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# Different types of inks having certain medicolegal importance: Deciphering the faded and physically erased handwriting

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**Abstract** Disappearing ink is a type of ink which could be used to forge documents as it will fade away without any trace within 40–65 h. Erasable ink is another type of ink easily removed by certain rubbers incorporated in each pen. Both types of inks were applied separately on different types of papers (checks, standard white foolscap, and plain white A4 paper). For vanishing ink, it was observed visually in the first 6 h and then every 6 h. It was found that the vanishing ink disappeared completely within 2 h on checks, 36 h on standard white foolscap paper, and 40 h on plain white A4 paper. For erasable ink, the written strokes were manipulated manually using the incorporated eraser. Deciphering the faded writing failed by the conventional methods, but oblique light can reveal the indentation marks. The faded writing became visible when treated with weak alkaline (NaOH) solutions. Erasable ink was deciphered with the aid of infra-red radiation combined with VSC-6000 as clear white traces against red fluorescence. It was concluded that the use of a weak (NaOH) solution is an effective method for revealing the faded writing, and the infra-red illumination is also effective.



## 1. Introduction

Inks that are visible for a period of time without the intention of being made visible again are called disappearing inks. Not all disappearing inks rely on the chemical reaction of thymolphthalein and a basic substance such as sodium hydroxide.

Thymolphthalein, which is normally colorless, turns blue in solution reacting with the base. As the base reacts with carbon dioxide (always present in the air), the PH drops below 10.5, and the color disappears.[1]

Amazing vanishing ink pens are types of pens containing inks developed by chemical reaction. Magic pens entered the country via illegal methods and were sold at low prices. The magic pen resembles a normal pen, but the ink differs. Recently, certain types of porous tip pen inks appeared in markets; such pens use auto-vanishing fluid inks. The main basic structural unit in such inks is of an acidic nature which could be affected by the surrounding environmental changes (humidity, temperature and so on).[2]

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Disappearing inks are used in the textile industry such as dressmaking crafts, and as a kind of teaching material; for example, printed questions are visible and the spaces for an answer exhibit disappearing ink. The answers only become visible using a coloring assistant.[3]

Disappearing inks are also used in paints. For example, when applying a new paint of a similar shade over an existing coating of white paint, it is difficult to determine the area which is not painted, but using the disappearing ink solves the problem. They can also be used as a marking system (a sole marking system) for dance lessons, sports, training of any other activities that require the proper placement of feet.[4]

Forensic document examiners are frequently facing the problem of vanished writings. In trials to demonstrate such vanished writings, there are two ways: either non-destructive methods (using magnifying hand lenses, electronic microscopes, different types of light, infrared illumination), or the destructive methods by the aid of chemicals. Usually the images cannot be retrieved under UV light.[5]

Other types of inks are now available which can be erased simply by swiping by a special rubber incorporated in each pen over the original text. These inks have been used for fraudulent purposes. Forensic scientists especially in the examination of questioned documents have long been familiar with the erasable ball-pen sold in the UK under the product name ''Replay'' and manufactured by Paper Mate. The long established Paper Mate ''Replay'' erasable ball-pens have been rebranded in the UK as ''Eraser.Max'': a recent addition to this class of writing instruments is the pilot ''Frixion'' erasable roller ball pen.[6]

The questioned document examiner is frequently faced with the problem of detecting the site of an erasure on a questioned document to detect that an erasure has been made and certain entries have been removed, altered or added, a document may ultimately determine the outcome of a contested civil matter, or may even directly determine guilt or innocence in a criminal trial. Fraudulent documents to which alterations and additions have been made by erasing the original entries are frequently produced by unscrupulous persons in an effort to prove an unjust claim.[7]

## 2. Aim of the study

The aim of this study is to decipher the vanishing and erasable inks, and to trace the methods involved in detecting such a particular type of fraud in a manner that could be easily used by all forensic document examiners, and to make these results demonstrable in the courtroom setting.

## 3. Materials and methods

### 3.1. Material

(I) Pens:
1- Ballpoint disappearing marking pen for dressmaking craft containing blue colored ink. It was obtained from a local sewing machine center (El-Badrasheen Factory). It is made in China.
2- Ballpoint pen containing blue colored erasable ink. The pen with a small eraser incorporated within the pen. It was obtained from a library in El-Fagalaha Street.
3- Paper Specimens:
4- Paper (1): Bank checks were obtained from a library. This safety paper came in the five most popular colors requested by the local banks.
5- Paper (2): Standard ruled white foolscap paper (60 $gm/m^2$).
6- Paper (3): A plain white A4 paper (printing paper) (80 $gm/m^2$).

(II) Equipment:
1- Magnifying glasses.
2- Ultraviolet lamp (Corning, 23 V–50 Hz).
3- Projectina Docucenter incorporates an infra-red lamp with a Video Spectral Comparator (VSC-6000), connected to a monitor that allows the differences in inks to be observed and recorded. Manufactured by Messrs Foster and Freeman Ltd. It was in the Department of Questioned Document Examiners in Authority of Forensic Sciences (Ministry of Justice – Egypt). Green light (wavelength 480–620 nm or nanometer) was directed at the document. An IR filter (645 nm) was inserted in front of the video camera of the unit.
4- A digital camera (10 megapixel).
5- Diluted sodium hydroxide (NaOH) solutions at concentrations (0.1–0.2–0.3) of a laboratory grade, from the Biochemistry department-faculty of Medicine – Minia University.

### 3.2. Methods

The three types of papers were each marked with the ink from the two types of pens separately. Names from mobile phone contacts were chosen to be written on the examined papers.

- According to El-Molla et al.[8] regarding the vanishing ink, the papers were observed visually to see if the ink disappeared, and if so, how long this process took. The writings were observed continuously in the first 6 h, and then every 6 h for 3 consecutive days.
- According to Welch[9] regarding the erasable ink, the ink lines were manipulated using the eraser that is incorporated within the body of the pen.

#### 3.2.1. Optical deciphering

The following methods were employed in an attempt to detect the disappeared writings:

- Magnifying glasses and the different light sources (-direct and oblique light).
- Ultraviolet and Infra-red illumination (VSC-6000 photos were scanned and fitted in the article).

#### 3.2.2. Chemical deciphering

NaOH solutions were then sprayed over the suspected writing using an atomizer to obtain a very fine mist which fills lightly