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STARCH BASED COATINGS: A SUSTAINABLE APPROACH IN PRESERVING AND DECIPHERING ORIGINAL CHARRED DOCUMENTS

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Abstract

Fire is a destructive force capable of wreaking havoc, destroying valuable documents such as books, affidavits, and cash within minutes. Heat, smoke, soot, and water from fires can cause additional damage. Burned documents often lose integrity, becoming brittle, yet retaining crucial evidence. This research develops a novel method using natural polysaccharides, like starch, to preserve and decode burned documents. A starch-based analog is used to decipher documents, including old checks, stamp paper, and printed notes. Various starch concentrations are tested on different burned documents. This sustainable, cost-effective, and environmentally friendly approach has significant implications for forensic investigations, archival preservation, and disaster recovery efforts. This study found that the best starch analog was 4%, which could partially or fully decipher most of the documents.

Keywords: *Charred documents, Decipherment, Starch analog, Coatings.*

INTRODUCTION

Documents, both printed and handwritten may be purposefully or unintentionally destroyed by severe heat and smoke in arson cases or other fire accidents. Due to a restricted oxygen supply, one or more pieces of paper placed together during a fire incident may burn entirely or partially. The intentionally or inadvertently destroyed documents might be useful as evidence and could establish a connection between a criminal and a crime. Many times, these documents won't burn entirely because of a number of factors, but they could still become brittle, fragile, or black and the writing might become unreadable or invisible to the naked eye because of the excessive smoke and soot from the fire. Such documents must be handled and kept with utmost and an appropriate approach must be used to decipher their important content. Preserving academic, legal, cultural, and historical documents for future generations depends on document preservation. It guarantees that important information is preserved and available over time, even in the face of physical, chemical, or environmental deterioration. Governments and organizations maintain records such as birth certificates, land deeds, contracts, and legal proceedings. If these documents degrade or become unreadable, it can lead to legal disputes, ownership conflicts, and administrative challenges. Preservation ensures that such critical records remain legally valid and accessible.

A charred document refers to a record that has become brittle and blackened due to extreme heat or burning. Burned or intentionally destroyed documents are often sent to forensic laboratories for restoration and text decipherment. However, traditional restoration methods are ineffective when documents reach a carbonized state, requiring innovative solutions.

Palimpsest imaging is a well-established technique used for deciphering burned texts through the application of thin coatings. The term "palimpsest" refers to a manuscript or document where new writing has been added over erased or obscured original text. In this method, a thin layer of specific materials, such as silver or gold, is applied to the surface of burned documents to aid in their decipherment.

Starch-based materials are gaining popularity as eco-friendly solutions for document restoration and preservation. They show great potential as decoding agents for faded or damaged materials. By enhancing contrast, stabilizing ink, and revealing concealed or deteriorated writing, starch-based coatings and solutions improve the readability of historical documents. Due to their strong affinity for water and ink residues, starch molecules help restore faded ink impressions caused by aging or environmental exposure.

This property can be beneficial for restoring faint or partially erased text on aged manuscripts. Charred documents are frequently encountered in criminal investigations, accidental fires, and intentional destruction of evidence. The ability to decipher such documents is vital in forensic science, as it aids in reconstructing lost information, exposing hidden crimes, and supporting legal proceedings. In cases of fraud, forgery, arson, or financial crimes, individuals may attempt to eliminate incriminating evidence by burning documents.

In this ongoing effort, we have successfully deciphered charred records and explored an innovative, sustainable approach to document preservation. This study utilizes starch, a natural polymer, to develop a protective coating material. The process involves applying a hydrophobic thin coating to burned paper, serving as an effective decoding agent without relying on analytical or spectroscopic techniques.

This research validated the decipherment of charred documents such as old chequebooks, stamp papers, and printed notes. The study holds significant value in the preservation of historical documents and forensic document analysis. In forensic science, starch-based coatings aid in the preservation, decipherment, and

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retrieval of critical information, allowing fragile, burned documents to be stabilized and used as evidence in legal proceedings.

OBJECTIVES

- To compare the legibility of untreated and treated documents using starch.
- To use a uniform application technique for starch-based coatings that conservators can utilize to reliably and efficiently recover burned manuscripts.
- To investigate the best percentage of starch in identifying various document's symbols, emblems and logos.

METHODOLOGY

PARTICULARS	METHODS
Signification of study	In the current situation, most documents are printed rather than handwritten. Nowadays, all documents are digital and are printed to obtain a hard copy. Therefore, the majority of the documents in question are likely to be printed rather than written by hand.
Universe of study	The original documents were gathered and burned, then efforts were made to decipher and preserve them using varying percentages of starch analog.
Sample collection	Printed notes, old cheques, and stamp papers were collected and burned using a candle, rendering the writings invisible. Primary focus was given to deciphering key elements such as signatures on cheques, account numbers, bank logos, certain security features, and amounts. The documents were categorized as light, moderate, or severe based on factors like charring, visibility, and readability. After burning, the samples were securely stored in a box for preservation. A total of nine samples were collected, charred, and analyzed for deciphering.
Research design	This study aims to explore the effectiveness of a starch-based coating as an eco-friendly method for preserving and deciphering original charred documents. It seeks to determine the optimal percentage of starch analog for successfully deciphering various documents.
Tools for study	Candle (burning purpose), brush (application purpose)
Limitation	Additional samples need to be included. Various types of papers should be incorporated.

RESULT AND DISCUSSION

Starch analog	Printed paper		Cheque			Stamp paper		Written documents	
	Newspaper	Printed notes	logo	sign	prints	emblems	seal	Using pencil	Using pen
2%	No	No	No	No	No	No	No	No	No
4%	Partial	Good	Good	Good	Good	Good	Good	Partial	Good
6%	Partial	Partial	Good	No	No	Partial	Partial	No	No
8%	No	No	No	No	Partial	No	No	No	No

Table 1: The results obtained on different documents by different percentage of starch analog

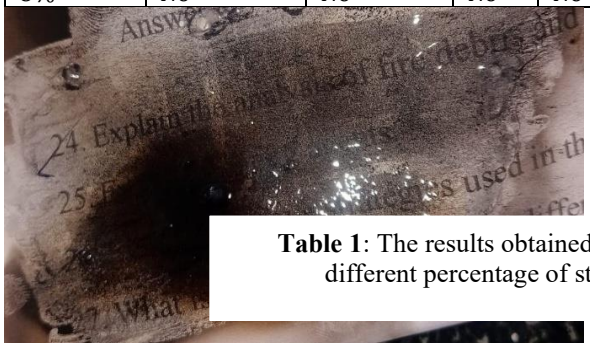

Fig 1: Printed matter deciphered using 4% starch analog

Fig 2: partially deciphered emblem using 6% analog

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Fig 3: Partially deciphered newspaper matter using 4% starch analog

Fig 4: Deciphered the emblem using 4% starch analog

Fig7: No decipherment of prints in cheque using 2% analog

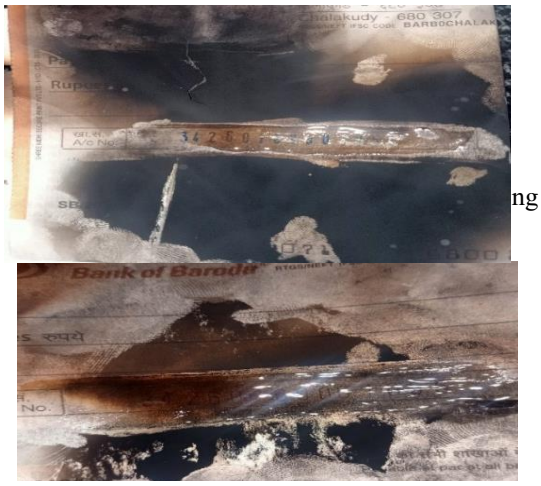


Fig 8: Partial decipherment of cheque using 8% analog

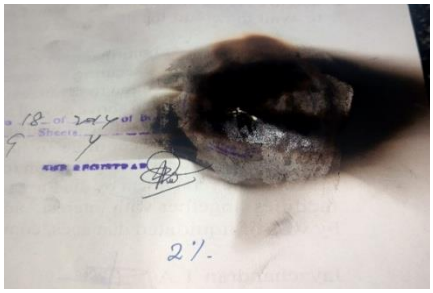
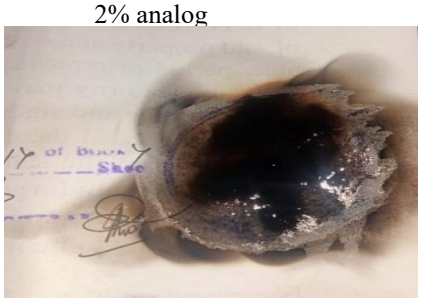


Fig 9: No decipherment of seal using 2% analog

Fig 10: Seal deciphered using 4% starch analog



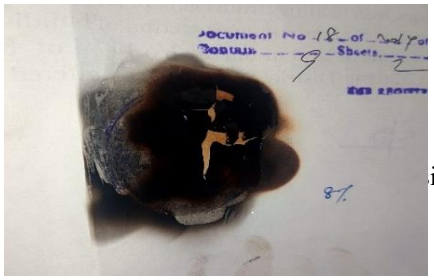


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Fig 13: deciphering the sign in the cheque using 4% analog

Fig 14: Partially deciphered matter written by pencil using 4%

Fig 15: Deciphered log in cheque using 4% analog

When preserving and analyzing charred documents, it is essential to consider that their physical and chemical properties vary based on the type of paper, ink, and the conditions under which they were burned. In this study, different starch analogs were prepared and tested to determine the most effective formulation for document decipherment. Various concentrations of starch analog were applied, with 4% proving to be the most effective. The 4% starch analog partially deciphered printed newspaper text and handwritten content with a pen, while effectively revealing printed notes, logos, signatures, cheque prints, emblems, and seals. The 6% starch analog also produced good results, partially deciphering newspaper prints, printed notes, emblems, and seals. The 8% starch analog showed limited effectiveness, only partially deciphering cheque prints, whereas the 2% analog failed to decipher any of the documents.

CONCLUSION

The study on starch-based coatings explores a sustainable approach to preserving and deciphering original documents, emphasizing starch's potential as an eco-friendly and effective preservation material. This research demonstrates that starch-based coatings can extend the lifespan of aged or deteriorating documents while preserving their authenticity. Due to its biodegradable and non-toxic properties, starch serves as an excellent alternative to synthetic coatings, minimizing environmental impact. Furthermore, its ability to enhance the legibility of faded text offers a promising solution for historical document restoration. This method not only safeguards valuable manuscripts but also aligns with sustainable conservation practices. Starch analog facilitate the decipherment of charred documents through hydrogen bonding, contrast enhancement, gel formation, surface protection, and controlled hydration. Their interaction with burnt cellulose stabilizes the fragile material, making text more visible while preserving the document's structural integrity. In summary, starch-based coatings provide a viable, cost-effective, and environmentally responsible solution for document preservation and restoration. Continued research and refinement can further improve their application in archival science, ensuring the protection of cultural and historical records for future generations. The results of this in-depth research could pave the way for improved methods and strategies in recovering and interpreting critical information from charred documents, thereby advancing the field of document analysis and historical research. Additionally, these findings may have practical implications for forensic investigations and archival preservation, ultimately aiding in the protection and comprehension of invaluable historical records.

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