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Advanced Scientific Research Innovations In Cyanoacrylate Stain Technology

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TECHNICAL REPORT
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NOTE: Further information about this report can be obtained by calling the CPRC information number (613) 998-6343

EXECUTIVE SUMMARY

This report addresses innovations in Cyanoacrylate stain technology including:

TECPhen - a new europium-based CA dye developed in Switzerland,

Brilliant Yellow - a textile dye that is used to stain cyanoacrylate treated fingerpirnts on non-porous surfaces, and

improved Cyanoacrylate procedures for cocaine exhibits.

Dr. Della Wilkinson's work over the past fiscal year addressed a number of issues on behalf of the police Forensic Identification community.

SOMMAIRE

Le present rapport porte sur les innovations apportées à la technique de coloration au cyano-acrylate, dont celles-ci :

TECPhen - un nouveau colorant de cyano-acrylate à base d'europium mis au point en Suisse;

la curcumine - un colorant textile utilisé pour colorer les empreintes traitées au cyano-acrylate sur des surfaces non poreuses;

l'amélioration des procédés au cyano-acrylate pour relever les empreintes sur les paquets de cocaine qui servent de pieces à conviction.

M^me^ Della Wilkinson, Ph.D., s'est penchée au cours du dernier exercice financier sur un certain nombre de questions pour le compte de la police judiciaire.

The research described in this report was conducted on a part-time basis from April 1995 to March 1996 under contract to the Canadian Police Research Centre (CPRC) and the Forensic Research and Review Section (FIRRS) of the Royal Canadian Mounted Police (RCMP).

1) Innovations in Cyanoacrylate Stain Technology

As a consequence of new information and new techniques being reported in the international Identification journals, the following studies were undertaken upon request from FIRRS.

(i) TECPhen

$Eu(TTA)_3Phen$ is a new europium-based CA dye, developed in Switzerland [1]. The formulation involves a stock solution containing acetonitrile and propanol,, and a working solution that consists of 5% stock solution and 95% petroleum ether. Although TECPhen was prepared according to the literature procedure a two phase solution was obtained with the propanol/ acetonitrile component forming the lower liquid layer (pinkish colour). Consequently fingerprints visualised with this technique were inferior to the original TEC formulation. In addition, the formulation uses solvents that would not be recommended in Canada due to health and safety issues.

The fluorescence intensity of **$Eu(TTA)_3Phen$** and **$Eu(TTA)_32TOPO$** were recorded using the spectrofluorimeter for comparison. They have very similar emission intensities, the differences of which

would be impossible for the human eye to record.Therefore there appears to be no advantage to using the phenanthroline (Phen) chelate for lipid detection.

(ii) Brilliant Yellow

Basic Yellow 40 is a textile dye that is used to stain cyanoacrylate (CA) treated fingerprints on non-porous surfaces [2]. The dye is also known as Maxillon Brilliant Flavine, Brilliant Yellow and Panacryl Brilliant Flavine. Stained fingerprints appear yellow when viewed under the blue (450 nm) filter of the Luma-Lite or equivalent filter from a different forensic light source. The prints are best photographed using a KV 550 nm viewing filter.

Basic Yellow 40 was first introduced into Canada in early 1991 **[3]**. At that time the recommended formulation involved a working solution containing only 0.03 grams of Basic Yellow 40 in methanol. The dye which is very popular in the UK has never been very popular in North America. Most Identification Specialists found the stained prints to be very weak.

The new formulation requires 2 grams of Basic Yellow 40 to be dissolved in 1000 ml of ethanol [4]. Not all of the dye may dissolve and the clear yellow solution can be decanted off into a clean container. Methanol can be used if necessary but the dye is less soluble in methanol and more solid will remain undissolved.

The processing of CA-treated fingerprints with Basic Yellow 40 is very straight forward. The exhibit is briefly immersed into the solution and then washed in a stream of water. Water washing has a tendency to produce water-marks which can be avoided by a second

wash with methanol. The exhibits are then left in a ventilated area to dry.

A comparison between Basic Yellow 40, Basic Red 28 [5], Ardrox [6] and Black Lightning Fingerprint Co. Powder was conducted on real exhibits from concluded cases. Plastic cigarette cartons were treated for thirty minutes with heat/ humidity CA and then divided into four groups. Each group was then treated with a different visualisation technique.

Basic Red 28 is a relatively new fluorescent stain which fluoresces red under the blue filter of the Luma-Lite and should be observed through red viewing goggles. The original formulation requires the highly flammable solvent, petroleum ether. In Canada this formulation is not recommended due to health & safety issues. For this study a methanol solution was used. Ardrox was also tested as a methanol solution. All exhibits, with the exception of those treated with powder, were washed with water.

In a typical experiment 80 plastic cartons were divided into four groups of twenty. A total of two identifiable prints were observed using Ardrox, six identifiable prints were observed using powder, eight identifiable prints were recovered using basic red and twenty-one identifiable prints were observed with Basic Yellow 40. In every experiment Basic Yellow 40 consistently visualised more fingerprints.

Obviously the more concentrated Basic Yellow 40 formulation is working well. The fingerprints were very bright against a background which showed minimal dye contamination. As a consequence of these studies, we are strongly recommending Basic

Yellow 40 to any Identification personnel who have access to a Luma-Lite or similar forensic light source.

None of the components of the Basic Yellow 40 formulation given in this bulletin are listed as carcinogens and all have low toxicity levels. Material Safety Data Sheets (MSDS) are summarised as follows; (1) Basic Yellow 40 - yellow, odourless powder. Do not breathe dust, avoid contact with eyes, skin and clothing. If possibly work in a fumehood and always wear protective eye wear, latex gloves and lab smocks; (2) Ethanol - colourless liquid with alcohol odour. Flammable liquid. Avoid contact with eyes, skin and clothing. Keep airborne concentrations to the lowest level by working in a fumehood and always wear protective eye wear, latex gloves and lab smocks. Threshold Limit Value (TLV) is 1000 ppm and the flashpoint is 57F.

Basic Yellow 40 can be purchased from; Lightning Powder Co. Inc., Salem, Oregon 97302-2121. Tel. # 1-800-852-0300.

ACKNOWLEDGEMENTS: I wish to thank Sgt. R. J. Ouellette for allowing me access to the laboratory facilities at A' Division and Cpl Carl McDiarmid for providing exhibits and evaluating the visualised latents.

(iii) Improved cyanoacrylate procedures for cocaine exhibits

Cocaine is often packaged in plastic wrapping which is sealed by adhesive tape. Superglue fuming followed by fluorescent dye staining would usually be the ideal treatment for the detection of latent fingerprints on most plastics. However, many Identification Specialists have commented on the high level of cyanoacrylate found

on the background of plastic packaging used for cocaine.

Vacuum Metal Deposition (VMD) is a technique which relies on sequential deposition of gold and zinc onto the plastic exhibit to visualize latent fingerprints [7]. It has proven to be very successful for plastics used for cocaine packaging. However, the logistics of treating all cocaine contaminated exhibits with VMD is impossible due to the limited availability of equipment, consequently, the technique is restricted to major drugs cases and homicides. For further information regarding VMD please contact A' Division Identification Section (613) 993 4631.

Methyl cyanoacrylate (CA) is the chemical component of Superglue that reacts with materials present within the fingerprint [8]. The reaction, known as polymerisation, produces a white polymer (polyCA) on the fingerprint ridge. When CA-treated fingerprints are exposed to fluorescent dyes, the dyes adsorb onto the polymer making the print highly visible against the non-fluorescent background.

Cocaine contains a chemical group that also reacts with CA to form polyCA. The drug is highly electrostatic and readily clings to exposed plastic surfaces, covering them in a thin layer. When cocaine-contaminated exhibits are CA-fumed and then treated with fluorescent dyes, the dye is attracted to the CA on both the fingerprint as well as the background. In such cases there will be no contrast between the fingerprint and the background, thus the latent remains invisible.

Several attempts to remove the cocaine contamination by washing with water have been unsuccessful since the water also

dissolves some of the components of the fingerprint.

The best approach appears to be prevention rather than cure. CA fuming is best performed before the drug is removed from the packaging which avoids cocaine exposure to the plastic and thus background polyCA formation. The exhibits can then be treated with dyes and the adhesive tape cut away, under fluorescence examination, with the knowledge that no identifiable fingerprints are being destroyed in the process.

ACKNOWLEDGEMENTS: This approach was brought to my attention during discussions at a recent Fluorescent Techniques Course. At that time it became apparent that Identification specialists in Quebec City, Montreal, London and Toronto were taking this approach.

(iv) References:

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