

“Stabilization and Examination of Charred Documents”: A Systematic Review

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Abstract

In spite of several researches already carried out during the past decades, only limited information is available on the preservation of charred documents and there is a need to recollect it. Therefore, there is a need to scrutinize literature that have portrayed its legal values and validating it in light of available works and published research studies to enlighten the methods and techniques used in forensic questioned document examination to help stabilization, separation, detection, investigation, collection, preservation, prevention and decipherment of the charred documents. This work will enlighten the forensic questioned document scientists, law enforcement agencies and also for awareness of public.

Keywords: Charred document • Questioned documents • Forensic science • Stabilization of charred document at crime scene • Preservation and prevention of charred document

Introduction

Crime involving documents ranges from fraud, threatening letters and anonymous letters to armed robbery, suicide, murder and other criminal activities [1,2]. The word document denotes as a piece of written material or contents, printed, or electronic matter on any surfaces such as paper, wall, rocks, leather, metal, cloth piece, body organs etc. and that provides specific information or interpretation and forms a record [3,4]. Documents have handwritings, signatures; mechanical or electrical machine printed or interpolated matters [5], letters, figures, diagrams, marks, signs, or symbols to make it understandable [6,7].

The handwritings and signatures are most vital evidence in white collar crimes and suicidal cases during forensic document investigation [8-11]. On other hand, questioned documents are documents in which authenticity is disputed, whether the documents are genuine or forge [12-14]. On the place of occurrences preservation, handling and visualization of charred documents are one of the biggest problems in the field of forensic questioned document science and arson investigation cases [15-18]. Because a charred document is extraordinarily brittle and requires immeasurable care in handling and in processing. Charred documents are also blackened, carbonized state renders ordinary restorative processes ineffectual [19]. It is evident that study of charred document

decipherment took place near the World War II. Taylor, Walls, Jones, Mitchell, Lucas, Tyrrell, Gross, Davis and other early pioneers in the field done experiments which are still accepted techniques in current era in the field of forensic questioned document science for handling and visualization of the charred documents. Some latest validated methods and techniques are also accepted by the Hon'ble Courts. Therefore, an attempt is made to scrutinize literature that have portrayed its legal values and validating it in light of available works and published research studies to enlighten the methods and techniques used in forensic questioned document to help stabilization, separation, detection, investigation, collection, preservation, prevention and decipherment of the charred documents [20].

Literature Review

Methodology

In present work an exhaustive review of the latest technical advances and developments concerning charred documents is undertaken. It is based on the materials published in the major forensic or generalist forensic science journals, conferences and books and presentations at international forensic meetings. The main aim of this article is to identify all the relevant work in the area of charred documents in the field of forensic examination of questioned

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documents. The present review will improve existing techniques and methodologies and will also help the forensic laboratories to implement new progress in document examination. It will help determine future axes of research that would try to answer real problems. Although every effort has been made to cover all developments about handling, preservation, transportation, stabilization, evaluation and decipherment of charred documents in this review, some omissions might occur.

Charred document: Evidence based data

Accidentally charred/burnt documents or those advisedly demolished documents are brought to the forensic science laboratories for restoration and decipherment of hand writings or printed writings on them [21]. As charred documents are extremely fragile or brittle in nature and they do not usually remain in their original shape and gets broken into tiny fragments and debris, residues [22]. Curved nature of bending is also observed near the peripheral of the edges of the charred documents [23,24].

Charred document and its investigation

The nature of investigation depends on type and severity of the fire, the location of fire and the procedures employed to extinguish the fire etc. and naturally control the manner in which a search for charred documents, evidence is conducted [25]. When surrounded by other charred objects, charred documents are usually inconspicuous and easy to overlook. The investigator must be particular in this aspect. Much of the charred document materials found at a fire and arson related scene of occurrence, including newspapers, paper currency, legal documents such as deeds, affidavits, agreements, undertakings, letters of consent and contract papers etc., bank and security documents such as currency notes, bank cheques, demand drafts, cash withdrawal slips, fix deposit slips, plastic cards, passports [26], essential documents and advertising materials will have evidential value and it is quite possible to quickly sort them out by the nature and composition of the materials. Newspapers, for example, are usually distinguishable from common writing materials by their larger size and characteristic appearance of the paper. Moreover, most newspapers and advertising materials are composed of cheap wood pulp paper which tends to oxidise quite radically as contrasted to rag or partial rag content paper which are more resistant to burning [27]. The location of the charred evidence relative to its surroundings is often of vital importance to a crime investigation. For that reason, photographs should be taken or drawings made of the exact position of each fragment. Similarly, photographs should be made of fragmented part of the same documents to aid the laboratory technician in reconstructing the evidence later. Therefore, it is essential to take supreme care in handling, preserving and transporting the charred documents to the forensic science laboratories [28]. A forensic questioned document scientist at times may be required to assist the field crime scene investigating officer at scene of occurrence to search the document of consequences which have been charred due to various reason of fire [29].

Handling, preserving and transporting of charred mass

The handling of charred document fragments must be carried out with the greatest care [30,31] and the evidence transferred to the document laboratory without subjecting it to further damage or disintegration.

Charred evidence found in outdoor crime scene/open area

In arson cases, important documents are charred deliberately or accidentally. In the case of "set yourself on fire" cases sometimes a suicide note is also found at the scene of crime [32]. When charred documents are found in open areas, it is usually best for the investigating officer to immediately place a box or other open-ended container (appropriately labeled) over the evidence to keep it from being destroyed or blown away [33].

The best procedure for picking up the evidence for later transportation to the laboratory is to slip a thin card board or thin metal sheeting beneath the charred fragments and the contents being carefully lifted and placed in cushioned (lined with cotton wool) card-board rigid boxes of appropriate size (larger than the documents to be transported). Cotton wool covered with tissue paper may be used to separate the different layers of the charred or burnt documents. It is usually advisable not to use tweezers or other instruments to pick up individual fragments [34,35].

Charred evidence found unusually in fragile documents

In some instances where charred documents are so obviously fragile that they cannot be removed from the site safely then it may be advisable to lightly spray a stabilizing mist of Polyvinyl Acetate (PVA) in alcohol on the surface to impart sufficient tensile strength to permit later removal [36].

Charred evidence found in waste baskets or other open containers

Sometimes during the search of evidence on the scene of occurrence, chars are found in waste baskets or other open containers, they should be left in as such condition. These documents should also be transported to the laboratory in the same container in which they were found making sure that precautions are taken against bumping or rough handling and if necessary, applying a light packing of cotton wool around the chars [37,38]. While it is entirely feasible to transport properly protected fragments by automobile, train, or plane but it is definitely not advisable to send this type of evidence through mail, no matter how well protected it is.

Charred evidence found in safes, file cabinets and other enclosed areas

When dealing with documents found in enclosed or semi enclosed areas [39], certain precautions need to be observed to preserve the evidence from further damage. For example, where charred evidence is enclosed in file drawers, frequently it will be found that the metal frame is warped so badly that it is virtually impossible to remove the file drawers without cutting away portions of the cabinet itself. Undue

force should never be exerted in attempting to withdraw the doors because the effect of the force might further fragment the documents enclosed within. Documents contained in large safes which cannot be transported to the laboratory, are best removed by adopting the same procedure as indicated for removal of single documents *i.e.*, to slip a thin metal plate beneath the entire mass of fragments, the plate and its contents being carefully lifted and placed in a cushioned cardboard box. On occasions when the contents of the safe primarily appear to be bundles of documents, it may be advisable to lift certain of the bundles from the top of the pile before withdrawing the remainders. As a word of advice, when investigations are conducted immediately following a fire, the safe should be allowed to cool off before it is opened.

Charred documents decipherment/restoration

In the field of forensic questioned document examination, there are two aspects of the problem concerning decipherment of the charred document [40]. First, the fragile and twisted material must be strengthened and made flexible so that it can be handled and unfolded. Second, decipherment of the writing over the charred document and its subsequent comparison with standard ones. The stabilizing and unfolding process depends upon the extent to which a document has been charred.

Methods for the stabilization of charred documents

Following are methods for stabilization of charred documents.

Boric acid method: In this method, mixture of 1.2% boric acid with 0.4% sodium hydroxide is poured lightly on the charred mass with the help of an atomizer. This makes it flexible. After this, some 10% solution of formalin is sprayed which helps in unfolding the charred documents [41].

Polyvinyl acetate method: This method employs application of 3% solution of polyvinyl acetate in acetone or methyl methacrylate (commercially known as Bedacyl ICI 40%) on the charred mass placed on a glass plate with the help of a pipette. To prevent charred documents from adhering, the glass plate is first treated with 1% solution of silicone in petrol ether. If the documents are sticking to one another these may be separated by running of sufficient quantity of acetone. When the charred document is purported to have been written in ball pen writing, polyvinyl-pyrrolidone solvent other than acetone is used [42].

Another method for the restoration and preservation of charred documents was disclosed by Bartha and Duxbury in 1968. It was discovered that the process of additional burning worked better on charred documents with typewriting and mechanical printing than on those with handwriting. Further research on this method using a controlled temperature Dyna-Tro11 muffle furnace with a maximum capacity of 2000°F and a glass window in the door through which the char could be observed revealed that the temperatures needed to make typewriting and printing legible are typically a little higher than those needed for handwriting. The paper begins to turn black around 550°F and this blackening is finished around 600°F. The char is about a quarter of the original size. In certain circumstances, the printing or typing can be read because of the poor contrast of the paper that has been carbonised. This can occasionally be captured in

a shot using a side light. The char turns grey at around 750°F and the typewriting and printing start becoming easier to read. The typewriting and printing become highly readable as the paper's color shifts to light brown and eventually to a cream-white colour at about 900°F. Printing and typewriting in black, remain in black. Printing and typewriting in red turn into different shades of brown. Some typewritten copies that were originally in black or blue turn into deep reddish brown and watermarks may also be read. This method was also done to burn more pieces of paper that had printing and typewriting on them. The char was a fine powder and so fragile that it was irreparably disturbed by even normal breath at close range. Literature and critical surveys reveal that stabilization of char is subjected to either "Neatan" new treatment or to lamination or a combination [43].

Cyanoacrylate fumes method: A quick and straight forward method is to apply cyanoacrylate fumes to charred documents on specific location. The polymer didn't show through. It did not obstruct optical examinations, and it is thought unlikely to preclude other forensic investigation paths [44]. From visual inspection, it appears that cyanoacrylate fuming strengthened delicate samples and would be helpful to prevent damage during transportation to the forensic science laboratory, where more thorough secondary treatments like PVA: Acetone treatment, may then be performed. For delicate and debris of charred papers, a pre-humidification procedure followed by cyanoacrylate fuming is advised as a stepping stone before PVA: acetone treatment. A fuming wand can be used in the field to stabilise the humidified, charred paper before shipment by exposing it to cyanoacrylate vapour to a forensic laboratory [45].

Techniques for evaluation of charred documents

Charred documents are evaluated using the following techniques.

Photographic methods: Some of the writings are visible upon closer scrutiny. It is captured on photographs. An infrared image can show the writings if the original ink contains carbon or another infrared opaque ink and the documents are not completely charred [46].

Contact procedure: The recently charred/burnt documents released gases that can record latent images on the photographic emulsion according to experiments by Davis of the Bureau of Standards. The ink, print, pencil marks, and other materials that are applied to the paper before it is burned, prevent these gases from escaping, keeping the photographic plate's emulsion clear on those areas. The process starts when the burned documents are cut into single sheets and brought into a darkroom for photography. The fragments are sandwiched between two standard colour blind commercial photographic plates beneath the red safelights with the emulsion side of the plates gripping the opposite edges of the burned document. The two plates are carefully but firmly pressed along and taped together. The plates that were kept in an airtight box are removed when the contact period is over, separated and processed in the customary photographic way. A harsh developer of the Eastman D11 type produces the desired effects because the image lacks contrast [47].

Filter photography: The procedure necessitates the use of commercial film and a Wratten deep blue filter. Although the filter's

operation is fully understood, it appears to amplify fluctuations in the backdrop charred document's power in comparison to other areas of the paper on which ink has been deposited [48].

Infrared photography: This is one of the most well-known decoding techniques. If the original writing was done with a typewriter, pencil or thick iron-gall ink, it works fairly nicely. The process uses Eastman infrared plates along with a Wratten 87 deep red filter and Eastman DK 50 developer which is used for the development of photographs. To decipher the burned writing, Silver Nitrate (AgNO_3) solution might occasionally be used. The document is placed on a photographic enamelled tray on top of a glass plate. It is covered by a second glass plate which is positioned so that it does not touch the page. The tray is filled with a solution of silver nitrate. Gray text is contrasted with a black background [49-51].

Decipherment of charred documents

After stabilization, decipherment is made by following methods:

By reflected light source: The charred document is examined in not too bright light from different angles. The writing is rendered visible as the reflecting power of the surface is modified [52].

Using oblique light source: Charred documents bearing indentation marks are best deciphered using oblique light through digital photography [53].

Image enhancement technique: This involves digital photography coupled with image enhancement through computer software [54].

Utilization of polar filters photography: The document may be photographed by using polar filters as the light polarized may differ at the inked and paper surface areas which may be recorded in different tones on the film [55].

Utilization of different ranges of ultra violet and infra-red photography: This is helpful in certain cases and depends upon the various factors such as nature of ink composition of paper and extent of charring [56].

Chemical treatment with the utilization of chloral-hydrate: When the charred documents contain printed matter, it is treated repeatedly with 20% to 25% solution of chloral hydrate in ethyl alcohol and dried. It is further treated with the above solution containing some glycerine in it and dried again. The developed writing can then be photographed [57].

Alcohol-glycerine immersion method: The char is placed on the surface of a liquid containing two parts of water, five-part of alcohol and three parts of glycerine. While the fragments are soaking up liquid decipherment are made. It has been observed that typewritten/printed document and those written with pencil are easier to decipher in comparison to documents written with washable and likewise inks [58].

Function through VSC[®] and other highly sophisticated scientific instruments: The writing on charred documents can be improved using Spectral Comparator (VSC) [59], Docubox DRAGON[®] and Docucenter NIRVIS[®] or other light source based scientific instruments with various features including flood light and white spot light. Compared to the flood light beam, the best improvement was visible under the source of white spot beam.

Certain letters that were not clearly visible under the usual flood light and source of white spot light were improved by adjusting the wavelengths of the beams. Regardless of the colour of the paper, pen pressure was shown to be significant in the charred documents.

Discussion

The document which has become black/brown and brittle through actual burning or by the exposure to excessive heat, either accidental or intentional, is known as a charred document [60-62]. Charred documents are also known as burnt/singed documents. Charred documents are mostly observed in arson, accidental, suicidal, explosion and electricity related fire cases. Sometimes it is also observed in some cases when a person fearing impending raid, burned the incriminating documents. Destruction of currency notes, financial documents, records, notebooks, diaries, bank instruments, educational documents, court documents or some other types of legal and essential documents may have been attempted. On the scene of occurrence, such documents may be completely charred (ashed) or partially charred (carbonised) or only part of them are charred/burnt. The affected documents may provide useful information if the forensic scientist properly handled such charred documents [63]. On the basis of the information obtained from publications, books and published scientific works and data, it is very encouraging reality that from most of the charred documents, which are not entirely reduced to fragments, their original condition can be deciphered. The nature of the charred papers varies in physical and chemical compositions. It is not required always to presume that handling, preservation, stabilization, evaluation and decipherment of charred documents or paper can react the same when treated with different chemical treatment methods [64].

It is advised to obtain document expert's help in all such type of cases on the scene of occurrence. Always avoid excessive handling. Avoid straightening or flattening the fold on the paper. Collect different charred documents in separate cotton wool padded boxes. Prevent scattering of the charred document pieces. Place cotton wool padding in a cardboard box and gently put the charred document on the padding. Cover the document with similar cotton padding before closing the box gently. Preparation for transporting the documents to the laboratory should be made by applying a light packing of cotton wool around the sides of the charred mass but only lightly touching them. When fragments of the same documents are found, they should be placed in a box in the same relative position in which they were found [65,66]. It is evident that there may be potential value for pre-treatment with alkyl-2-cyanoacrylate ester (superglue fumes) as an intermediary step prior to treatment with PVA [67].

When a VSC or other tools were used on charred documents, it was evident that there was a noticeable contrast between the writing and the charred background. In conclusion, using a VSC or other light source-based scientific instruments tools could be a trustworthy substitute for enhancing the writings on charred documents [68].

Conclusion

Even though it doesn't happen often, the issue of restoring and deciphering charred documents is crucial and a very difficult task for a forensic document expert. However, the present systematic review

gives us step by step and clear cut suggestions, indications, and references to scientific literature and material for further research into the forensic questions of today's forensic scientists. Therefore, it is concluded that this kind of systematic review study would further help in various investigations related to stabilization, separation, detection, investigation, collection, preservation, prevention, and decipherment of charred documents for forensic scientists, law enforcement agencies, vigilance and surveillance departments as well as financial institutions such as banks and insurance companies. Stabilization should be done using the most appropriate method choosing from various methods and techniques for fixing and hardening the suspected charred documents. To decipher the charred documents, most appropriate method should be used choosing from various photography techniques using various light sources, such as oblique light sources, image enhancement techniques, polarizing filter use, UV and IR light source photography etc. Some other sophisticated scientific instruments such as VSC, Docubox DRAGON, Docucenter NIRVIS etc. are facilities with different light sources which are the best method for the decipherment of written content on charred documents and provide a new avenue by which forensic document scientists may identify the charred writings that might otherwise go undetected with other more frequently used techniques and methods.

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