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Identification, Risk Factor Analysis and Cleaning of Textile Artifacts

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ABSTRACT

Textile conservation is a multidisciplinary field aimed at preserving and safeguarding historical, cultural, and artistic textile artifacts for future generations. This review paper delves into the essential prerequisites for effective textile conservation, focusing on three critical aspects: fibre identification, risk factor analysis, and cleaning methodologies. Fibre identification is the cornerstone of textile conservation, as it provides crucial insights into the material composition of the textile artifact. Various fibres, such as cotton, wool, silk, and synthetic blends, possess distinct properties that influence their response to environmental factors and conservation treatments. This meticulous analysis enables conservators to tailor preservation strategies that mitigate degradation risks and ensure long-term stability. Risk factor analysis is integral to the conservation process, allowing conservators to identify and mitigate potential threats to textile artifacts. Environmental factors such as light exposure, temperature fluctuations, humidity levels, pollutants, and pests can significantly impact the condition of textiles over time. Through comprehensive risk assessments, conservators evaluate the vulnerability of artifacts to these factors and develop preventive conservation measures. Implementing controlled storage environments minimizes risks and prolong the lifespan of textile collections. Cleaning plays a pivotal role in textile conservation, facilitating the removal of surface soiling, stains, and contaminants that compromise the aesthetic and structural integrity of artifacts. However, cleaning interventions must be approached with caution to avoid causing irreversible damage to delicate fibres and dyes. Conservators employ a range of techniques, including surface cleaning, dry cleaning, wet cleaning, and targeted stain removal, depending on the nature of the textile and the extent of soiling. Prior knowledge of fibre properties, dye stability, and historic manufacturing techniques helps the selection of appropriate cleaning methods, ensuring optimal outcomes while preserving the authenticity of the artifact. To summarize, textile conservation requires a thorough grasp of fibre identification, risk factor analysis, and cleaning techniques.

Keywords : Textile, Culture, Artifacts, Conservation, Cleaning, Risk factors

INTRODUCTION

Textile conservation is a specialized field dedicated to preserving and restoring textiles of historical, cultural, and artistic significance. Textile conservation plays a vital role in museums, historical sites, and private collections, enabling to connect with heritage and appreciate the artistic and cultural achievements of our ancestors. These textiles encompass a wide range of objects, including garments, tapestries, flags, quilts, and more. Textiles are susceptible to various forms of deterioration over time, such as fading, staining, tearing, and structural weakness. The primary goal of textile conservation is to ensure the longevity of these precious artifacts while maintaining their historical and aesthetic integrity. Textile preservation involve careful cleaning, repairing and stabilizing fragile materials. Conservation professionals employ a combination of scientific techniques and artistic expertise

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to address these issues. Their work involves assessing the condition of textiles, documenting their history and provenance, and devising conservation strategies tailored to each unique piece. Conservators use specialized tools, materials and methods to handle delicate fabrics, dyes. The work of textile conservation is guided by ethical principles that prioritize reversibility and minimal intervention, ensuring that the textile's original state can be retained and studied by future generations. In addition to preserving the physical aspects of textiles, textile conservation also contributes towards understanding of history, culture and art. It allows us to unlocks the stories hidden within these fabrics, shedding light on the societies, traditions and innovations of the past. It has been noted in experimental studies cotton, wool and silk fibre the largest part of the museum textiles. Curators face a variety of problems while maintaining artefacts made of these fibres (Sachdeva *et al.,* 2021). These problems arise due to the chemical constituent of the fibre and their susceptibility to the environmental conditions and biological factors.

Fibre identification methods:

There are mainly two types of fibre identification methods which are generally used. First is non-technical method; feeling test and burning test, second is technical methods; microscopic test, chemical tests

Non-technical test method:

Feeling test/Subjective test method:

It requires skilled perception that is acquired after handling many types of fabrics over a time. It involves touching a fabric and feeling the fabric to know its component fibres *i.e.,* cotton fibre will feel cool to touch because it is good conductor of heat, wool fabric will feel warm when touched because of heat generated by wool and silk fabric feels very smooth due to its smooth longitudinal structure and monofilament yarn. Limitation of feeling test is that various synthetic fibres which are available in the market feels like natural fibres which makes confusion. But this may be of less importance in case of ancient artifacts because at that time mostly natural fibres were used in apparel making (Corbman, 1983).

Burning test:

Burning behaviour comprises behaviour of the fibre when approaching flame, in flame, after flame, its odour and residue **(Shekhri, S., 2022)**. Cotton fibre gives paper burning smell, during burning due to cellulosic chains. If the fabric self-extinguishes and give the hair burning smell then it is wool. Silk also gives burning hair like smell but it can be distinguished from wool by its ash residue that is lighter than residue of wool. If fabric burn with black smoke and gives hard bead that is hard to crush then it's a synthetic fibre. This test is more efficient than feeling test but presence of chemical finishes on fabric and blend fabric makes its less reliable (Corbman, 1983).

Technical test methods:

Microscopic test:

It involves identification of fibres with help of microscope (with 100x minimum magnification). This test can easily distinguish between natural fibres.

Chemical test:

It is also a technical test that distinguish between different fibres. These are generally not performed by consumers, these are performed in laboratories. Different tests are taken to identify fibres used in various fabrics. These tests are much reliable and valid for accurate identification of fibres (Corbman, 1983). Different type of chemical reagent reacts with specific compounds present in the fibres. Some of the fibres get dissolved in specific chemicals and hence it is also called as "solubility test" can also be used for this method of fibre identification **(Shekhri, S., 2022).**

Table 1 : Microscopic view of the various natural fibre

Sr. No.	Fibre name	Cross section	Longitudinal section
1.	Cotton	Kidney shape	Ribbon like, convulsions arepresent
2.	Mercerized cotton	Oval to circular	Less convulsions Almost straight
3.	Wool	Oval shape	Scales present
4.	Silk	Triangular	Smooth rod like structure
5.	Linen	Polygonal	Bamboo stem likenods

Deteriorating factors/Risk factors:

Textile artifacts can suffer from various factors such as ageing, deterioration and degradation by the various factors that affects their aesthetic, ethnological and economical values. The environmental conditions i.e. temperature, humidity, light and microbes etc. contribute in deterioration of artifacts with multitude affect gradually. Some changes are visible and curators' interventions

aimed to partially restore them and minimize the impact (Ferrari *et al.,* 2017). The risk factors are mainly of three types; Physical-chemical environmental stressors, microbial factor and human generated/ due to human interventions.

Physical-chemical factors:

It involves light, temperature and pollution (gases and particulate matters) these causes to the appearance alteration (aesthetic aspect) in artifact **(Rubeziene *et al.,* 2012)**. Solar light comprises visible light, infrared (IR) and ultraviolet (UV) components. Infrared radiations heat the material, but UV radiation causes photochemical damage in textiles. Photooxidation reaction is accelerated by presence of heat and moisture by oxygen of environment **(**Szostak- Kotowa 2004 **and Rubeziene *et al.,* 2012)**. Silk fibres are most sensitive to photooxidation by UV radiation which leads to change in colour and makes textiles rigid and mechanically weak due to loss of flexibility of fibres. This problem is much serious in case of weighted silk **(Shubhra *et al*. 2011).** UV radiation may cause to different degrees of yellowing in synthetics and decrease in mechanical strength as well. The presence of high content of water/humidity favours the degradation of fabric structure as well as colour (Gutarowska *et al*. 2017). The chemical reaction (photooxidation) takes place in presence of light and pollutants which result into harmful end products that affect the textile artifact negatively and decrease the life of them.

Microbial factor:

High level of relative humidity and high temperature favours the growth of microorganisms both bacteria and moulds which deteriorate the textile artifacts**.** The microorganisms use the textiles (polymer of organic substances *i.e.*, cellulose, protein, and starch) as food and grow in favourable conditions (Mazzoli *et al.* 2018a). Plant based fibres mainly linen and cotton have major risk because they are rich in pectin and hemicellulose which are easily degradable by microbial enzymes (Szostak-Kotowa, 2004). On the other hand, hemp and jute fibres comprises non cellulosic components like lignin that is resistant to degradation because very few microbes possess enzymes to degrade it (Gutarowska *et al.* 2017). Most of the protein fibres are made up of fibroin which are composed of amino acids and degrade at slower rate. But these are very sensitive to light. While wool is composed of keratin protein that contains cross-linkage (strongest bond). So, generally degrade very slowly. But wool fibres are very sensitive to attack by moth and insects because they attack on disulphide bridges.

Human interventions:

Curators in museum play an important role in cultural heritage preservation from damages over the years (Sterflinger and Pinzari, 2012). The fabric can damage over the years due to various detrimental factors. During ageing some parts can be broken and adhesive like protein based and vegetal (starch) employed for pasting and consolidating artifacts. The pretentious glues such as collagen originated from mammalian bones and cartilages. While plant derived glues are made up of polysaccharides like amylose and amylopectin derived from grains (rye, oat barley, wheat, corn, and potato (Barbabietola *et al.*, 2016 and Ferrari *et al.,* 2017). Over the years these glues cause to enhances fibre distortion and fabric fragility. Some starch-based glue can cause yellowness and make rigids (loss of flexibility) to the textile artifact, also nutrient rich niche for the bacteria and moulds which promotes the deterioration over time. Hence, cleaning and restoration intervention can be required for conservation purposes.

Cleaning methods:

The cleaning of heritage textile artifacts is not simple as laundering of routine textiles. In cleaning of textile artifacts standard methods are used after analysing the pros and cons of each method for a particular article. There are different methods available for cleaning *i.e.* surface cleaning (air cleaning and vacuum cleaning), wet cleaning, dry cleaning, and bio cleaning.

Surface cleaning:

Refers to the removal of soil, dirt and abrasive sand particles from the surface of textile artifacts with the help of soft brushes and vacuums. The choice of cleaning tool depends upon nature of textile artifact condition and ornamentation. It may be sometimes a preliminary step before proceeding to further cleaning methods. It is most useful technique for cleaning of the fragile textile artifacts (Singhal and Bhagat, 2015).

Wet cleaning:

Involves use of water for textile cleaning. It is universal solvent that is why it can dissolve most of the

additives and help in cleaning of textiles. The additives used in cleaning are various chemicals *i.e.*, surface active agents, sequestering agents and dirt carrying agents or may be enzymes (bio cleaning) which enhance cleaning potential of solution.

Dry cleaning:

Refers to cleaning method which use organic solvents to wash the textile artifacts. It is also called solvent cleaning but commercially it is known as dry cleaning. This method is useful for removing the greasy/ oily dirty stains effectively. It is mostly preferred for the silk articles and velvet artifacts or embossed surfaces because water harm these textiles. Some examples of the organic solvents used are petroleum ether, white spirit, benzene, toluene, acetone, diethyl ether, turpentine, ethyl acetate, etc. one should be careful while using organic solvents as they are toxic in nature and highly flammable (Srivastava and Dave, 2015).

Target stain removal:

It is least invasive cleaning methods that used for the textile artifact which have very low flexibility and physical strength. In this method stain removal solvent used only to the targeted stain with help of spray and textile artifact supported with help of cushions. There is no requirement for immersing the whole textile artifact into the solvent for cleaning.

Bio cleaning:

It involves the live microorganisms or enzymes for the cleaning of textile artifacts, mainly used in restoration. It is the best alternative over the surface cleaning/ wet/ dry cleaning because these cause to aggressive and not always useful for precious ethnographic textiles (Mazzoli *et al.,* 2018b). The very high catalytic specificity of proteases and amylases render this method applicable on both collagen and starch. Besides, a wide range of microbial-derived bio catalysts permits the choice of the best fitting (optimum temperature and pH) according to the textile article treated (Germinario *et al.,* 2017).

Conclusion:

Textile conservation involves the careful preservation, restoration, and maintenance of textile artifacts, ensuring their longevity for future generations. So, proper identification of fibres for protection from the environmental conditions *i.e.* fluctuations in humidity, temperature, pollutants, biological agents are required. Further cleaning is also needed to preserve from future risks that may occur due to presence of foreign matter on surface of the textile artifacts. Conservators may preserve textile history for future generations to love and study by combining scientific knowledge, rigorous evaluation, and specific treatments.

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