Fingerprint and Footwear Forensics Newsletter

May 2008 Publication No.24/08

Home Office
Scientific Development Branch

SPECIAL EDITION: FOOTWEAR MARK RECOVERY

Author: Dr Helen Bandey

IN THIS ISSUE

CONTACTS

Valerie Bowman	01727 816209
Vaughn Sears	01727 816216
Helen Bandey	01727 816385
Stephen Bleay	01727 816252
Chris Selway	01727 816266
Andrew Gibson	01727 816272
Lesley Fitzgerald	01727 816433
Laura Powell	01727 816475
David MacPhee	01727 816295
Adam Michalik	01727 816290

SALES OF FINGERPRINT PUBLICATIONS

Tamara Lloyd	01727 816454
Fax	01727 816253

ADDRESS

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

INTRODUCTION

In addition to the regular biannual newsletters produced by the Fingerprint and Footwear Forensics (FFF) group at HOSDB, we are pleased to send you an update dedicated purely to footwear mark recovery.

HOSDB's involvement in footwear mark recovery started following a joint ACPO/PSU workshop held in August 2005 to define a vision for the capture and exploitation of footwear evidence and intelligence by the police service of England and Wales. This was held ahead of legislation changes on 1st January 2006 enabling the police service to take footwear impressions from suspects apprehended by the police. For this vision to succeed, gaps in the current system were identified and work streams set up to fill these gaps. Two areas of work were identified for HOSDB: setting standards for imaging of footwear marks at scenes of crime or in custody suites and providing information on development techniques and retrieval methods for the recovery of footwear marks at the crime scene. This newsletter will concentrate on the latter.

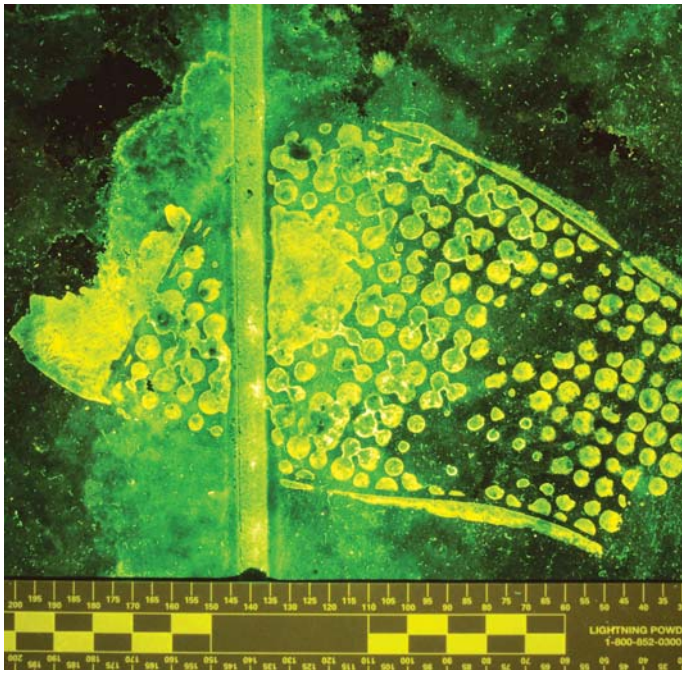


Figure 1: *Footwear Mark in Blood Enhanced with Acid Yellow 7 on a Floor Tile*

Since the ACPO/PSU workshop, we have visited police forces, forensic suppliers and companies in order to improve our understanding of the whole process from scene of crime or custody suite procedures to methods for making comparisons for intelligence or identification purposes. In March 2006 a workshop was held at HOSDB – its purpose being to identify where current recovery methods work well and where there is little success and possible scope for improvement. The level of success is dependent upon several factors including: (1) the mark material or contaminant (blood, soil etc), (2) the substrate (carpet, tarmac etc) and, (3) the recovery process (lifting, chemical enhancement etc). We also explored the likely frequency of occurrence of these contaminants and surfaces in investigations and the perceived difficulty of retrieval of footwear marks in these situations. This allowed us to focus our efforts during the subsequent feasibility study (June – December 2006) where we tested a broad range of footwear mark recovery methods, including those methods traditionally used to develop fingerprints, using surfaces and contaminants identified in the workshop.

Findings from the feasibility study were presented, in the form of 14 recommendations for further work, to the newly formed National Footwear Board (chair: DCC Clive Wolfendale, North Wales Police) in December 2006. The report was distributed to forces via the regional representatives for prioritisation of the tasks identified. As a result of the prioritisation, and with some flexibility for innovation from HOSDB, a programme of work was established in March 2007. Progress updates from HOSDB are discussed at the National Footwear Board's Research and Development sub-group meetings which are held on a quarterly basis: minutes can be found on the Genesis website.

In November 2007, NPIA Harperley Hall issued a 'Footwear Mark Recovery Manual' to all scientific support managers within UK police forces. The manual is based around current practices taught during CSI courses. It is intended that best practice recommendations established by HOSDB will be incorporated into the manual periodically. Imaging guidelines, as a result of the HOSDB trials, have been issued to the NPIA and will be implemented via the manual. In the meantime updates will be presented to forces via newsletters.

We are now at the stage where we can start to share our findings on footwear mark recovery methods. In some cases areas of work are complete and we are able to make specific recommendations which are clearly highlighted. Other articles are merely progress reports so that you are informed of current activities.

PRODUCTION OF A WET MARK DRYER

Background

Wet footwear marks cannot be recovered effectively using conventional methods such as lifting and must be dried first. It is not good use of a scene examiner's time to wait for a mark to dry or return at a later date, and for this reason many wet marks are not recovered. To enable rapid recovery of these types of marks the need for a safe, effective and cheap drying system was identified.

Objective

To design, build and test a piece of equipment that will dry wet marks at crime scenes so that they can be recovered and taken back to force using conventional methods.

Prototype Design

Several design options were considered before building the prototype shown in Figure 2. This design takes into account the key considerations listed in Table 1. In summary, the wet mark dryer consists of a standard hairdryer fitted with a 'footwear' size diffuser unit. Placing the dryer over the area, switching on and waiting for a few minutes dries the mark.

Operational Trial

Eight prototype units have been built at HOSDB and are currently being tested by scene of crime officers at Thames Valley Police with one unit deployed within the Fingerprint Development Unit for the drying of chemically enhanced marks at crime scenes. Trial results will be published in future newsletters.

Figure 2: *Prototype Wet Mark Dryer*

Key Considerations	Solution
Low cost	• The diffuser can be fitted to any recommended hairdryer, or alternatively it can be engineered to fit a range of nozzle diameters • Minimal engineering is required as the heating and fan components are standard parts enclosed within the hairdryer • All electrical parts are low cost
Short drying time	• Less that 10 minutes for a very wet mark
Reliability	• All electrical parts are reliable • Construction is robust
Ease of use	• The unit has three feet for stable positioning and to assist air extraction
Safety	• All electrical parts are safe • Circuit breaker incorporated into dryer • All materials are heat-resistant • The unit temperature is safe to handle
Must not destroy any detail within the mark	• The diffuser unit evenly distributes the airflow, so as not to disturb the mark

Table 1: *Key considerations and proposed solution for the wet mark dryer.*

'FINGERPRINT' PROCESSES FOR FOOTWEAR MARK ENHANCEMENT

Background

Many footwear marks are enhanced either at crime scenes or in a force fingerprint laboratory with processes that would typically be used to find latent finger marks. Very little research has been conducted to determine how effective these processes are for developing footwear marks. As part of the feasibility study these processes were evaluated, but at this stage the practicality of using some of the processes for footwear mark enhancement was not considered.

Objective

To assess the suitability of fingerprint development technique (from MoFDT[1]) for enhancing footwear marks made in a wide range of contaminants on a range of surfaces commonly encountered at crime scenes[2].

Experimental

A range of clean surfaces and contaminants from those identified at the March 2006 workshop were used. Surfaces were cut to ~ A4 size for ease of handling and in sufficient quantity so all processes could be tested on each surface. A shoe stamp was used to deposit marks in a range of contaminants on all surfaces (Figure 3). All of the marks were heavy – at this stage it was considered more important to roughly identify which contaminants are enhanced by the various processes rather than try to assess the sensitivity of the process. Marks were subjectively graded in terms of their ability to enhance detail. See Appendix 1 for further details.

Results and Discussion

Table 2 summarises the ability of the range of processes to enhance marks in a wide range of contaminants taking average performance scores. The red boxes represent no or little enhancement, the yellow boxes represent some enhancement and the green boxes represent good enhancement on average. The main points drawn from this preliminary study are:

- The ability of 'fingerprint' development techniques to enhance footwear marks depends upon the constituents within the mark.

1. Manual of Fingerprint Development Techniques, Ed. V. Bowman, 2nd Edition, Updated 2004
2. Identified in the HOSDB workshop in March 2006

- Sudan Black, Iodine, Fluorescence Examination and SPR, typically are poor processes except on contaminants that it is designed to target (Sudan Black, Iodine and SPR – various fats; Fluorescence Examination – relies upon a difference in fluorescence between the surface and the mark).
- Vacuum Metal Deposition (VMD) is generally a good process for enhancing contaminants (although its use is limited to exhibits that can be removed to a laboratory).
- The results from fingerprint powders were relatively consistent with all powders targeting similar contaminants. The data is too crude to distinguish between powders.
- Powder suspension was very effective on most contaminants and was the single most effective process on 50% of the tested contaminants.

Conclusions

We have a basic knowledge of the effectiveness of a range of 'fingerprint' development processes for enhancing footwear marks made in a variety of contaminants. Table 2 can be used to assist in the selection of an enhancement method if needed although non-destructive methods should always be used prior to the more destructive chemical methods. Powder suspensions were studied in more detail as described in the next section.

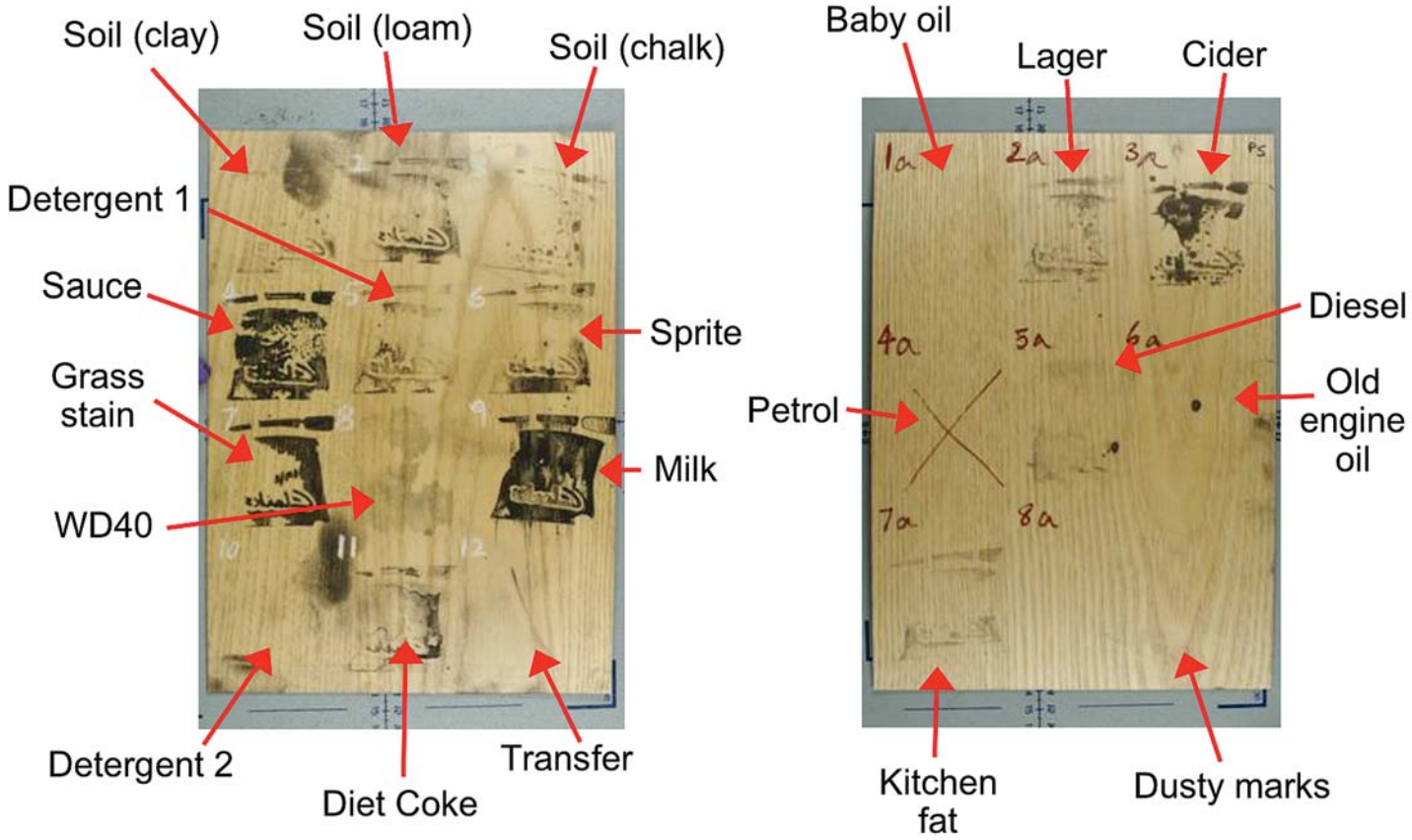


Figure 3: *Typical substrate with various contaminants treated with a fingerprint development process (in this case powder suspension on laminate flooring)*

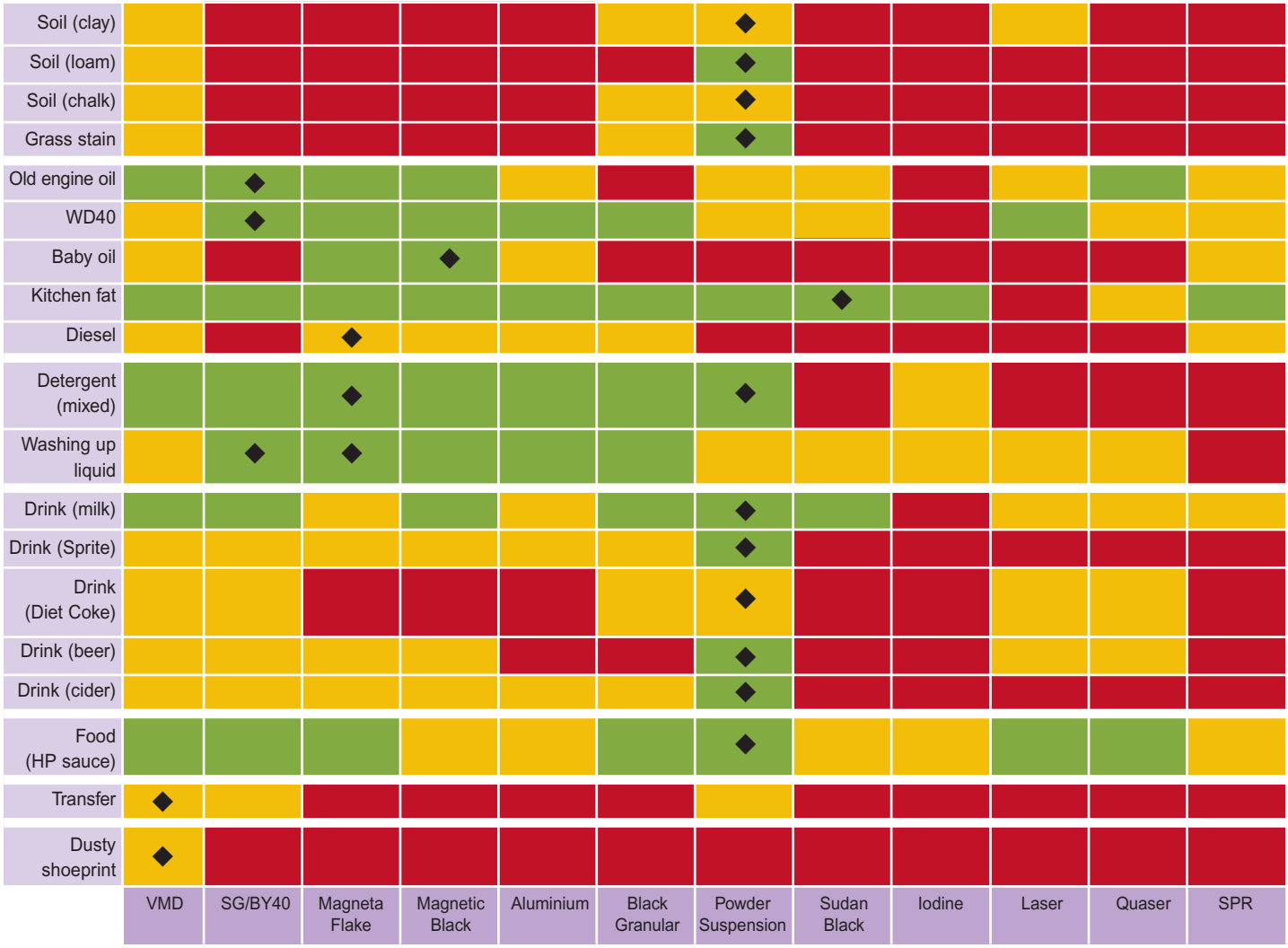


Table 2: *Summary of the effectiveness of fingerprint development processes across all tested surfaces on a range of contaminants that may be present in footwear marks. Red, yellow and green highlighted boxes indicate poor, average or good enhancement respectively. ◆ indicates the process most likely to be effective for that contaminant.*

USE OF POWDER SUSPENSIONS FOR FOOTWEAR MARK ENHANCEMENT

Background

Traditionally, powder suspensions have been used to enhance finger marks on the adhesive side of tape. More recently, they have been used successfully to develop finger marks on many surfaces, in particular non-porous surfaces[3] and those recovered from arson scenes[4]. From the footwear feasibility study it was apparent that powder suspension could be a very useful and sensitive tool to enhance footwear marks made in a range of contaminants.

There are several commercially available powder suspensions in addition to the HOSDB formulations published two years ago[5]. All have varying effectiveness that is dependent upon the situation in which it is used. The chemical constituents within each vary, but generally consist of a powder, detergent and water. The powder is often iron oxide or carbon for the black formulations and titanium dioxide for the white formulation. In previous fingerprint studies[3], we have shown on light non-porous surfaces that iron oxide based formulations are more effective than the carbon based ones.

Objective

To determine which powder suspension formulation is most suited to the enhancement of footwear marks on non-porous flooring materials and to give guidance on the application of powder suspension at crime scenes.

Experimental

Partial footwear marks in mud were deposited as shown in Figure 4 onto a range of surfaces (tiles, u-PVC and polypropylene). In total, 10 soil/mud samples from around the UK were used. Samples were left overnight to dry and then treated with either an iron oxide based formulation or a carbon

based formulation. A similar comparison was also conducted on various other contaminants as listed in Appendix 1. The process is described in a previous newsletter[5] and should be referred to for full details.

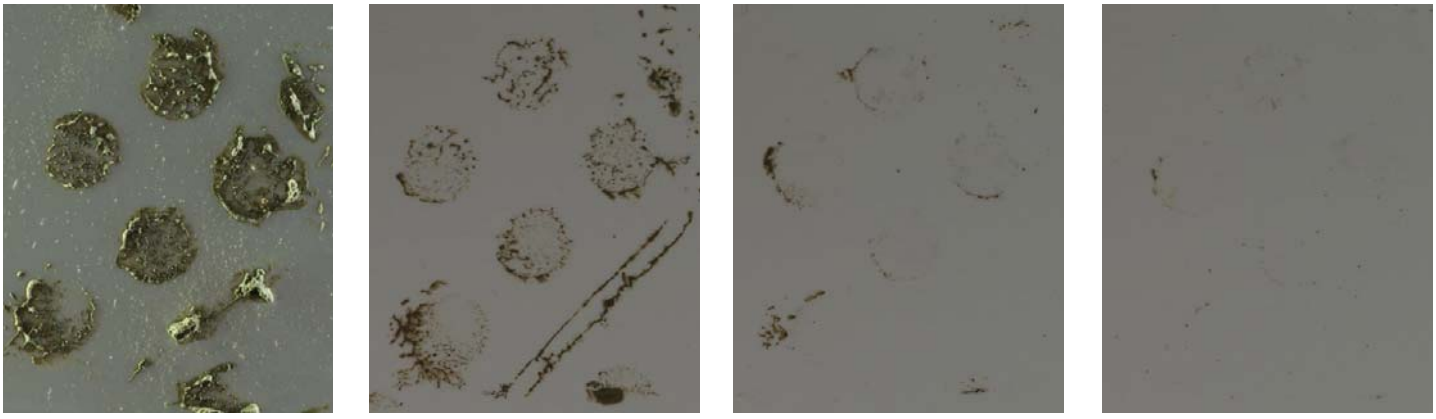
Results and Discussion

For all soil/mud samples, the iron oxide based formulation was more effective than carbon based ones on non-porous surfaces. An example of a depletion series before and after treatment is shown in Figure 4. Those marks barely visible prior to treatment revealed the clearest fine detail. The results were mixed for other contaminants. In general, the carbon based formulation gave a higher degree of background staining than iron based on all substrates and so reduced the contrast between the mark and surface.

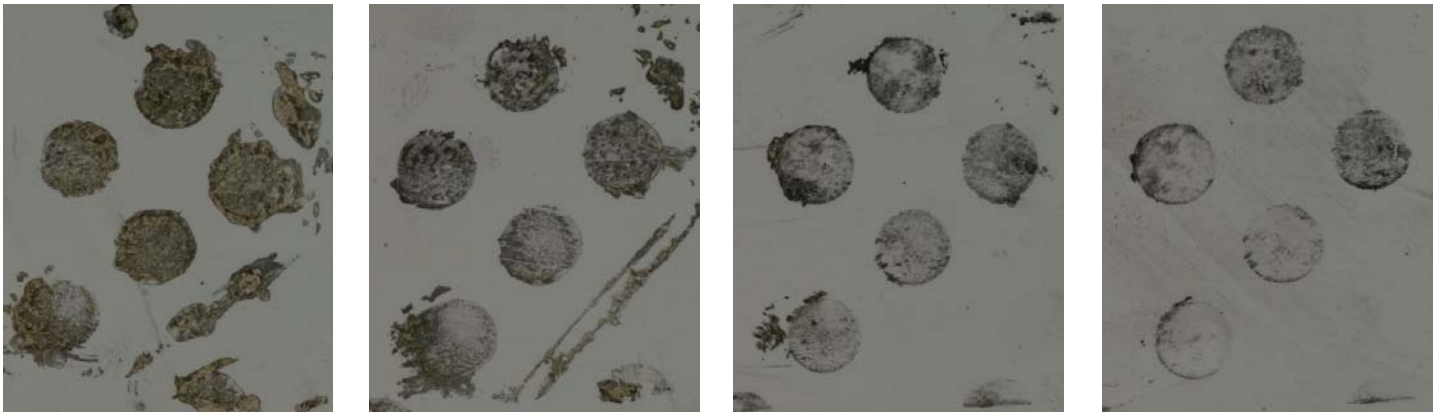
Figure 5 demonstrates the successful enhancement of footwear marks deposited on a floor tile after walking across wet grass. In this case, it was very difficult to see any of the marks prior to treatment with iron oxide based powder suspension, yet the clarity post treatment is exceptional for all eight marks within the depletion series.

Although extremely effective at times, the performance of powder suspension was inconsistent throughout this trial. Little is currently known about the mechanism of the process, although HOSDB are working with Brunel and Lincoln Universities to further our understanding of the process.

The greatest drawback to the process is the application difficulty caused by the necessity for excessive rinsing post application. This may make it unsuitable for application on large horizontal areas such as flooring. However, if used on small targeted areas it may prove useful.



Set a



Set b

Figure 4: *Partial footwear mark depletion in one of the tested soil samples before (set a) and after (set b) treatment with iron oxide powder suspension.*

3. Fingerprint and Footwear Forensics Newsletter, Home Office Pub. No. 59/07
4. Fingerprint Development and Imaging Newsletter, Special Edition: Arson, Home Office Pub. No. 26/06
5. Additional Fingerprint Development Techniques for Adhesive Tapes, Home Office Pub. No. 23/06

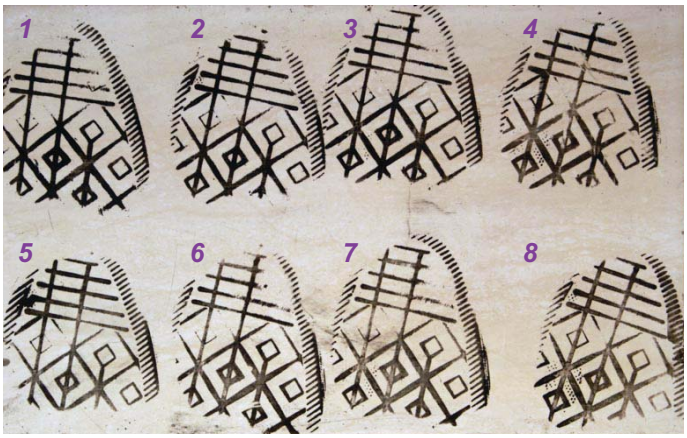


Figure 5: *Footwear mark depletion series on a ceramic tile after walking over wet grass. The tile is treated with iron oxide powder suspension.*

BEST PRACTICE GUIDELINES

- At this stage, powder suspension should be used after other conventional footwear imaging, lifting and chemical enhancement techniques, as little is known about the process mechanism or its effects on other processes. However, in some circumstances it can enhance detail that other processes do not detect.
- On non-porous surfaces, iron oxide based powder suspensions are generally more effective than carbon based ones, however, it may be useful to test the process away from the area of interest to identify possible interference caused by background staining.
- Powder suspensions can require a lot of rinsing water and may permanently damage some surfaces. Therefore although safe to use at crime scenes, thought must be given to scene clean up prior to use. Advice on the application of powder suspensions at scenes should be sought from laboratory staff.

STORAGE OF GELATINE (GEL) LIFTERS

Background

One of the most effective and commonly used methods for recovering latent and powdered marks from crime scenes is gel lifting. However, little guidance exists on how to preserve and protect the mark during transportation and storage in force. UK forces are currently split in their methods: some replace the original acetate sheet and some store the lift uncovered in a box.

Objective

To determine best practice for mark preservation whilst transporting gel lifts from the crime scene and subsequently for longer-term storage.

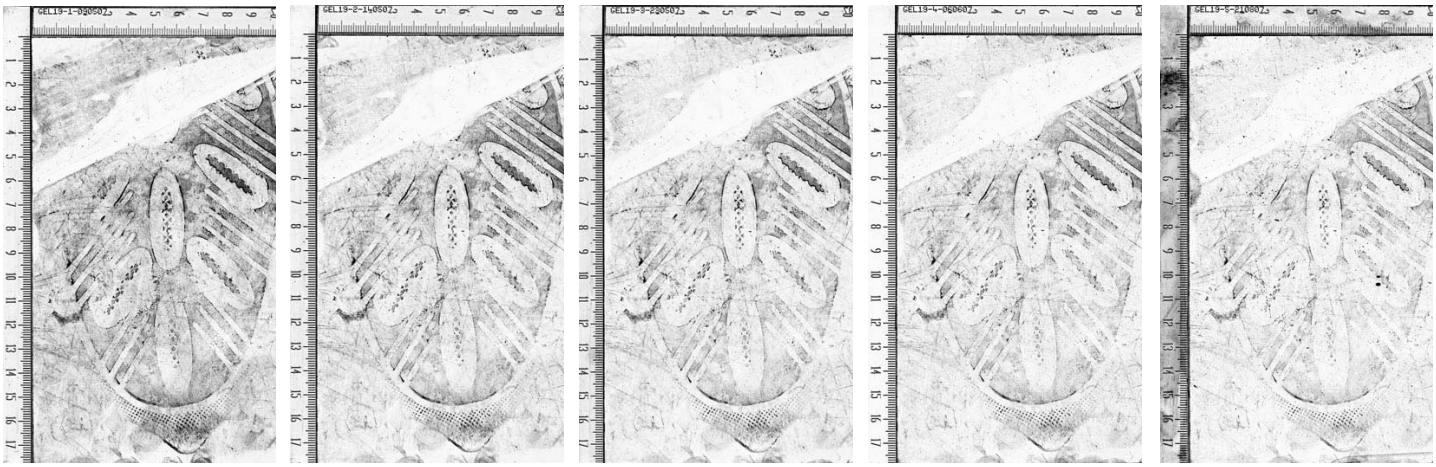
Experimental

Realistic latent and powdered footwear marks from the flooring of buildings at HOSDB were lifted using black gel lifts and stored either with or without the acetate sheet replaced. Those left uncovered were stored in a range of boxes. Lifts were imaged using GLScan equipment prior to storage and subsequently at regular intervals. Acetate sheets were removed before imaging and a new one was replaced before going back into storage. See Appendix 2 for further details.

Results and Discussion

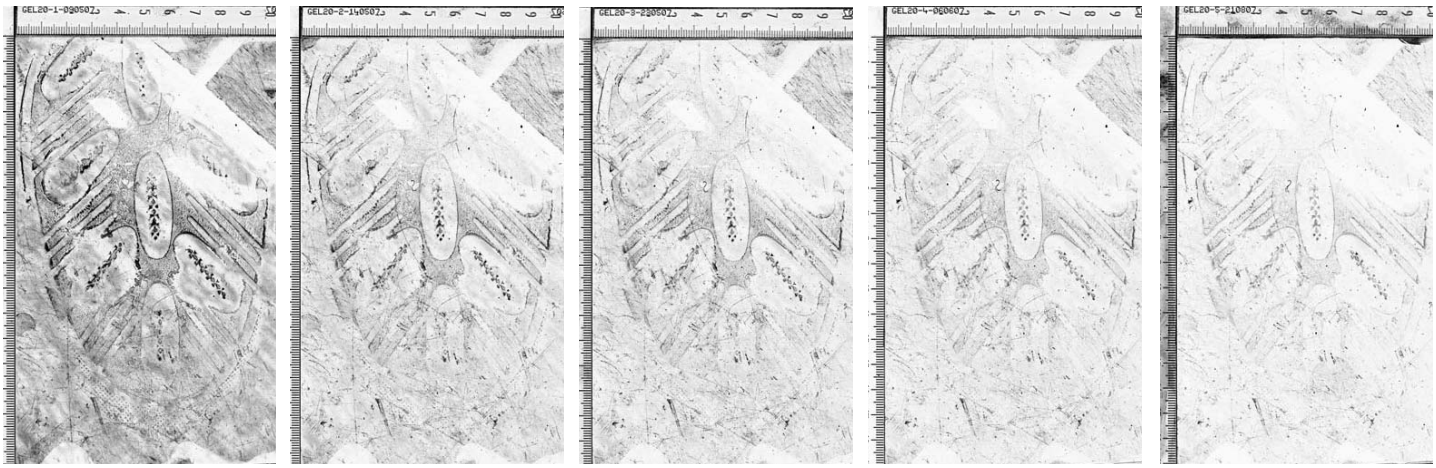
Gel lifts stored uncovered in a box were generally well preserved. In most cases there was negligible difference between images taken at different times. However, on a small number of gel lifts, there was a slight fading of the mark (Figure 6). Low grade cardboard boxes shed fibres onto the gel lift, which may interfere with subsequent examination. Breathable boxes should be used to avoid potential condensation forming on the gel.

The majority of gel lifts stored with the acetate sheet on lost detail when it was subsequently removed (Figure 7). Taking off the acetate tended to remove some of the mark or other debris from the gel lift. Repeated removal of acetate sheets degraded the mark further. In general, powdered marks were heavier than latent marks and deterioration caused by replacing and removing acetate sheets was not as significant. However, the weaker the mark, whether powdered or latent, the more chance there is of destroying faint detail. In some cases replacing and removing the acetate sheet improved the quality of the mark by removing excess powder. This was typical for marks that had been over-powdered or lifted from surfaces that produce a high background (Figure 8).



Fresh *5 days* *14 days* *28 days* *43 days*

Figure 6: *Typical example of a latent footwear mark lifted with a gelatine lifter and stored in a box. The various images were taken after storing for the given time. The fresh mark was imaged prior to any storage.*



0 *1* *2* *3* *4*

Figure 7: *Typical example of a latent footwear mark lifted with a gelatine lifter and stored with an acetate sheet cover. The cover was removed prior to imaging and a new one replaced subsequently. The numbers indicate the number of times an acetate sheet was placed onto the gelatine lift.*

BEST PRACTICE RECOMMENDATIONS

Early photography > Store uncovered > Store covered

- Gelatine lifts should be stored uncovered in a non-shedding breathable container for transportation back to force for subsequent examination/photography.
- After transportation gelatine lifts should be photographed in preference to storage as marks may slowly fade. This is more important for lifted faint latent marks.
- Some over-powdered marks may be improved by replacing and removing an acetate sheet. The gelatine lift should be photographed at all stages if this method is to be used to clean out the mark.

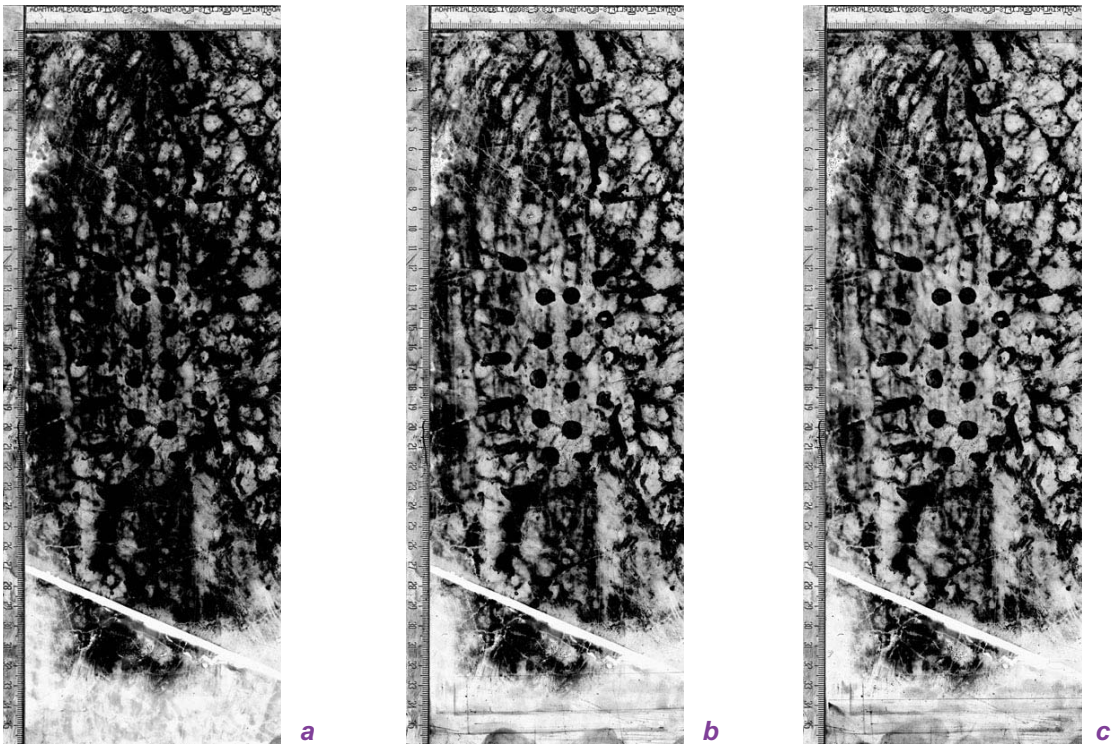


Figure 8: *Powdered (black magnetic) mark on marble floor (a) lifted with a gelatine lifter and imaged, (b) acetate sheet replaced and removed and re-imaged, and (c) a second acetate sheet is replaced and removed and re-imaged. In this case the acetate has the effect of removing excess powder from the mark and so increasing the clarity.*

STORAGE OF ELECTROSTATIC LIFTS

Background

Electrostatic lifting is known to be an extremely effective method for recovering dusty marks from crime scenes. There are various methods used around the UK for the transport of the lift from scene to force and also for long term storage. The lift can be photographed at the scene, stored uncovered in a box, or rolled up and stored in a tube.

Objective

To determine best practice for mark preservation whilst transporting electrostatic lifts from the crime scene and subsequently for longer-term storage.

Experimental

Realistic dusty footwear marks from the flooring of buildings at HOSDB were lifted and the films stored either flat in a box or rolled up and placed in a box or tube (some with silica gel packs in to reduce humidity). Lifts were imaged prior to storage and subsequently at regular intervals. The rolled sheets were unrolled before imaging and then re-rolled before going back into storage. See Appendix 3 for further details.

Results and Discussion

Marks lifted with electrostatic film and stored flat in a box were, on average, preserved more effectively than those stored via rolling, although both methods have disadvantages and early photography is encouraged (See Figures 9-11). When lifts are stored flat, dust is attracted towards the surface, especially when open to the air or stored in a low-grade cardboard box. Rolling of lifts causes different problems. It can cause lines to appear on the lift and/or the detail can become faint and diffuse (this is more noticeable if the rolled lift is stored in a plastic tube).

When the film is initially charged, dust is attracted to the surface by electrostatic forces. Residual charge remains on the film once used – this stops the dust from simply falling off the lift. Over time this static charge will reduce and eventually disappear altogether, resulting in loss of some or all of the mark. The surrounding conditions such as humidity and the material of the storage container can alter how quickly the static charge is removed. High humidity is likely to increase the rate at which the mark degrades. In this trial, silica gel packs were taped to the inside of each storage container ensuring that the relative humidity did not exceed 50% - ideally it would be as low as possible. The increased mark degradation of lifts stored in a plastic tube is likely to be caused by the ability to generate static charge on the tube when rubbed against surfaces. Cardboard containers do not hold charge so the lift contained within is well protected from outside charges.

Fresh

1 week

2 week

Figure 9: *Typical example of a dusty footwear mark lifted using electrostatic lifting apparatus and stored flat in a box. The various images were taken after storing for the given time. The fresh mark was imaged prior to any storage.*

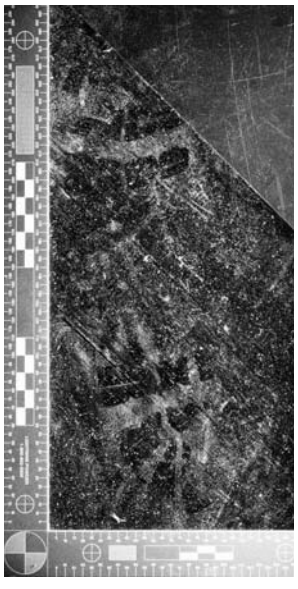
Fresh

1 week

2 week

Figure 10: *Typical example of a dusty footwear mark lifted using electrostatic lifting apparatus and stored rolled up in a cardboard box/tube. The various images were taken after storing for the given time. The fresh mark was imaged prior to any storage.*

Fresh



1 week

2 week

Figure 11: *Typical example of a dusty footwear mark lifted using electrostatic lifting apparatus and stored rolled up in a plastic knife tube. The various images were taken after storing for the given time. The fresh mark was imaged prior to any storage.*

BEST PRACTICE RECOMMENDATIONS

Early photography > Store uncovered > Store rolled

- Electrostatic lifts must be photographed as soon as possible in preference to any storage methods.
- For transportation purposes, electrostatic lifts may be stored flat in a non-shedding breathable container (not plastic) for transportation back to force for subsequent photography (to be done as soon as possible).
- If it is not possible to store flat due to the length of the film then it should be rolled up and stored in a suitable container (non-plastic).
- Humidity should be kept as low as possible in the storage container. This can be achieved by taping silica gel packs into the container.

SPECULATIVE APPLICATION OF PROTEIN STAINS TO FLOORING TO ENHANCE MARKS IN BLOOD

Background

Previous studies[6,7,8] have shown that protein stains, such as acid black 1, acid violet 17 and acid yellow 7, are more effective at enhancing finger marks in blood than hæm specific blood reagents, such as leuco-crystal violet (LCV) or luminol. However, they are not widely used as a speculative search tool for bloody footwear marks due to application difficulties when presented with large floor areas. The technique involves treating fixed marks with a dye solution which requires a lot of rinsing before the mark becomes clearly visible.

Hæm specific reagents are often used in preference to protein stain due to their ease of application, which involves spraying the solution onto the floor and observing a colour change in the presence of blood. Although easier to apply, the enhanced blood marks may be weaker and more diffuse than if developed with a protein stain and photography may be difficult.

Objective

To develop a safe, effective and easy to apply method to speculatively search for footwear marks in blood on non-porous flooring using protein stains described in MoFDT[1].

Experimental

Two trials were conducted. The first involved independently finding the most appropriate application methods for the fixing, dyeing and rinsing solutions, taking into account all health and safety issues with respect to use of the technique at scenes. See Appendix 4 for further details.

For the second trial a pool of blood was poured onto a lino surface (1.8m x 1.2m) and walked through. The person then walked around the area several times. This area was left for two days and then treated as a mock crime scene so that the preferred method from trial 1 could be tested on a larger floor area. In addition, all health and safety guidelines listed in MoFDT[1] for application of blood dyes at scenes were followed.

Results and Discussion

It was shown in the first trial that fixing the mark appeared to be the critical step. All of the fixing methods described in Appendix 4 worked to some extent. However one of the most effective methods was spraying, so long as the nozzle was relatively coarse to allow sufficient liquid to be applied to a large area in a reasonably short period of time. This resulted in fixing that was indistinguishable from fixing by submersion (see Figure 12). Once fixed, the application of the stain and rinse solutions is less critical and the most practical method can be chosen.

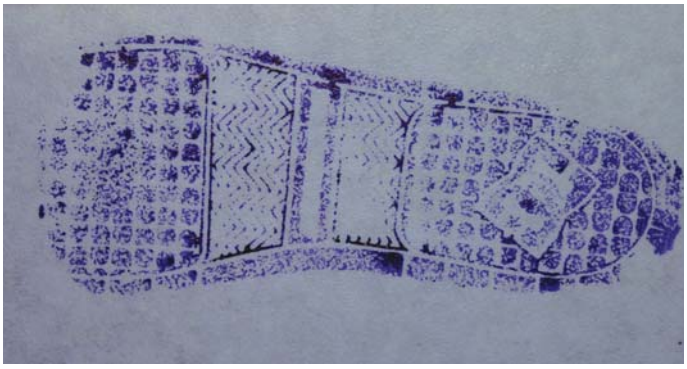
The large floor area used in trial two was successfully treated (see Figure 13) using the fixing method described above and appropriate dyeing and rinsing methods as shown in the step-by-step guide in Figures 14 and 15. Speculatively fixing the floor was quick and easy and the area was left for 30 minutes prior to staining. The staining and rinsing process took less than one hour and used less than 1 litre of stain and rinse solution.

6. V Sears et al, J Forens Ident, 2000, V50 (5), p470
7. V Sears et al, J Forens Ident, 2001, V51 (1), p28
8. V Sears et al, J Forens Ident, 2005, V55 (6), p741

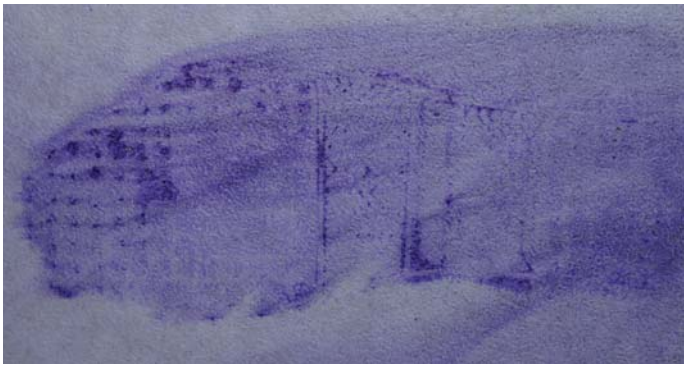
BEST PRACTICE RECOMMENDATIONS

If the surface is suitable, a protein stain (as described in MoFDT[1]) should be used to enhance footwear marks in blood, using the method shown in Figures 14 and 15, in preference to other less sensitive reagents.

a



b



c

Figure 12: *Trial 1. Examples of footwear marks treated with acid violet 17 where (a) shows a footwear mark in blood during the fixing stage (spray application). The photograph is taken with oblique lighting conditions so that it is possible to see the amount of fix sprayed onto the surface. (b) Shows a mark fixed with 5-sulphosalysilic acid using the spray method. (c) Shows a poorly fixed mark for comparison.*

a

b

Figure 13: *Trial 2. Footwear marks in blood on a laminate flooring (a) prior to treatment and (b) after treatment with acid violet 17.*

Figure 14: *Trial 2. The flooring surface was fixed by spraying the fix solution with a garden spray and leaving for 30 minutes.*

a

b

c

d

e

f

g

h

Figure 15: *Trial 2 - Application of acid violet 17. (a) Place a dry cloth onto the floor and soak with the dye solution. (b) After 5 minutes remove and discard the cloth to avoid possible transfer of materials. (c) Gently place dry cloth onto the treated area to mop up excess dye. If time permits, the next area of flooring can be treated as above as shown in these images. (d) Remove and rinse the area. (e) and (f) Gently soak up the rinse solution with more cloth, repeat until the area is clean. (g) and (h) Continue methodically until the whole floor is treated.*

SEQUENTIAL PROCESSING

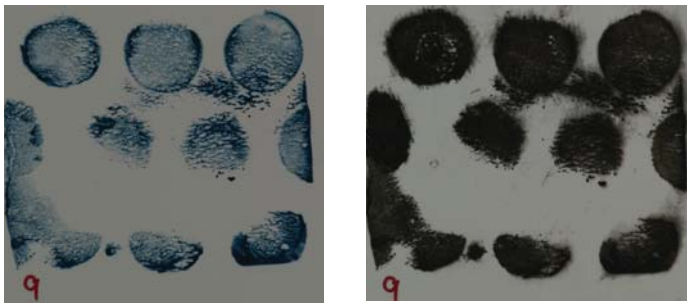
For fingerprints it is well understood that different enhancement techniques can develop different marks as they often target different constituents. For this reason, multiple techniques are used sequentially in order to maximise the chances of finding marks. When work was originally directed to HOSDB for footwear mark recovery, sequential processing was thought to be of major interest. On reflection, the tasks requested have generally focussed on single treatments in response to immediate needs for information. However, below are two examples of where sequential processing can enhance different footwear marks.

Example 1

Powder suspensions can be used successfully after conventional powders to enhance additional fingerprints. This is also the case for footwear marks and Table 2 gives an indication of which contaminants might give good results with powder suspension.

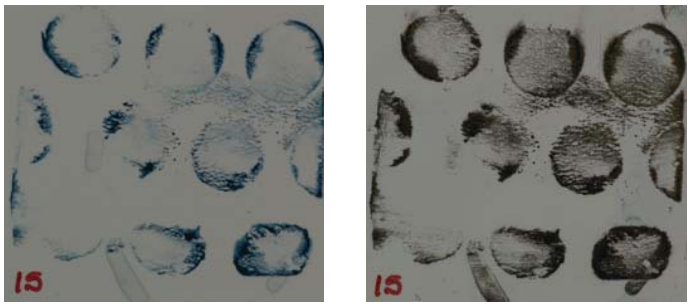
Powder suspension was tested to see if it was a suitable blood enhancement reagent. The results showed that although it was capable of enhancing marks in blood, it was not as effective as any of the protein stains listed in the MoFDT[1]. When used sequentially after a protein stain on heavy marks detail was lost as the mark became diffuse (Figure 16). However, when used sequentially on lighter marks extra detail was enhanced (Figure 17).

Use of powder suspension after blood reagents could offer another advantage. The protein stains, although not necessary specific for blood, generally will not enhance most other common contaminants such as soil or dirt – powder suspensions may. Figure 18 shows marks from the mock crime scene, described in the previous section, where the flooring has been treated with acid violet 17 then powder suspension. Additional marks are developed with the powder suspension: it is unclear whether or not they are in blood.



a *b*

Figure 16: *Heavy footwear mark treated with (a) acid black 1, then (b) iron oxide powder suspension.*



a *b*

Figure 17: *Light footwear mark treated with (a) acid black 1, then (b) iron oxide powder suspension.*

a *b*

Figure 18: *Footwear mark in blood on lino flooring treated with acid violet 17 followed by iron oxide powder suspension*

Example 2

Figure 19 shows an image of a gel lift of a powdered mark lifted from a lino floor (mark origin unknown). The lift has picked up most of the powder and clearly shows several overlaying marks. A second lift was taken from the same area and a different mark is now clearly visible.

a *b*

Figure 19: *Powdered (black magnetic) mark on a lino floor where (a) is the first gel lift and (b) is the 2nd gel lift.*

Future Requirements

The footwear project at HOSDB will continue whilst there is still an operational requirement for evaluating or developing processes to recover footwear marks from crime scenes and that it fits within current Home Office objectives.
The operational requirements are fed to HOSDB through the National Footwear Board's Research and Development sub-group chaired by Dick Johnson (SSM, Bedfordshire Police) and progress in continually reviewed enabling the most important issues to be tackled ahead of other tasks.

Please contact

Helen Bandey
(Helen.Bandey@homeoffice.gsi.gov.uk)

Dick Johnson
(Richard.Johnson@Bedfordshire.pnn.police.uk)

or your regional footwear representative if you have any comments or suggestions about footwear mark research and development.

Acknowledgements

I would like to acknowledge student contributions from Waichee Law (MSc student Strathclyde University), Melissa Black and Laura Powell (undergraduate placement students, Strathclyde University) and Adam Michalik (undergraduate placement student, Bradford University). Thanks also go to the National Footwear Board's Research and Development Group for direction and guidance.

Appendix 1

Contaminant	Surface	Process
Soil (clay)	Ceramic Wall Tile	Fluorescence Examination
Soil (loam)	White Laminate Shelving	Aluminium Powder
Soil (chalk)	Wood Effect Laminate	Black Granular Powder
HP Sauce	Ceramic Floor Tile	Black Magnetic Powder
General Purpose Detergent	Laminate Flooring	Magneta Flake Powder
Sprite	Gloss Painted Door	VMD
Grass Stain	U-PVC	Superglue / BY40
WD40	Vinyl Floor Tile	SPR
Milk	Glass	Powder Suspension
Washing-up Liquid	Melamine Worktop	Solvent Black 3
Diet Coke	Black Polyethylene	Iodine
Transfer from Shoe	Stainless Steel	
Baby Oil		
Lager		
Cider		
Petrol		
Diesel		
Old Engine Oil		
Kitchen Fat		
Dusty Shoemark		

Table A1: *Summary of contaminants, surfaces and processes used in the feasibility study.*

Appendix 2

Contaminant	Surface
Equipment	• Black Gellifters® from BVDA (through UK suppliers) • Replacement acetate sheets
Surfaces	• Lino, Marble, Laminate, Tiles, Metal, Wood
Number of lifts	• Latent = 21
	• Powdered = 43
Storage Conditions	• Acetate replaced • Uncovered in photographic paper cardboard box • Uncovered in cardboard box with window
Time in Storage	• Typically fresh, 5 days, 2 week, 1 month, 3 months
Imaging Equipment	• GLScan, BVDA, Holland
	• For each set of images, identical lighting and exposure conditions were used
Powders Used	• Aluminium, Black Magnetic, Black Granular

Table A2.1: *Experimental condition for the storage of gelatine (gel) lifters.*

Time in Storage	Latent (uncovered)	Powdered (uncovered)	Latent (covered)	Powdered (covered)
5 days	20 (0)	13 (0)	72 (27)	72 (20)
2 week	20 (0)	19 (0)	91 (36)	84 (28)
1 month	30 (0)	19 (0)	100 (45)	84 (40)
3 months	30 (0)	19 (0)	100 (50)	84 (56)

Table A2.2: *Percentage of marks with some degree of damage. The figure in brackets indicates the number of marks with significant amounts of damage.*

Appendix 3

Experimental Conditions for Storage of Electrostatic Lifts	
Equipment	• PathFinder (CSI Equipment)
Surfaces	• Lino, Laminate
Number of lifts	• Dusty marks = 26
Storage Conditions*	• Mark cut out and stored flat in a cardboard box • Rolled up and stored in a cardboard container • Rolled up and stored in a plastic knife tube
Time in Storage	• Typically fresh, 5 days, 2 week, 4 weeks
Imaging Equipment	• Oblique lighting using the Crimelite 80L • Camera: Canon EOS 5D

**Note: all storage containers had silica gel packs in so that the relative humidity was reduced*

Table A3.1: *Experimental condition for the storage of electrostatic lifts.*

Time in Storage	Stored Flat in a box	Stored Rolled up in a box	Stored Rolled up in a knife tube
5 days	34 (21)	57 (36)	85 (71)
2 week	59 (21)	100 (36)	100 (79)
1 month	81 (38)	100 (57)	100 (93)

Table A3.2: *Percentage of marks with some degree of damage. The figure in brackets indicates the number of marks with significant amounts of damage.*

Appendix 4

Speculative Application of Protein Stains to Flooring to Enhance Marks in Blood		
	Method	**Comments**
Process	Acid Violet 17	MoFDT formulation
Blood	Defibrinated horse blood	
Surfaces	Lino flooring	
Fixing	Build a plasticine well around the area of interest and fill with fixing solution	Excellent results but not suitable for speculative searching. Uses excess solution. See Figure 12b.
	Spray the fixing solution with a coarse nozzle	Excellent method if left on for at least 30 minutes
	Spray the fixing solution with a fine nozzle	Patchy. Difficult to get enough solution onto the surface.
	Place absorbent cloth/tissue over the area of interest and apply the fixing solution with a squeezy bottle	Patchy. Probably due to non-uniform contact of the cloth/tissue with the surface. Coloured tissue may bleed onto the surface. Some tissues were too weak and disintegrated when wetted. Some were too absorbent and didn't allow enough of the fix solution to make contact with the surface.
	Pre-wet absorbent cloth/tissue with fixing solution and place over the area of interest	
	No fix	Poor. See Figure 12c.
Staining	Build a plasticine well around the area of interest and fill with dye solution	Excellent results but not suitable for speculative searching. Uses excess solution.
	Place absorbent cloth/tissue* over the area of interest and apply the dye solution with a squeezy bottle	Excellent results. Minimises the amount of solution used.
	Pre-wet absorbent cloth/tissue with dye solution and place over the area of interest	Excellent results. Slightly more difficult to apply than the above method.
Rinsing	Use a squeezy bottle to apply the solution directly onto the surface and mop up gently with tissue.	Excellent results. Minimises the amount of solution used.

**Tork Premium Multipurpose Cloth 510 Combi Roll White. Specialist non-woven material for use with solvents and for wiping delicate surfaces. Lint-free with solvents, meaning it will not leave fibres behind. Extremely absorbent on contact means fast efficient wiping. There may be other suitable materials available.*

Table A4: *Supplementary information for the speculative application of protein stains to flooring to enhance marks in blood. The highlighted methods are those used in Figure 15.*

Newsletter publications can be downloaded from:
http://scienceandresearch.homeoffice.gov.uk/publications/fingerprint-publications

For further information contact: hosdb@homeoffice.gsi.gov.uk

ISBN 978-1-84726-654-5