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Decipherment of Disappeared Ink: A Case Study

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Abstract. The disappeared or invisible inks are fluids used to for secret writing. These types of inks are revealed by heat, chemical reaction and UV light. Disappearing inks are acid base indicators showing different colours at different pH. Writing with this type of ink disappears after about 65 h. These inks could be used for forging the documents such as agreements, cheques, property documents and other important documents. Many destructive and non-destructive methods are available for forensic decipherment of these disappeared writing. In present communication, a simple nondestructive method is applied for decipherment of disappeared signatures on share transfer agreement and other related documents.

Keywords: Forensic Science, Disappearing ink.

1. Introduction

Basically, ink is a composition of dyes or pigments along with some additives to give desired physical properties. Nowadays, varieties of ink composition are available in the market which consists of various organic, inorganic and synthetic material with various characteristics and properties^{1,2}. Disappearing ink is used as marking system for sports, in dress making industry. It is also used as teaching material to make answer invisible. By using coloring agents, answers become visible. Disappearing inks are also applied in paint industries to locate the area which is not painted. However, these are a great challenge for forensic document examiner as used in forgery or counterfeiting documents.

The alteration is one of the most common types of fraudulent observed in the examination of questioned documents. It includes addition, subtraction, and obliteration and to alter any security features on the documents. There are two methods used for examination of questioned documents namely non-destructive and destructive. A non-destructive method involves use of magnifying lenses, electronic

microscope and different types of lights. On the other hand, a destructive method includes use of chemicals. More surely, destructive methods give much detailed information. Certainly, a destructive method involves spectroscopic and chromatographic techniques which provide detailed information but this also causes damage of documents³⁻⁵.

A thin layer chromatographic technique is used to compare and characterizes ink. Staphanie *et. al.* used filtered light for the evaluation of writing inks analysed by thin layer chromatography⁶. Currently different methods have been used for decipherment of handwriting by disappeared ink. Manal Abd-Elaziz Abd-ElZaher developed method for deciphering of faded a physically erased handwriting. In this method, they used dilute sodium hydroxide solution as effective method for deciphering the faded and physically erased handwriting⁷. Further Shama *et. al.* studied fading time of reappeared ink with different concentration of sodium hydroxide solutions⁸. The VSC 2000 is useful for visualization of disappearing ink writing has been reported by Vaid and co-authors⁹. Previous studies proposed non-destructive method for detection of documents frauds using thermal ink. In this study deciphered ink on different papers with the help of VSC 6000/HS¹⁰. Ink analysis is great challenge in front of forensic expert today because of number of ink formulations are available in the market. The analysis of such types of cases has become tedious work due to paucity of research and literature.

In present communication a non destructive method for decipherment of disappeared ink writing is illustrated. The aim of the present work is to decipher the vanished inks and to find out whether the writing could be deciphered with exposure to different light sources, alkaline solution, vapour, or thermal effect and to make these results demonstrable in the court.

2. Case history

A complaint was lodged at police station about disappearance of signatures made by transferor on share transfer agreement, share transfer form and on the list of shares. All the documents were submitted in the forensic laboratory for examination.

2.1 Material and methods

2.1.1 Microscopic and optical methods

All disappeared signature sites of documents were examined under stereo microscope of Leica make (magnification 20X-40X) with direct light and oblique light. Further these sites were observed under UV and spot light of VSC5000 manufactured by Froster and Freeman Ltd.

2.1.2 Chemical Methods

The signature sites were sprayed by dilute sodium hydroxide /dilute ammonia solutions. All chemicals used were of analytical grade and distilled water was used for preparation of solutions. The signature sites were exposed to iodine vapours in standard vapour chamber. Reappeared signatures were photographed using digital camera.

2.2 Results and discussion

Microscopic examination in direct and oblique light neither revealed any ink strokes nor indentation marks at signature sites. This was indicating that signatures were made with a pen which does not create any indentation marks. Both UV and IR light of VSC failed to prove the presence of faded ink strokes of signatures at signature sites.

The magnifying glasses and the direct light source method used traditionally for detect the invisible ink. But in this case, as shown in Figure 1(a) and 2(a), light sources and magnifying glasses fail to detect disappeared ink. Spraying ammonia/sodium hydroxide did show appearance of signatures in bluecolour but made document wet and stained. The faded or disappeared signature becomes visible for few minutes. The blue colour marks of signatures were last for short time. Exposure to iodine vapours appearance of brownish signatures at sites and shown in Figure 1(b) and 2(b). Colours of these signatures disappear after some times. Fading of colour depends on time of exposure to iodine fumes.

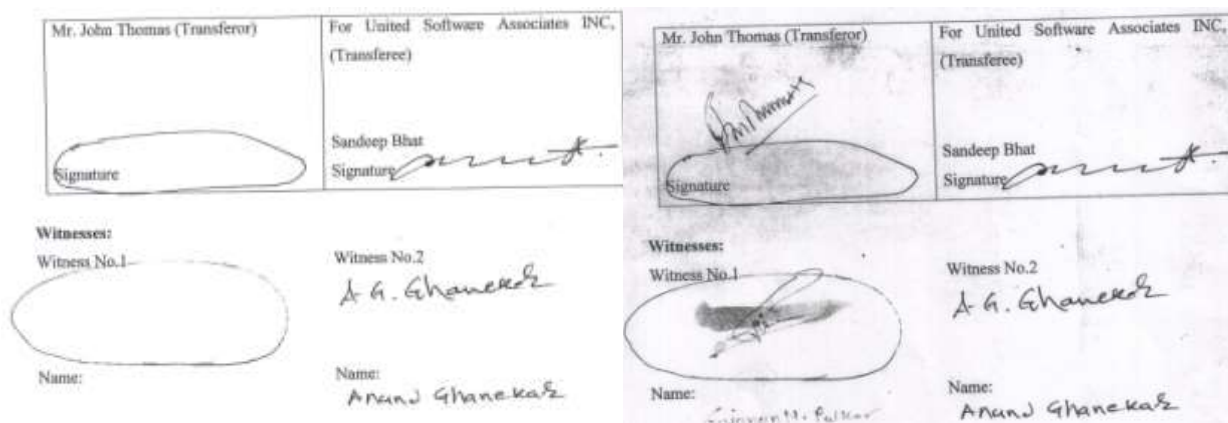


Figure 1. (a) Showing disappeared sign; (b) showing recovered sign on agreement.

Disappearing inks are acid base indicators changing colours on exposure to atmospheric CO₂ in presence of air. The most common indicators such as thymolphthalein blue and phenolphthalein are used for preparation of such type inks. Deep blue colored ink can be prepared by dissolving thymolphthalein in ethanol and water. The pH of solution can be adjusted using sodium hydroxide solution to obtain deep blue colour (pH range 9.3 to 10.5).

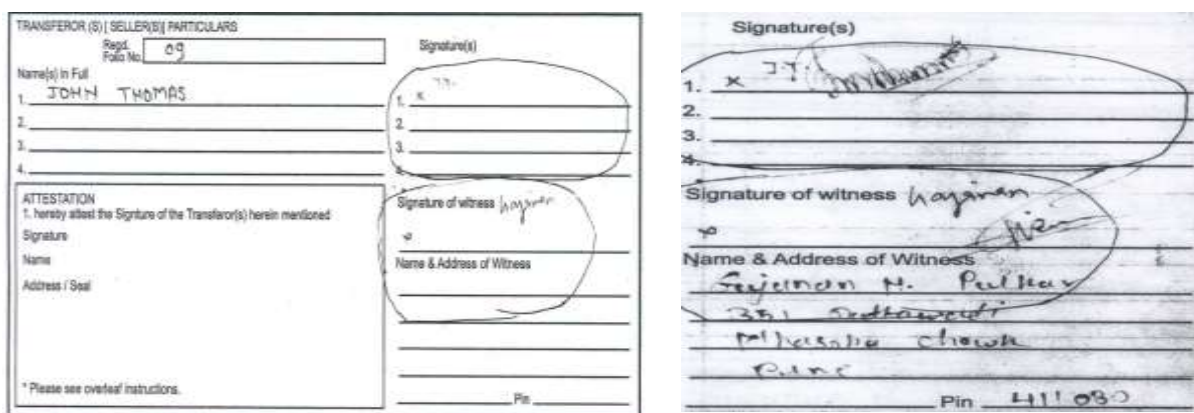
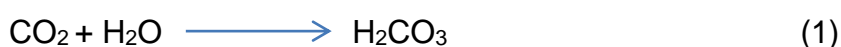
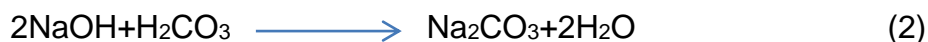


Figure 2. (a) Showing disappeared sign; (b) showing recovered sign on share certificate.

For writing on the paper results blue colour writing. On exposure to atmosphere, carbon dioxide reacts with water of ink forming carbonic acid (weakly acidic). It is presented in the following equation:



This neutralization reaction of carbonic acid with NaOH forming salt and water as follows:



The carbon dioxide present in air reacts with sodium hydroxide to form sodium carbonate, which is less basic than sodium hydroxide. The resulting sodium carbonate change the blue color to colorless, the alcohol evaporates and left the colorless residues of ink on documents. Due to said neutralization, pH changes and makes indicator colourless, hence ink disappears. When this exposed to iodine vapours iodine adsorbed on the surface of sodium carbonate and writing appears in. After removal of document from chamber iodine sublimes then brownish color slowly disappears.

3. Conclusion

The spraying of aqueous sodium hydroxide and ammonia solution is effective method for deciphering of disappeared inks. However, it may harm the important document. For decipherment of disappeared ink writing on important document exposure to iodine vapours is effective method. This method is nondestructive method. In this study, we propose the effective method for deciphering of disappeared inks.

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Conflict of interests

The authors declare that they have no conflict of interest.