploughshare Innovations Limited (the technology transfer organisation for UK MOD). This product is now sold as RECOVER: Latent Fingerprint Technology (LFT).

The team have been actively involved in assessing prototype equipment and performance of the process in small scale tests leading up to the licencing of the process. It has become important for potential purchasers to have some understanding of the performance of the process relative to others that could be used on metal surfaces. With this in mind, a study has been conducted that compares the prototype equipment with VMD, Superglue Fuming and dye staining, gun blueing and Powder Suspensions on metal surfaces representative of those that may be associated with criminal activity (brass, bronze, copper and stainless steel). The variables considered in the experiments have included sensitivity (extended depletion series), selectivity (multiple donors), and exposure to extreme environments (extended ageing, water wash, acetone wash and heating to 600°C). Work has also been conducted to look at whether there are any benefits in using this new process in sequence with any of the other processes used in the initial study.

Although the work has limitations in that is has been conducted using early 'proof of concept' equipment rather than a pre-production prototype, and the method of generating the S_2N_2 vapour has changed in production, the results do give an indication that this is a potentially useful process. It was found that S_2N_2 was the most consistent process of those evaluated in visualising marks on metals across the range of exposure conditions investigated.

Proof of concept equipment used during testing at CAST.

Notable features of the S_2N_2 process include:

- Ability to develop an identifiable fingermark on brass to at least the 36th mark in a depletion series (i.e. high sensitivity);
- Ability to develop high quality fingermarks from a wide range of donors;
- Ability to develop fingermarks up to 3 months old across the range of metals tested;
- Ability to develop fingermarks on surfaces exposed to adverse conditions including water/detergent washing, acetone washing and exposure to extremely high temperatures.

The study also showed that the other processes were capable of visualising fingermarks on surfaces exposed to adverse conditions, and this was more common than anticipated at the beginning of the study and needs further investigation. However, in the case of Superglue Fuming and dye staining the marks found were often significantly dimmer than those normally developed, and would probably be missed during an examination.

The results of the experimental work to date have been submitted as a journal publication. Dstl intend to conduct further testing using the commercially available RECOVER: Latent Fingerprint Technology (LFT) equipment, and to expand the trials to cover operationally relevant items (such as fired bullet casings and knives).

The new RECOVER: Latent Fingerprint Technology equipment available from Foster + Freeman. (Image provided by Foster + Freeman)

Powder suspension reformulation

CAST have been researching a new iron oxide Powder Suspension formulation to replace the one currently recommended in the FVM. The driver for this was the need for a new detergent to replace Triton X-100, which will likely be banned in the near future. By considering the recent Powder Suspension research efforts of Australian academics, we've found that Tween 20 is an effective alternative detergent for this visualisation process. In the process of these investigations, we also noticed that there are differences between batches of the recommended iron (II/III) oxide powder from Fisher Scientific (I/1100/53). A less effective batch not only caused fewer marks to be detected in side-by-side comparisons, but the marks that were detected were poor in contrast (see image below). Measurements performed on these powders indicate that there is a difference in

particle size distribution between them. The less effective powder batch had a lower percentage of fine particles compared to the more effective batch.

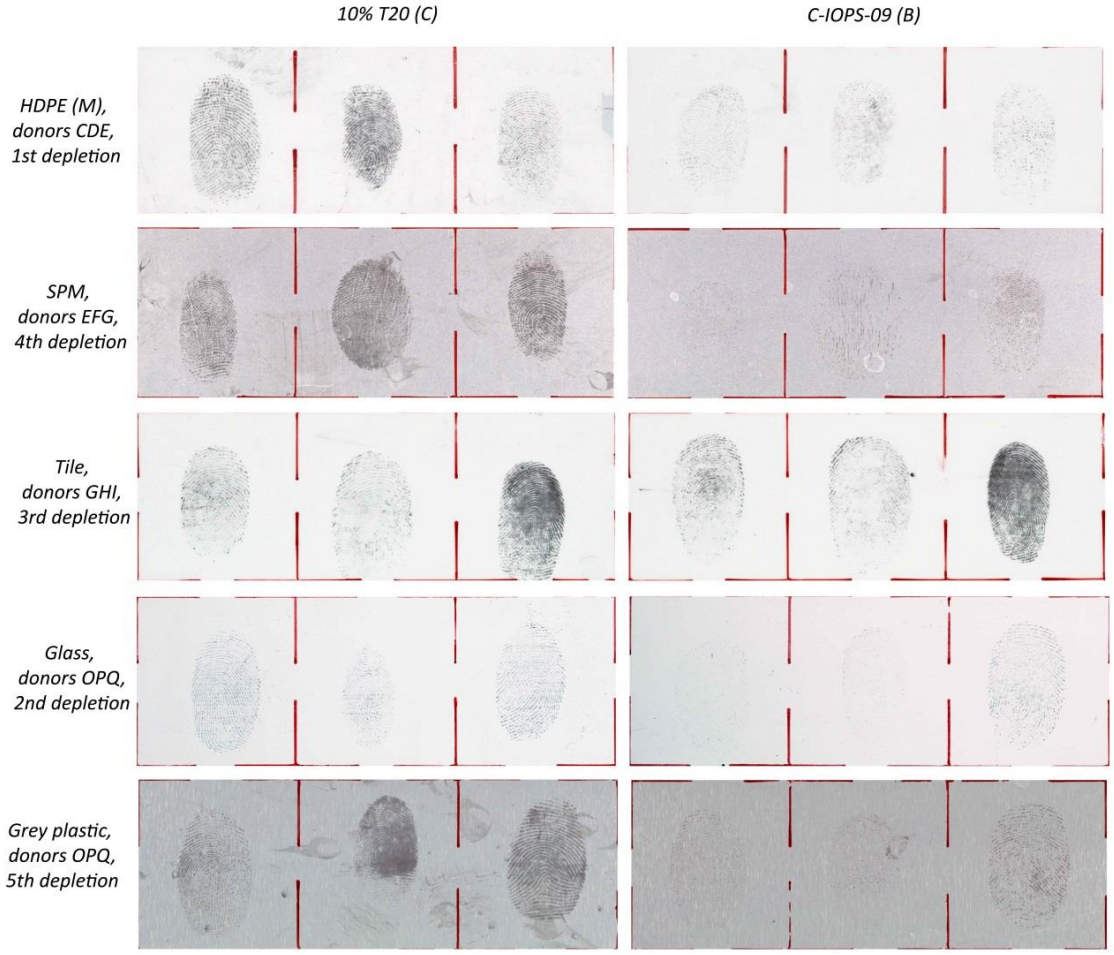
We have identified a higher quality iron oxide powder that has a more precise particle size specification, and it is effective in the new Tween 20 detergent solution. We hope that this powder will be less likely to vary significantly between batches than the Fisher Scientific material previously recommended; however, further investigations may be required. It is anticipated that a new Powder Suspension formulation will be available for operational use in 2019.

In the meantime, we advise those using iron oxide Powder Suspension for casework to be on the lookout for a general decline in fingermark contrast. This would indicate that your batch of powder may be less effective.

It may be possible to monitor Powder Suspension effectiveness with control samples, but it is important to note that the difference between effective and less effective powders might not be apparent for some very good fingermark donors.

The difference between powders may be subtle on some surfaces as well. Any in-force investigations should therefore include a good spread of donors, and more than just 1 or 2 surfaces.

'Wetwop black' and 'black Wet Powder' are two commercial carbon-based Powder Suspension formulations. They are often as effective as iron oxide Powder Suspensions on general non-porous substrates, but they are more likely to cause background staining on some materials. If using these instead of iron oxide Powder Suspension, please proceed with caution and perform spot-tests on evidential items if possible.



10% Tween 20 solution with new Sigma Aldrich iron oxide (1 ml : 0.5 g ratio) (Left) and current FVM formulation (i.e. uses Triton X-100) with Fisher Scientific iron oxide (a less effective batch) (right)

Visualisation after Superglue Fuming

We have conducted in-house evaluations of UVA-reflection as a method for searching and imaging superglue treated marks to see how it compares to BY40 staining. If successful, it offers the advantage of being non-destructive and could save time if dye staining is not required.

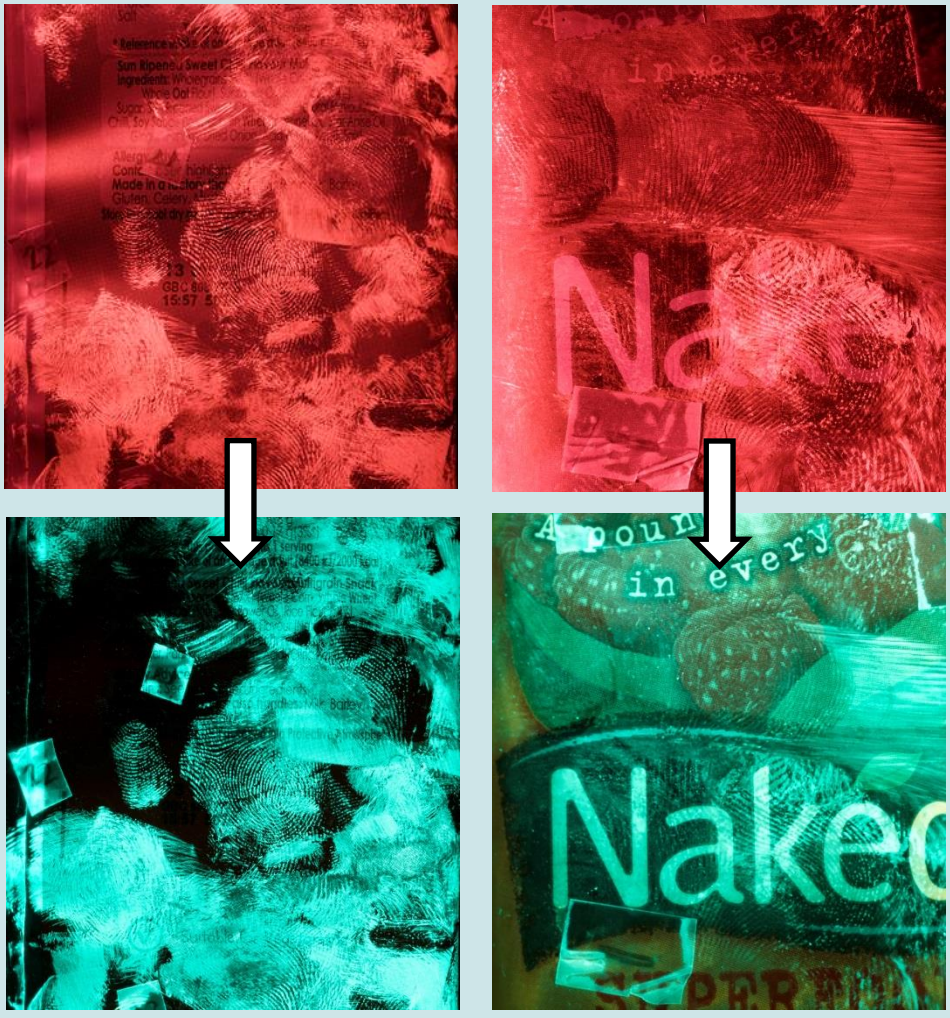
We're using the Foster and Freeman UVA crimelite and full spectrum Sony a7RII cameras with UV lenses (one for searching and one for image capture). Data from a pseudo-operational trial show that it is considerably more effective than visual examination. It is marginally less effective (on average) than BY40 although both enhancement methods find marks that the other may not.

We did investigate whether violet-reflection could be used instead of UVA-reflection, the theory being that they are of similar wavelength (and so may interact with the surface in a similar way), but without the added costs of having to purchase specialist equipment (UV sensitive camera and/or UVA light source). UVA-reflection proved to be much more effective that violet-reflection, so this was dropped from future work.

Related to this study, in the February 2016 CAST FVM, we provided initial guidelines on the use of one-step superglue processes, as they also show promise in this area. We now have additional data that support these guidelines.

The majority of the in-house research based around Superglue Fuming to date has focussed on non-porous surfaces. Further studies will need to include re-evaluating the semi-porous chart where both UVA-reflection and one-step processes may offer more that the currently recommended 'Superglue Fuming-Powders' or 'Superglue Fuming-VMD' routes.

In summary, although these chemical and optical methods have not outperformed current practice on non-porous substrates, they are certainly worth considering if there are justifiable reasons for not using traditional wet dye stains.



Items treated with Superglue Fuming and resultant marks visualised with UVA Reflection (top) and Basic Yellow 40 & Fluorescence Examination (bottom). The two examples show cases where the two processes show differing amount of detail.

Support to academic studies

Anglia Ruskin University

Fingerprints on Walls: For the past few years we've been providing external supervision for a PhD study at Anglia Ruskin University investigating fingermark visualisation on painted walls. The study is in its final stages with the thesis due for completion in early 2019. There are some interesting findings which show that the guidance in the FVM is outdated, mainly due to the composition and porosity (or lack of) of modern paints. This information will be fully reviewed before considering the need for additional validation data and ultimately changes in the FVM.

Sheffield Hallam University

Matrix Assisted Laser Desorption Ionisation (MALDI): Dstl have agreed to provide full funding to Sheffield Hallam University for a PhD titled: '*Method refinement and validation for the operational non-presumptive and informative detection of blood in stains and fingerprints'* to continue the MALDI work on human blood identification. SHU have been working on fingerprints for 10 years and blood for the past 5. They have almost completed studies to demonstrate that their novel application of MALDI to fingerprints is scientifically sound and validated for its intended purpose – in this case to categorically identify human blood via MALDI MS Imaging and Profiling methods. It is anticipated that the PhD study will start in February 2019.

Journal publications

In the months leading up to the integration of CAST into Dstl, several pieces of work were completed and submitted for publication. These have subsequently been accepted and published in appropriate journals. For any police forces wishing to add these documents to their validation libraries, the appropriate references are:

- N. Nicolasora, R. Downham, L. Hussey, A. Luscombe, K. Mayse, V. Sears. *A validation study of the 1,2-Indandione reagent for operational use in the UK; Part 1 – Formulation optimization*, Forensic Sci. Int. 292 (2018) 242-253
- N. Nicolasora, R. Downham, R-M. Dyer, L. Hussey, A. Luscombe, V. Sears. *A validation study of the 1,2-indandione reagent for operational use in the UK: Part 2 — Optimization of processing conditions*, Forensic Sci. Int. 288 (2018) 266-277
- A. Luscombe, V. Sears. *A validation study of the 1,2-Indandione reagent for operational use in the UK: Part 3—Laboratory comparison and pseudo-operational trials on porous items*, Forensic Sci. Int. 292 (2018) 254-261
- R.P. Downham, E.R. Brewer, R.S.P. King, V.G. Sears. *Sequential processing strategies for fingermark visualisation on uncirculated £10 (Bank of England) polymer banknotes*, Forensic Sci. Int. 288 (2018) 140-158
- R.P. Downham, V.G. Sears, L. Hussey, B-S. Chu, B.J. Jones, *Fingermark visualisation with iron oxide powder suspension: the variable effectiveness of iron (II/III) oxide powders, and Tween® 20 as an alternative to Triton™ X-100*, Forensic Sci. Int. 292 (2018) 190-203
- Pitera M, Sears V, Bleay S, Park S, *An investigation of the influence of surface condition on fingermark visualisation on metal surfaces*, Science & Justice 58 (5) (2018) 372-383

ADVICE

Enquiries

Word cloud showing common topics such as Indandione and the FVM

During the first six months of this financial year, the fingerprint team at Dstl answered 82 fingerprint-related forensic enquiries. This has decreased compared to last year, which saw a particularly high number of enquiries (134 in total between April and October 2016).

Some interesting enquiries have included providing advice on processing paper impregnated with drugs, the safe chemical treatment of a vape pen and a review of historical information on the health and safety of powders. Common enquiry topics were Indandione, Powder Suspensions and Physical Developer.

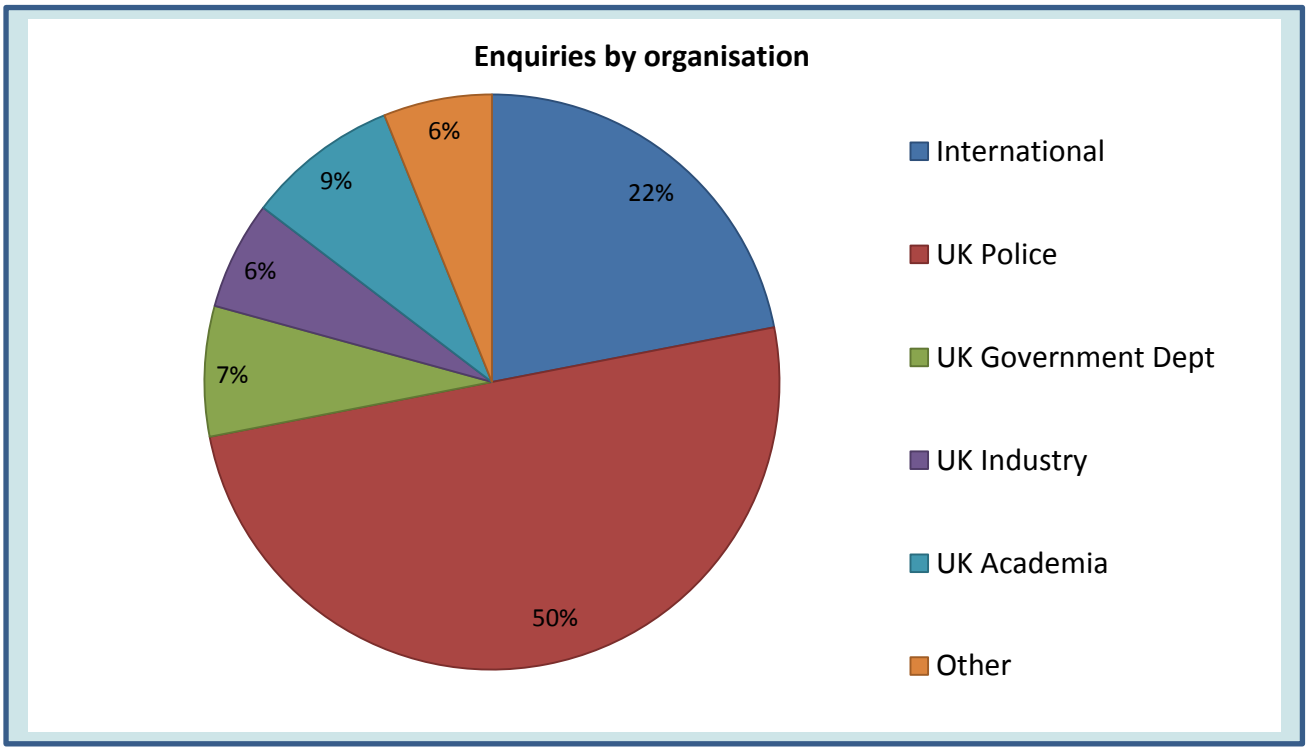
Health and safety of aluminium fingerprint powder

A recent enquiry, via the Forensic Science Regulation Unit (FSRU), sought information relating to any guidance or policies, particularly around personal protective equipment, for the use of aluminium powder by CSIs over the decades. This was in response to a specific long-term health and safety matter where aluminium powder was thought to be a contributory factor to ill health.

Dstl holds extensive Home Office information on the topic of aluminium fingerprint powder health and safety from the 1970s onwards. This comprehensive holding of historical documents enabled us to provide a summary of key information in a report.

A redacted version of the report was prepared, at the request of the FSRU, for wider circulation to UK public sector organisations that carry out or previously carried out fingermark recovery using aluminium fingerprint powder. This was subsequently circulated to the NPCC Forensic Enhancement Laboratories and CSI expert networks. Details of the report are:

History of Aluminium Fingerprint Powder Health and Safety Compiled from Dstl Records 1970 – 2018, DSTL/CR110442, 13th August 2018



Tips for powders validation for scene use

Powdering using a granular powder with a squirrel hair brush

The team actively follow conversations within relevant communities on the Police OnLine Knowledge Area (POLKA) (UK only) as a method to keep abreast of operational needs. We input to discussions when we can add benefit by providing technical guidance. This article relates to a post enquiring about fingerprint powders and the impact of temperature on process effectiveness – something many forces are considering in the lead-up to ISO 17020 accreditation and scene use of powders. We're aware that not everyone follows discussions on POLKA, so felt it was valuable to repeat our thoughts on the topic in this newsletter.

Trying to determine the impact of temperature on the effectiveness of fingerprint powders is extremely complex and not something that we believe should be the main focus when carrying out verification studies for powders at scenes. Temperature alone is only one of the variables that may impact of the effectiveness of the process. Chapter 2 of the Fingermark Visualisation Manual (FVM) gives a comprehensive overview of the main factors that can influence mark development and should be consulted in order to get a broader view.

It is also worth noting that these environmental factors can have a big impact on the fingermark itself i.e. its constituents. A simple example of this is: if it's hot, you are likely to sweat more. So the fingermark constituents (type and quantity) are likely to be responsible for differences in performance that cannot be attributed to differences in the processes itself (e.g. type of powder or applicator), or substrate (e.g. texture, cleanliness). So we may see seasonal differences anyway.

This is where experimental design is important and those conducting trials must ensure they are actually answering the question they think they're answering. For example, if you put test samples in the fridge at 5°C, take them out and powder, then inferring anything about the effectiveness of the powder is difficult or flawed. It certainly does not represent powdering on a cold day. In any case, in the real world there is often little that can be done about this variability and we generally have little information about the constituents anyway.

Based on this, we would suggest that verification studies should focus on the following areas:

- Use existing validation data. See the FVM and Source Book which contains extensive validation data on powders. Check that it is fit for purpose. It took 3–4 years to generate that data which included ~30,000 fingermarks. It is by far the biggest applied study of fingerprint powder in the world so make use of the data.
- That study was done more than 10 years ago. So, we should ensure that it is still valid i.e. are the powders used then the same as the powders used now? Are the substrates used in the study still applicable? What about batch-to-batch variability?
- Staff competence is one of the main factors for the success of powders and shouldn't be underestimated – this should also be a major focus.
- If using other powders that were not part of this original study then these need to be fully validated. There are international guidelines for how this should be done. Appendix 2 in the FVM will give you a head up of what is required and point you towards the relevant publications.

It is worth noting that the points in this article come from the scientific perspective. There may be additional requirements for accreditation.

Source Book – a reminder

The team has always sought to make the outputs of its research available to the UK law enforcement community. The introduction of ISO 17025 and the Forensic Science Regulator's Codes of Practice and Conduct reinforce the need to have access to information relating to the scientific validity of processes used to obtain forensic evidence and its subsequent use in the Criminal Justice System.

The Fingerprint Source Book v2.0 gives a snapshot of the state of knowledge and validation studies conducted for the processes within the Fingermark Visualisation Manual taken in early to mid-2017. However, as further research is completed it is our intention that this will be published in peer reviewed journals, an approach that is supported by the Forensic Science Regulator and the NPCC Forensic Enhancement Laboratories Expert Group.

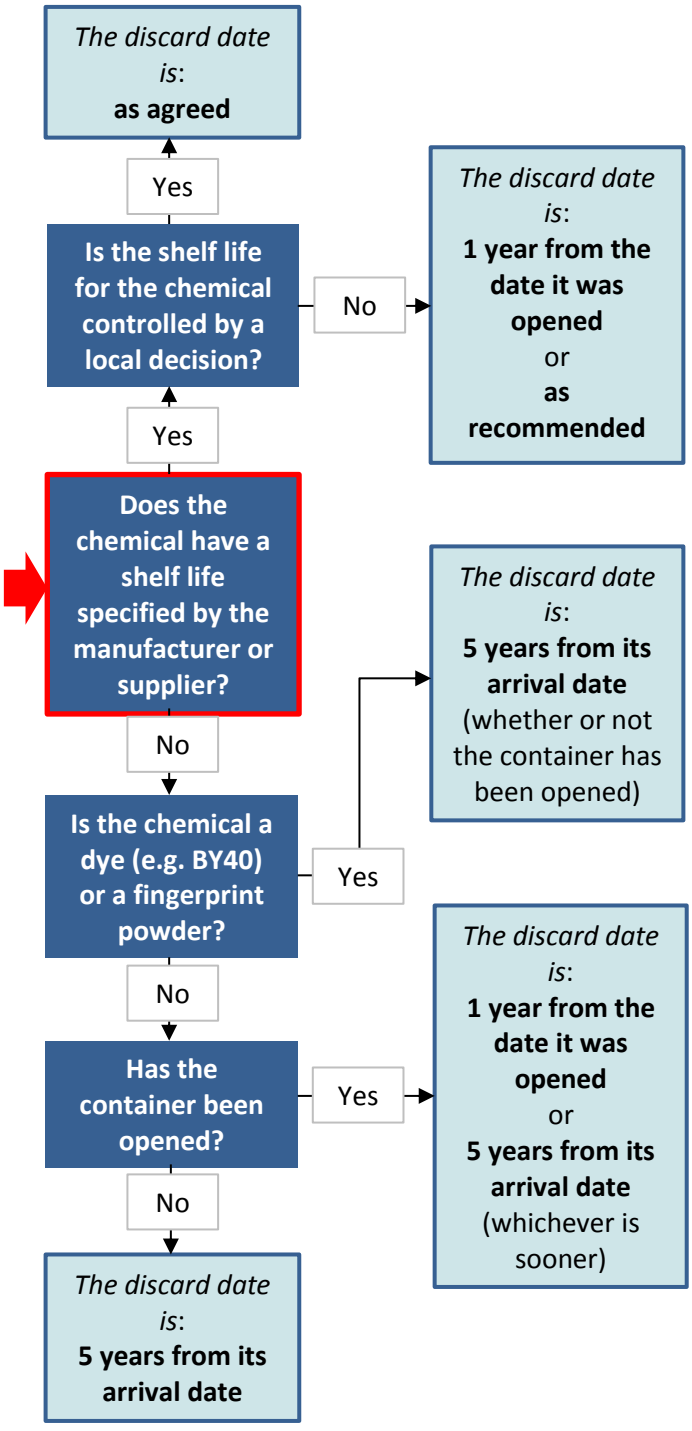
We've been made aware of an error in the Indandione formulation within v2.0 of the source book. As this is a critical error, we felt it needed correcting so we've updated the source book, but kept it as version 2 (second edition). The only change is:

- Update to *Chapter 3: Chemical and Physical Processes, page 287 (3.IND.14), 3.18, table: 'Formulation of 1,2 Indandione used in 2015-2016 comparative trials [24]'*: the methanol quantity has changed from 1 mL to 45 mL.

Guideline expiry dates

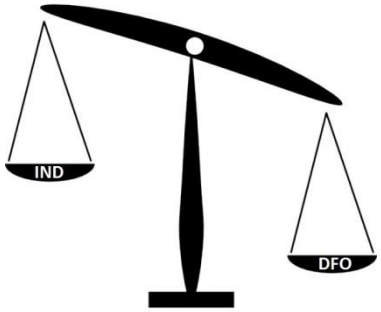
Determining sensible expiry dates for chemicals can be confusing due to missing, conflicting or misleading information from suppliers. Following several enquiries on the topic, we felt it would be helpful for us to share our approach. The information should be taken as guidance only. It is not definitive and can be adapted for local needs.

The flow chart on the right is a chemical shelf life determination chart, developed for internal use when CAST's fingermark research laboratories were accredited to ISO 17025. The flow chart was created after reviewing the storage and shelf life information for each chemical used in the category A fingermark visualisation processes (FVM 3.1.18-20), from multiple suppliers. Local decisions were made and documented in situations where supplier information was conflicting. The central logic to this system – that most chemicals have a shelf life of 5 years unless stated – was evidenced as common practice in industry. The 'one year from opening' shelf-life concept was also considered best practice, and helps to mitigate against contamination, and chemical quality reduction due to repeated exposure to oxygen and moisture.



Chemical shelf life determination chart, developed for internal use when CAST's fingermark research laboratories were accredited to ISO 17025

Choosing one amino acid reagent? Choose Indandione!



Since the last newsletter, we have published in the scientific literature the results of extensive laboratory trials from the last 15 years of research at CAST into Indandione as a fingermark visualisation process (see *journal publications*). The pseudo-operational trial showed that Indandione was developing approximately 1.6 times more marks than DFO. This is a significant improvement in mark recovery and police fingerprint laboratories, such as Lancashire and Greater Manchester Police (GMP), have carried out operational trials/pilot studies to verify the use of Indandione on casework. GMP, so far, have found approximately 40% more marks with Indandione and they discovered a greater improvement in mark recovery with Indandione was achieved in the winter. We are collating data from the verification studies so please get in touch if you have carried out a similar exercise in your lab.

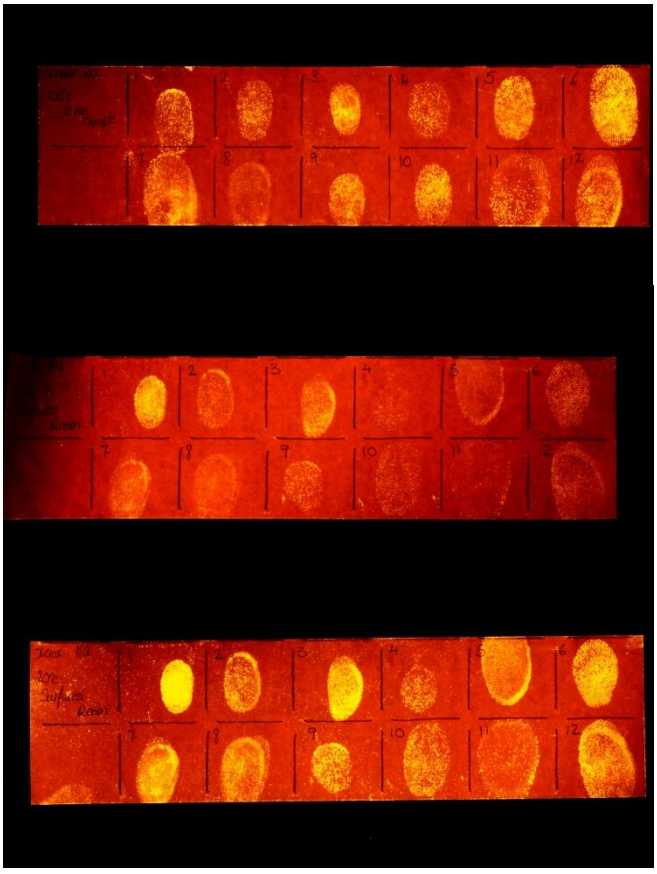
There are several reasons why we are recommending police force laboratories use Indandione rather than DFO, these include:

1. Greater number of marks developed;
2. It typically produces brighter marks making them easier to find;
3. The oven processing time is faster (10 minutes compared to 20);
4. Lower temperatures, such as room temperature, will still develop marks over time if the oven cannot be used (see photos);
5. The guideline expiry date of the working solution is longer (12 months compared to 6).

There is still benefit to using Ninhydrin after Indandione in a sequential process as ~15% extra marks can be developed. If only one amino acid reagent can be used on a case due to local protocols then we would strongly encourage the use of Indandione instead of Ninhydrin. This is because Indandione is the most effective at developing marks. A recent independent study showed that over 40% of marks were lost by only treating with Ninhydrin compared to Indandione [Olszowska *et al*, FSI, 284, pp5364].

Due to the Indandione process being a fluorescent technique, we anticipate marks will gradually fade with time once removed from the oven and we will be exploring this further in a small study. Currently we recommend photographing the marks soon after heating in the oven at 100°C and storing items in the dark to minimise marks fading (the protocol as for DFO items).

Further information on Indandione can be found in the latest version of the source book (see *Source Book – a reminder*). We are happy to provide advice on the use of Indandione or answer any further questions on the process.



Examples of planted marks processed at 100°C for 10 minutes (top), 20°C for 1 hour (middle), and 20°C for 2 days (bottom).

CONTACT US

Enquiries

Please direct all enquiries to the following central mailbox: FI_Enquiries@dstl.gov.uk

Note: Dstl's email system does not send out-of-office replies to non-Dstl accounts. To avoid delay to enquiries that are time-critical, please ensure that the central mailbox is used in preference to individual staff mailboxes.

Address

Dstl, Woodcock Hill, Sandridge, St Albans, Hertfordshire, AL4 9HQ, UK

Publications

Past newsletters and the Source Book v2.0 (second edition) can be found on the following website: https://www.gov.uk/government/collections/centre-for-applied-science-and-technology-information#fingermark-documents

For sales of the Fingermark Visualisation Manual (FVM) please contact Clare Polley, Official/Library Channel Sales Manager, Williams Lea Tag, WLT (Clare.Polley@wlt.co.uk)

Home Office Commissioning Hub

This fingermark visualisation research has been funded by the Home Office. If you have a new work requirement that you would like the Dstl team to explore, please contact the Home Office Commissioning Hub, who are responsible for tasking Dstl on behalf of the UK Home Office & Law Enforcement; their email address is CommissioningHub@homeoffice.gsi.gov.uk.