

Role of Ink In Partial Burnt Documents

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ABSTRACT

In most of the arson and other fire cases, partially charred state of documents are encountered and the decipherment of these documents are the main objective of the forensic document examiner without damaging the evidence by using an array of non-destructive techniques. In this study, with the objective to find the best non-destructive technique, five different types of partially charred papers are taken consisting three different kinds of ink i.e., ballpoint pen, gel pen and fountain pen. Results showed that samples consisting gel pen ink had excellent results under normal light while oblique light, diffuse light and ultra-violet light enhanced the result of both the samples consisting fountain pen and ballpoint pen ink.

Keywords: Partially charred document, Normal light, Oblique light, Ultra-Violet light, Diffuse light, Gel pen, Ballpoint pen, Fountain pen.

INTRODUCTION

A document is anything which contains symbols, writings, and marks either visible or invisible and conveys information for someone and when the authenticity of that document is disputed then it is termed as questioned document. Documents can be altered by using obliterations, indented writing, erasures and charring.

Most of the documents are made of paper and are completed in inks that were written by the writing pens such as ballpoint pen, fountain pen, and gel pen and so on. If these kinds of papers are burnt from fire, all the written contents will disappear and the paper becomes charred. A charred or burnt document is any document that has completely transform into ash and become

brittle and darkened through exposure to intense fire but sometimes the document does not completely become ash and that type of document is termed as partially charred documents. This state of document is extremely fragile and requires a great amount of care in handling and processing. If the document is recovered before being completely destroyed, there is a good chance that some of the writing in that document can be identified because although the paper may become charred, the written ink may not quite char easily.[1]

The charring of document depends on two main factors i.e. type of paper and ink used. Paper is a multifaceted material that has been used for many centuries, mainly for the exchange of information, for storage or for the protection of goods.[2] It is a fine material which is produced by pressing together moist fibres of pulp of cellulose that is derived from wood, grasses or rags, and then drying them into pliable sheets. Depending on the use, paper can be produced with a variety of properties. Sometimes, papers as physical evidence found at the crime scene especially in suicide and homicide cases and in arson cases where the property of victim either burnt accidentally or intentionally including the paper documents which may contain important information. So, it is very important to understand the chemistry of paper.

Now-a-days, the most common variety of paper that has been employed are Butter paper is also known as vegetable parchment paper. It is prepared with chlorine-free highly refined pulp which results in excellent water-proof as well as fat resistant properties. It is much lighter than the ordinary paper. Tracing paper is a semi-transparent paper which is widely used in architectural and engineering drawings and plans. The action of sulphuric acid on the cellulose fibres which are broken up almost completely results in this kind of transparency. This type of paper is lighter but much stronger than the ordinary paper. Copier paper is multifaceted and lightweight in nature and is made from a fibrous substance called cellulose. In this paper, chalk has also been used to fill in the spaces between fibres and also give a brighter and whiter colour to each sheet. Depending on the brightness of copier paper, hues of purple and/or blue dye are used to convert the naturally yellow-tinted pulp into a whiter shade.[3] Bond paper contains high amount of cotton rags or cotton textile fibres, which gives it much thicker and more substantial kind of texture. The high-quality bond paper contains about 20% to 100% of cotton rag fibre and makes the paper more durable. Construction paper or sugar paper is a rigid, coarse, coloured paper with a slightly rough texture and unfinished surface. On the paper's surface, very small particles can be seen due to the source material. This paper is mainly used for projects or craft work.[10]

In writing inks, the three most common inks that are utilised by everyone are ballpoint pen, fountain pen and gel pen ink. Ballpoint pens are the most typical of all the writing instruments. It contains synthetic dyes which are dissolved in glycol (propylene glycol or butylene glycol) or alcohol (e.g. benzyl alcohol). Modern ink consists of dyes that are highly soluble in the solution of glycol or alcohol. The dyes present in ballpoint inks can contain up to 50% of total formulation. Chelated dyes, of varying colours, are generally employed as they are very stable towards light. Additional dyes such as basic triarylmethane dyes for example, crystal violet, victoria blue, methyl violet etc. Other additives including fatty acids (oleic acid), resins, corrosion controlling ingredients, surface-active agents, and viscosity adjustors. The most typical dyes are blue which are mainly based on the copper pthalocyanine compound and are further treated by sulfonating or chlorosulfonating copper pthalocyanine pigments. Ballpoint pen ink is usually oil-based which give it its thickness nature. Oil also is one of the reasons why ballpoint pen ink dries rapidly and remains permanent.[8] Fountain pen ink In this type of ink, water acts as a solvent medium while the solute that occurs in almost all fountain pen inks is a water soluble aniline dye contains nitrite group which is bound to a phenyl group and thus, forming a basic amine i.e., phenylamine. There are other common solutes such as surfactants to elevate the ink flow, biocide compounds to halt the fungal growth in ink, and glycerine to elevate the ink viscosity. There are two main types of inks used in modern fountain pens are the solutions containing either iron- gallate or synthetic dyes.[6] The iron gallotannic type of ink composed of iron salts and Gallo-tannic acid in an aqueous solution. When it is first applied to the paper it was colourless but rapidly darkens up due to oxidation in air. This type of inks is stable in nature but due to the presence of acids in the ink can destroy the nib of the pen so this type of ink cannot be used in a good quality fountain pen. So, aqueous solutions of synthetic dyes replaced them, which does not contain any acid but have similar tinctorial power as does the modern iron-gall inks. This type of ink is also very stable in nature. The modern inks of this kind contain pigmented dyes, like copper pthalocyanine that makes these types of inks much more everlasting.[5] Gel pen inks consist of insoluble color pigments instead of organic dyes. It is a water-based ink but in a gel form which is wholly insoluble in both water as well as strong organic solvents. Writing with this type of ink is close to the appearance with that of a ballpoint pen.

The decipherment of partially charred document is the main objective of the forensic document examiner without damaging the evidence that is to use an array of non-destructive techniques.

The most common and preferable techniques are optical techniques mainly, ultra-violet light, infrared radiation, oblique light and many more to recover the written content on the burnt document which is at the point where the content is not quite readable. These techniques also allow the forensic document examiner for quick and thorough analysis of the charred documents.[4]

Material and Methodology

Total 75 partially charred samples i.e., 25 samples per ink are prepared by heating it with a clothing iron. Each paper contains a writing content, "THE BURNING PAPER" in English capital letters by 3 different types of pen namely, 045 Reynolds fine carbure ballpoint pen, Flair rapid gel pen and Rorito flymo fluid ink fountain pen. Once the samples were prepared, they were collected and preserved carefully. Photography of each sample is carriage. Instrument used for the examination is Torch, U-V chamber, 12 megapixel camera of Apple iPhone 8+



Fig 1: The sample of butter paper with gel pen ink

All the samples were observed using different optical techniques. The written content on the samples containing gel pen ink was clearly visible while many variations were seen in the samples containing fountain pen and ballpoint pen ink. The ink was faintly visible on some areas and indentation marks were observed but in some fountain pen ink samples, written content was also clearly observed while in the samples containing ballpoint pen ink, ink was evaporated completely but in some of the samples ink was observed in some areas and indentation marks were also observed.

Further optical techniques were employed to analyse the samples containing ballpoint pen ink and fountain pen ink in order to get better results and following observations were made. The 3

techniques namely, oblique light, diffuse light and ultra-violet light were used to analyse the above samples. With oblique light, it was observed that the samples containing both a ballpoint pen as well as fountain pen ink, all the written contents were clearly visible.

RESULTS

This work was carried out with the sole objective to find the best non-destructive technique using various light sources to decipher the written content on different kinds of partially burnt documents consisting of different types of inks. The samples containing gel pen ink irrespective of type and thickness of paper show significant result under normal light unlike the samples containing fountain pen and ballpoint pen ink because the ink was not destroyed due to excessive heating and the written contents were completely visible through unaided eye. Due to the undesirable results shown by the other two ink samples, further optical methods were employed, namely, oblique light, diffuse light and ultra-violet light, respectively.

With oblique light, samples were examined in such a way that the light focuses only at a particular angle on the paper and it is observed that both the ink samples give desired results which are the pen pressures or indentation marks that were present even though the ink was not and among these samples, the partially charred butter paper consisting ballpoint pen ink and partially charred construction paper consisting fountain pen ink gave the best result.

With diffuse light, the samples were placed near the window so that the diffused sunlight falls on the paper and the same results were observed as in with oblique light i.e., pen pressures were observed. Among the samples containing ballpoint pen ink, all the variety of paper except partially charred butter paper and among the samples containing fountain pen ink, partially charred construction paper gave excellent result. If both ink samples were compared under diffuse light technique, it can be concluded that the samples containing ballpoint pen ink gave much desired result than the ones containing fountain pen ink.

Every ink has different wavelength and thus absorb ultra-violet light at different intensities. With ultra-violet light, the samples were placed in a ultra-violet chamber and samples were analysed under short wavelength ultra-violet radiation and observed that out of both ink, ballpoint pen ink is the one which gives desired results especially partially charred butter paper and construction

paper as the indentation marks or pen pressure points of all the written contents were observed while in the samples containing fountain pen ink only partially charred construction paper was the only sample which gave the desired result.

CONCLUSION

The purpose of this study is to find the best non-destructive techniques using array of light sources to recover the written content on five different kinds of partially charred documents consisting of different types of inks. In this study, four different techniques are performed for the analyses which gave desired results. Through normal light, samples consisting of blue gel pen ink gave excellent result irrespective of paper type and thickness. The rest of the inks gave desired results in other optical techniques i.e., oblique light, diffuse light and ultra-violet light. Irrespective of paper type and thickness, both the type of sample containing blue ballpoint pen and fountain pen ink gave desired result in both oblique and diffuse light. The result of partially charred butter paper and partially charred construction paper containing blue ballpoint pen ink and partially charred construction paper consisting blue fountain pen ink were enhanced when examined under ultra-violet radiation at short wavelength. Analysis of a variety of partially charred paper consisting of different types of writing inks with non-destructive technique is the best way to recover the written content on partially charred document.

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