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Deciphering writings created with erasable/disappearing ink: A new method

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Abstract

A document examiner may face a large variety of cases pertaining to handwriting, ink, and paper examination. In cases of ink examination, issues may include identifying the ink as well as determining its permanency. These days there is an increasing number of cases pertaining to a cheque presented in the bank with an amount which was later denied by the drawee. Upon physical examination with the naked eye in daylight, the claim of the drawee appeared to be true – however, in case of doubt the financial institutions dealing with such transactions, including banks, send the document for examination.

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It has been observed that a good number of ink pens are available in the market whose writings get invisible after some time ranging from hours to days. These types of writing pens are manufactured for fabric/garment manufacturing companies to mark the fabric for tailors, instructing them where cuts should be made. These marking pens are used now a day quite frequently throughout the world by the criminals to write the cheque and to later deny the amount on the cheque because of the fact the writings written with such inks fade or become invisible. Thus, the document is sent for examination. A number of methods have been reported to deal with the problem of decipherment of such writings but in present study very simple and readily accessible technique has suggested to visualise the writings which disappeared on heating. In this work, the disappeared writings which were produced by the PILOT FriXion erasable ink pen are made visible by cooling the document containing the aforesaid writings in a freezer of an ordinary refrigerator.

Keywords: erasable, visualisation, microwave-oven, freezer, thermal, disappearing ink

Introduction

The problem involving visualization/decipherment of the secret writings is not a new in the field of forensic documents. Every time, with advancement of technology, new ink fluids are invented. In the past, colorless fluids such as distilled water, lemon juice, onion juice, etc. were used for producing sympathetic writings. When such types of documents are exposed to controlled heat, the portion where writing exists gets oxidized and burns faster than the surrounding paper. The fluid portion turns brown, thus developing the invisible ink.[1] Another method to decode the invisible ink was by using some salt on the paper. Further, these writings can be made visible using UV light[2] along with the study of the indentation, if present on the back side of the document. With time, some coloured fluids/inks are used to produce visible writings which become invisible after certain chemical/physical treatment. The first of these types of inks which came to the knowledge of the authors is based upon the pH value of the ink. These fluids/inks are blue in colour, with their pH value over 7, i.e. they are alkaline in nature. Carbon dioxide present in the atmosphere combined with the water vapours to produce carbonic acid which further

[1] *Invisible ink experiment*, https://explorable.com/invisible-ink-experiment (accessed: 12.11.2017).

[2] W.R. Harrison, *Suspect documents*, Delhi 1997, p. 135; O. Hilton, *Scientific examination of questioned documents*, Boca Raton, FL 1993, p. 148.

reacts with the ink and neutralize its alkaline nature. Due to neutralization, the pH value of the ink decreases, which causes the change in the colour of the ink, i.e. it becomes colourless. The resultant document can be used for committing crime, particularly in bank get-rich-quick schemes, where the writings of the bank instrument are written with disappearing/erasable ink and the signatures – with the usual non-disappearing ink. The invisible writing was made visible using spot light option/arrangement present in the VSC-2000.[3]

Although heat was applied to develop the invisible ink, in the present case heat is used to make the visible writing invisible. A thermosensitive pen PILOT FriXion erasable ink pen (Figures 1 and 2) is easily available on the market and has ink that can be removed by heat produced due to friction of the eraser provided along with the pen[4] as one of the factors. Due to the eraser, the surface of the document might get affected and its presence can be felt by a trained document expert. Since heat is responsible for disappearing ink, as such it is assumed that when the document is heated in a microwave oven at controlled temperature and time, the writing will disappear. In such cases, assuming the process is reversible, the writing can be developed by cooling the document.

Material and methods

Sample document in the form of a blank bank cheque was prepared by writing with the PILOT FriXion erasable ink pen. The document was then kept properly in the microwave oven and heated gradually. Proper care is taken so that the document does not get charred. It is found that the writing became invisible when the document is heated at around 50°C temperature. Since thermal effect causes the ink to disappear, it was therefore assumed that the process is reversible. As such, the document was kept in the freezer of an ordinary refrigerator at around 0°C and, as per our assumption, the writings became visible. The experiment was also

[3] B.A. Vaid et al., "Visualization of disappearing ink writings", *Journal of Problems of Forensic Sciences* 92, 2012, pp. 311–318.

[4] "The science behind frixion erasable pens", https://www.nippon.com/en/features/c00520/ (accessed: 27.11.2019).

conducted by writing on a bank cheque using the PILOT FriXion pen and keeping it in the sunlight for more than 3 days, but the writing failed to disappear. Furthermore, it was found experimentally that when the writing produced by the FriXion erasable ink pen on the cheque is erased with the eraser provided with the pen and the resultant document is kept in the freezer at around 0°C, the writings re-appear.

Results and discussion

Figures 3 to 6 indicate the various stages of experiments performed during this research on decipherment of erased writings. Figure 3 is the photograph of the original blank cheque considered for experimentation. Figure 4 is the photograph of the writings produced on the cheque using the PILOT FriXion erasable ink pen. Figure 5 is the photograph of the cheque after controlled heating in a microwave oven for a short time (about 5 minutes) at around 50°C. Figure 6 is the photograph of the cheque after keeping the original from Figure 5 in the freezer of a refrigerator for 3 to 4 hours; however, the duration can be extended if deemed necessary. The original writings could easily be read from Figure 6 and are photographed for further examination and record.

Chayal et al.[5] also reported the decipherment of the erasable inks but they did not try this innovative method. They could decipher such type of writing in an actual case with the help of video spectral comparator (VSC). Throckmorton[6] has reported in detail about such a type of writing inks which could be deciphered by pH variation mechanism through applying a simple reagent used in washroom cleansing. It was found that this reagent contains sodium hydroxide, which reacts with the contents of the ink made invisible and gives colour to the erased writings.

Since the pH-based pens are not easily accessible to an ordinary person, while the above-mentioned thermal pens are widely available on the market at a reasonable price, as such the probability for its misuse is very

[5] V.M. Chayal et al., "A sensitive non-destructive method for detection of document frauds using thermal ink", *Australian Journal of Forensic Sciences* 48, 2016, no. 5.

[6] G. Throckmorton, "Disappearing ink: Its use, abuse, and detection", *Journal of Forensic Sciences* 35, 1990, no. 1, pp. 199–203.

high. Moreover, with such a very simple, easy, and readily accessible technique, fraud committed with the pen could even be detected by an ordinary person with a little technical knowledge. This may also be helpful in reducing the burden on heavy-loaded forensic document examiners and take forensic science to the doorstep of an ordinary citizen. Combining the mentioned technique with other available methods may increase the probability of deciphering the disappearing ink and enhancing objectivity in the visualization of disappearing writings for forensic document experts.

Precautions

1. While cooling the document, every precaution should be taken so that the moisture, if present in the freezer, does not affect the document/writings.

2. Prior permission should be taken from the competent authority before keeping a questioned document/cheque supposed to contain a thermal secret ink in a freezer.

Suggestions

1. Always use a personal pen for writing/signing all important documents.

2. Bank officials should be given training in dealing with such types of frauds in various forensic science laboratories or courses which may be organized for them by forensic scientists.

3. As per the mode of operation in such frauds, the signature on the bank cheque was created with original non-disappearing ink, while the body writing – with the disappearing ink, so is manipulated. Hence, bank officials should take extra precautions while dealing with bank instruments which are written and signed with two different inks.

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Figures

Figure 1. PILOT FriXion erasable ink pen

Figure 2. Front and reverse side of wrapper of PILOT FriXion erasable ink pen

Figure 3. Original blank cheque considered for experimentation

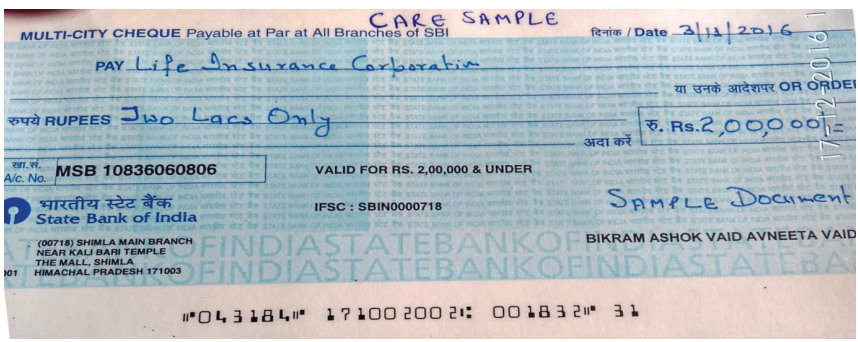

Figure 4. Writing produced on the above cheque using the PILOT FriXion pen

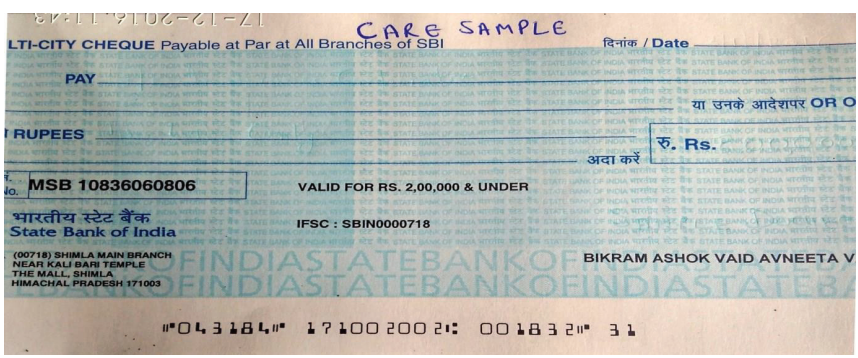

Figure 5. Cheque after controlled heating in the micro-oven for a short time at minimum temperature

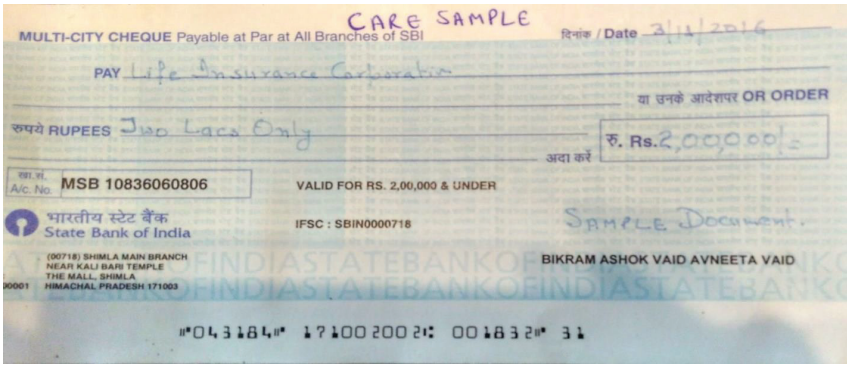

Figure 6. Cheque after keeping the original of Figure 3 in the freezer of a fridge

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