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TECHNICAL NOTE

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Examination of Writings Concealed by Black Pressure Sensitive Adhesive Tape

ABSTRACT: Examination of concealed writing is often a challenge for forensic document examiners. Although the published literature describes many techniques, these are often only successful when the writing has been concealed by pencil, pen, or by spreading inks of different tint or by smearing of the writing with colored fluids. When black pressure sensitive adhesive (PSA) tape is used, these procedures are ineffective. The present report describes the use of a straight chain hydrocarbon to remove the PSA tape and allow a comparison of the concealed writing with that of a suspect. The use of the solvent had no observable effect on either the writing or the substrate. The procedure is rapid and easy to use and is also effective with other colored PSA tapes.

KEYWORDS: forensic science, obliteration, adhesive tapes, hydrocarbon, decipher

Crumpled adhesive tape strips are sometimes encountered in criminal cases involving rape, murder, kidnapping, and bombing. These tapes are referred to forensic laboratories for detection of latent prints, or to establish a physical match, or to be examined for other evidence such as hair, fibers, or paints adhering to the tape surface. Recently, a case was referred to the State Forensic Laboratory of Himachal Pradesh (India) for the examination of writing concealed beneath black-colored pressure sensitive adhesive (PSA) tape. This case involved an accusation of embezzlement. Following the recommendation of Hilton (1), the exhibits were first photographed in the laboratory.

Numerous procedures are used to conceal writing and the literature is replete with references for these procedures and the methods currently used to reveal concealed writing (2–9). Traditional methods using sophisticated instruments (2,3) are only of use where the color of the original strokes has been concealed by a different color ink. Some of the equipment-based methods are destructive in themselves (4,5). Recently, computer-aided techniques (6–9) have been employed to decipher obliterated writings, but such techniques are applicable only for opaque writing or writing concealed by smearing different colored fluids.

Adhesive tapes generally consist of a flexible carrier and a backing with a permanently tacky adhesive that sticks to most substrates by contact under pressure. Physically peeling off the adhesive tape from the paper surface may result in damage to the surface. A solvent system was evaluated to remove the PSA tape from the surface and in doing so allow for the comparison of the concealed writing with that of the suspect.

Materials and Methods

Preparation for this research began by obtaining five different types of tape: BOPP (biaxially oriented polypropylene), electrical, duct, masking, and Cello in colors that included red, green, black, and transparent. Other items obtained for this research were:

1. Fifteen different writing instruments comprising: five ballpoint pens, five fountain pens, and five Pilot porous tip pens.
2. Plain white JK bond paper size A-4.
3. Analytical grade solvents—chloroform, carbon tetrachloride, acetone, and saturated hydrocarbons (*n*-butane, *n*-pentane).

Equipment made available was: a microwave oven (Thera Scientific Instruments, Delhi, India), heating press, dropper, tweezers, stereo microscope (SDZ-TR-PL; Kyowa Optical Co. Ltd., Tokyo, Japan) used at magnifications 7× to 45×, hand-held magnifying glass, and the Video Spectral Comparator 2000 (VSC—Foster and Freeman, England).

Preparation of Samples

Between 15 and 20 words were written on control and sample sheets of paper using a different writing instrument for each set. The writing was then concealed with black PSA tape. Studies were performed to determine the effect of the organic solvent on:

1. The surface of the paper and the adhesive surface of the tape;
2. The writing ink made with each different instrument; and
3. The concealed writing on the sample sheets.

Chemical Treatment

Initially the effect of the solvent was observed on the control sheets using the stereo microscope followed by observation of the adhesive surface of the tape and the writing. A drop of solvent was then applied at the corner of the adhesive tape on the sample sheets. It was noted that within a few seconds after contact with the solvent, the adhesive side of the tape began to separate from the paper.

The adhesive tape was then held and another drop of solvent applied. This process was repeated until the entire tape was peeled off.

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Comparison of Revealed Writing

After peeling off the adhesive tape, the paper was allowed to dry for a few seconds. The writing was then examined using the VSC 2000 and the stereo microscope.

Results and Discussion

In this study, it was found that colored PSA tapes used to conceal writing, formed strong bonds with the surface of the paper. Such tapes exhibit the properties of a black body, a term coined by Gustar Kirchoff in 1862 (10). Despite the name, black bodies are not actually black; however, they do radiate energy. The type and amount of energy they give off is directly related to the temperature. Black bodies below 700 K reflect very little electromagnetic radiations of visible wave length and appear black to the naked eye. Thus, the writing concealed by employing the black-colored PSA tapes could not be deciphered by making use of sophisticated instruments like the VSC 2000. The freezing and heating process described by Vernon (11) was also attempted, but was unsuccessful.

The effect of organic solvent on ink was studied by putting a drop of solvent on the control sheets and examining each sheet under that stereo microscope. It was found that chloroform, carbon tetrachloride, and acetone caused the ink to bleed, whereas petroleum ether, *n*-pentane, *n*-hexane, and *n*-heptane did not.

The peeling off of adhesive tape from the surface of the paper was tested by using chosen solvents. It was observed that *n*-heptane peeled off the adhesive tape effectively, whereas other alkanes performed unsatisfactorily. After treatment with *n*-heptane, not much force was needed to remove the adhesive tape from the paper surface, which revealed the writing for further examination. This simple procedure also worked with all of the tapes used in this study (data not included).

The black PSA tape in question was then successfully removed by the application of *n*-heptane and it was also found that the application of the solvent had not affected the white masking fluid present below the adhesive tape. The revealed writing was then examined under the VSC 2000 and the authorship confirmed after comparison with the suspect's writing.

Conclusions

The technique described in this paper using *n*-heptane is a simple, rapid, and nondestructive method for removing commercially available adhesive tapes from paper and can be used in the examination of writing concealed by these tapes. Use of this solvent did not damage the surface of the paper or the ink used in the writing.

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References

1. Hilton O. Scientific examination of questioned documents. Rev. ed. New York, NY: Elsevier, 1992;131.
2. Harrison WR. Suspect documents. London: Sweet and Maxwell Ltd., 1958;169.
3. Ellen D. The scientific examination of documents. London: Ellis Horwood Ltd., 1989;161.
4. Day SP. Evaluation of the application of the argon laser on document examination: a review of case work and experimental data. J Forensic Sci Soc 1985;25:285–96.
5. Mathyer J, Pfister R. The determination of the sequence of crossing strokes by the Kromekote paper lifting process and by the SEM method. Forensic Sci Int 1984;24:113–24.
6. Hicks AF. Computer imaging for questioned document examiners I: the benefits. J Forensic Sci 1995;40:1045–51.
7. Szabo GA. Decipherment of opaque writing with scanning technology. Int J of Forensic Document Examiners 1997;3:363–6.
8. Jasuja OP, Garg VK. Deciphering obliterated writings: a computer based simple method. Int J of Forensic Document Examiners 1999;5:270–9.
9. Holland N. An obliteration case with a novel solution: a case study. Proceedings of 57th Annual Meeting ASQDE; 1999; Los Angeles, CA: The American Society of Questioned Document Examiners, 1999.
10. Wikimedia Foundation Inc. Wikipedia, the free encyclopedia, http://en/wikipedia.org/wiki/Black_body, 2006. Accessed May 5, 2006.
11. Vernon JH. Latent fingerprint development: special techniques for obtaining latent fingerprints on duct tape and similar tapes. Identification News 1987;15:16–7.

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