ENHANCEMENT OF MUDDY FOOTWEAR IMPRESSIONS

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ABSTRACT: Methods for chemical enhancement of muddy footwear impressions were compared to differentiate between utilisation at the scene of crime, the local (regional) police laboratory and the Netherlands Forensic Institute (NFI).

KEY WORDS: Mud; Footwear; Shoeprints; Impressions; Enhancement.

Problems of Forensic Sciences, vol. XLVII, 2001, 405–412
Received 10 April 2001; accepted 15 September 2001

INTRODUCTION

To meet the demand for suitable crime scene methods for enhancement of shoeprints to be utilised by the police, chemical methods to enhance muddy footwear impressions were compared.

Experiments were carried out with methods currently encountered in literature and with methods developed by the research group.

The best methods were selected and advice was given on suitable methods to be used at the scene of crime, the local police labs and at a specialised forensic science laboratory.

METHODS EMPLOYED

- Alizarine;
- Ammonium-pyrrolidine-dithiocarbamate;
- Ammonium thiocyanate;
- Arsenazo;
- Bromophenol blue;
- Bromocresol green;
- Cyanoacrylate;
- Diazofluorenone (DFO);

– Diazofluorenone (DFO)/preceded by pressing black gelatin lifter[1];
– Dipyridil;
– Gentian violet;
– Gentian violet;
– Hydroxyquinoline;
– Iodine;
– Iodine-naphtoflavone;
– Lifting with black gelatin lifter, followed by photography[2];
– Ninhydrin;
– Ninhydrin (preceded by pressing black gelatin lifter)[1];
– Phenanthroline hydrosulfite;
– Physical developer;
– Potassium ferrocyanide;
– Potassium thiocyanate;
– Safranine[3];
– Safranine (followed by lifting with white gelatin lifter)[4];
– Silvernitrate;
– Small particle reagent (molybdene disulfide);
– Sticky side powder;
– Sudan black;
– Tetramethylbenzidine.

SUBSTRATE

The following white, porous and non-porous materials were chosen:
– non-porous; white (opaque) glass;
– porous; white (copier-, newspaper- and glossy-) paper;
– porous; white sheet (cotton).

[1] It was shown that treatment of shoeprints present on porous substrates with diazo-fluorenone and subsequent pressing black gelatin lifter (BVDA International BV, Haarlem, Netherlands) on these prints followed by lifting, resulted in fluorescence (enhancement) of these prints on the lifter. Probably amino acids from the gelatin lifter are transferred to these (partly latent) prints. Because of this the "gelatin lifter/diazofluorenone" as well as "gelatin lifter/ninhydrin" methods were also added to the list of methods.

[2] The crime scene protocol currently used by the Dutch police dictates that after photographing, muddy shoeprints are lifted with (black) gelatin lifter. When photographing these lifts, often very good results are obtained. It was shown that these lifts did not have a negative influence on the results obtained with the chemical enhancement techniques when applied subsequently to the original shoeprints.

[3] Safranine was found to be absorbed by muddy prints on non-porous material (glass) resulting in print enhancement.

[4] When lifting safranine treated prints with white gelatin lifter (BVDA International BV, Haarlem, Netherlands), fluorescent prints on the lifter are obtained.

MUD, SHOEMARKSTAMP, DIMINISHING SERIES AND PHOTOGRAPHY

- Soil samples were collected, a mixture was made and some water was added. A thin layer of mud was uniformly spread out on the bottom of the tray.
- A stamp was made, using a shoesole.
- Diminishing series were made by dipping the stamp in the mud tray. On the substrates a diminishing series of 14 prints was placed with a once dipped stamp.
- The series were photographed before and after treatment.

Using special lighting techniques the pictures of the prints on glass before treatment may show more details compared to those obtained with diffuse lighting.

For glass we considered reflective lighting photography as an (optical) enhancement technique and added it to the list of methods to compare.

CHOICE OF ENHANCEMENT METHOD

In choosing the most appropriate enhancement method, many factors need to be taken into account:

- the performance of the reagent on the substrate;
- the safety of the reagent;
- the ease of preparing solutions and the ease of application;
- the availability of equipment.

When dealing with substrates whose response to a specific enhancement method is not known, the general advice is to perform a test first.

REAGENT PREPARATION, APPLICATION AND SAFETY

The formulations of reagents and methods of use listed may be found in our publication in *Forensic Science International* which will appear in May 2001.

Spraying was carried out with a hand-operated spray bottle.

The safety of all investigators involved with the enhancement methods played an important role in giving advice on which method to use.

Recommendations were made about methods to be used by the police officers at the scene of crime, in their own regional police laboratories and at the specialised Netherlands Forensic Institute (NFI).

Tetramethylbenzidine, a suspected carcinogenic, is recommended for use only in the NFI. Flammable and toxic solvents like petroleum ether and methanol were regarded as not suitable for use at the scene of crime.

RESULTS

The following qualification and scoring system was adopted for the treated shoemarks:

++ +	very much enhanced	3 points
++	much enhanced	2 points
+	somewhat enhanced	1 point
+/–	unaltered	0 points
–	deterioration	–1 point

A panel of six members of the working group independently rated the photographs of each series. The results are shown in Figures 1 to 5.

DISCUSSION

Both untreated and treated prints were photographed using diffuse lighting. For glass photographing, the use of reflective lighting was found to show more details.

Another (indirect) photographic technique involves lifting the prints with black gelatin lifter followed by photographing the images on the lifter.

The experiments showed that for all substrates, this combination resulted in excellent print details on the photograph.

It was demonstrated by partly lifting the prints with gelatin lifter followed by applying a chemical method, no loss of detail in the lifted parts of the original prints was observed.

Very good results on opaque glass were obtained with safranine treatment, followed by lifting with white gelatin lifter and observing the fluorescence of these prints on the lifter.

This safranine lifting/fluorescence technique was only successful with glass; only slight fluorescence was found on glossy paper.

Pressing black gelatin lifter on paper and cotton sheet and subsequent treatment of the substrate with diazofluorenone, may result in fluorescing prints. This is probably caused by amino acid transfer from the gelatin lifter to substrate fibres.

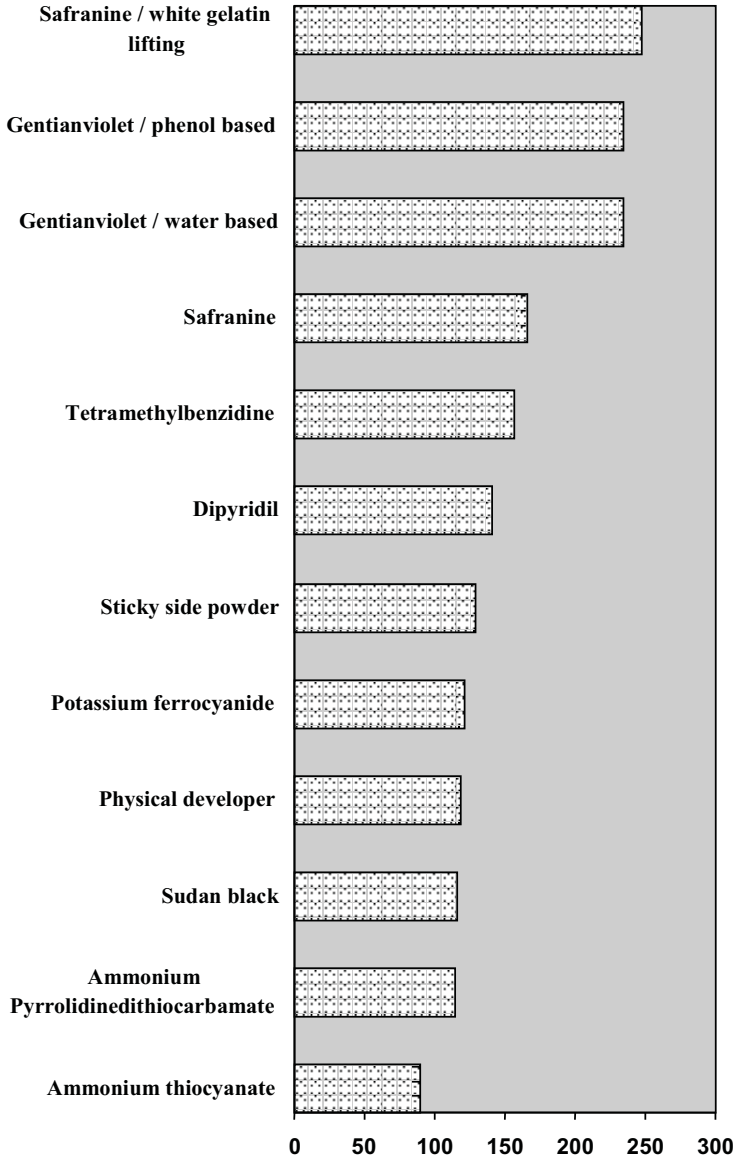

Fig. 1. Non-porous (glass).

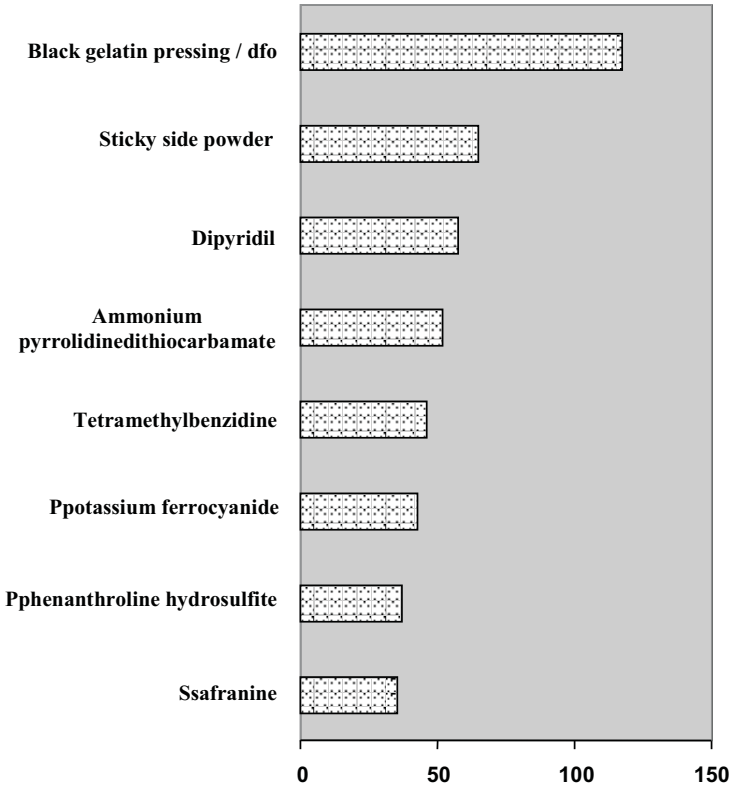

Fig. 2. Porous (copier paper).

LIMITATIONS OF THE SELECTION SYSTEM

The authors are aware that crime scene investigation practice differs considerably in the various countries.

The purpose of our research was to provide the police with some (relatively) simple and safe techniques to visualise and enhance muddy shoeprints.

In actual casework it is not always easy to decide whether the item to be treated should be considered as “porous” or “non-porous”.

The figures presented in this paper will often be not directly applicable and should merely be regarded as indicative.

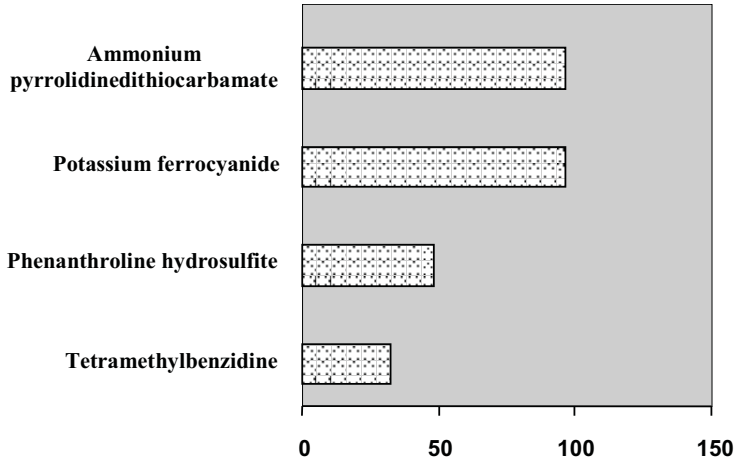

Fig. 3. Porous (newspaper).

SEQUENCING OF METHODS

Prior to the application of chemical enhancement technique, prints should be photographed using specialised lighting and forensic photographic methods.

Gelatin lifting followed by photographing the image on the lifter proved not to be harmful to prints which are later submitted to a chemical method. In our view gelatin lifting/photography may precede chemical treatment.

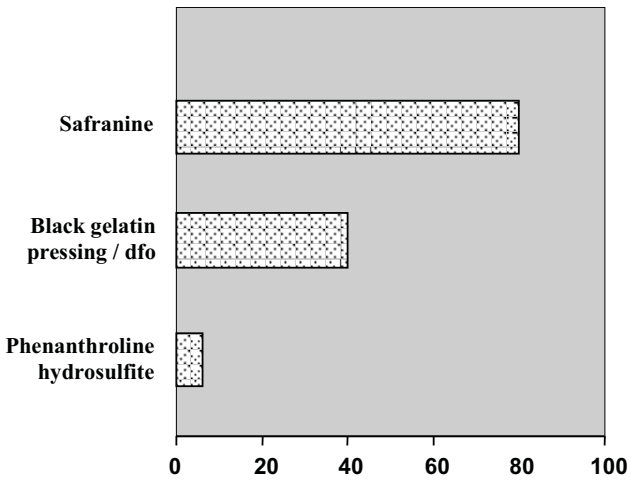

Fig. 4. Porous (glossy paper).

The working group did not investigate the effect of different order of application of chemical enhancement techniques.

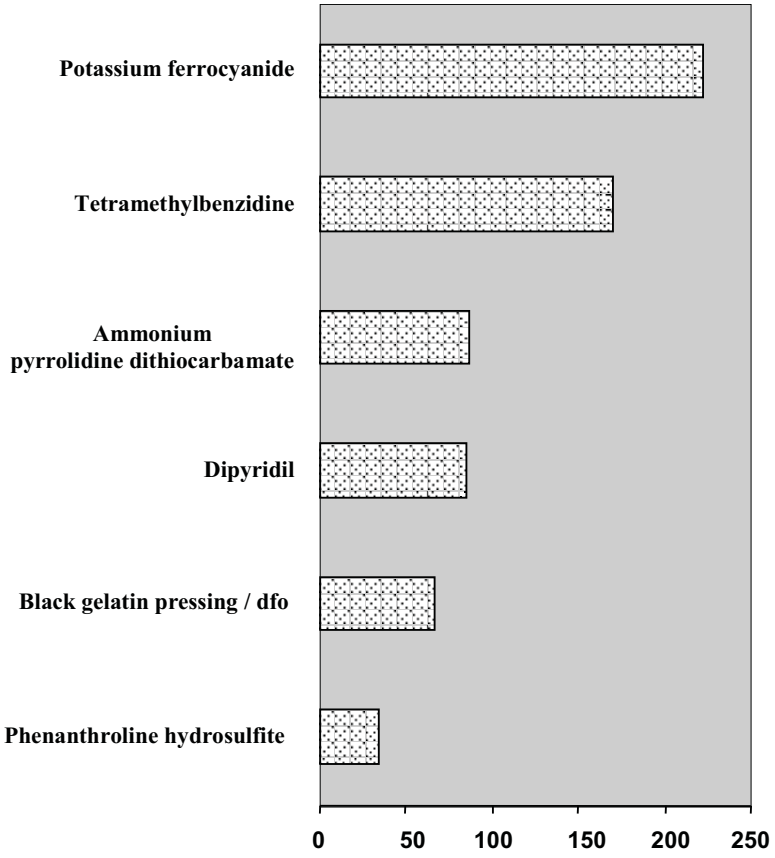

Fig. 5. Porous (cotton sheet).