CONSERVATION OF PAPER MANUSCRIPTS CONCEPT OF PREVENTIVE AND CURATIVE *P.Renganathan*

INTRODUCTION

The concept and use of conservation, is an age old tradition. The priority of placing materials in conservation is based on their rate of deterioration. The more rapidly decaying materials are given first importance than others. In the late 1980s, Sir Bernard Feilden defined the word conservation as "the process of dynamic management of change in order to reduce the rate of decay, and to prolong the life cycle of the concerned objects". The former is controlled by preventive conservation methods while the latter is taken care by curative conservation methods.

CONCEPT OF PREVENTIVE CONSERVATION:

The concept of preventive conservation measure is to prolong the life cycle of the object concern by reduce its rate of decay by external ways. Here we deal with archival paper and its conservation methodologies. In the last decade or so, the stress in the field of conservation is on the reduction of deterioration rate and increasing the life cycle of the archival paper. The preventive measure can be generalized under three headings:

1. Storage
2. Good housekeeping and handling.
3. Pest control.

CONCEPT OF CURATIVE CONSERVATION:

The concept of curative conservation measure is to prolong the life cycle of the object concern by reduce its rate of decay by direct action on the objects. It can be define as cultural, scientific and natural heritage must be conserved as authentic documents. Intervention should be limited to actions strictly necessary to insure the techniques and materials used should not impede future treatment or examinations".

The curative measure can be generalized under these headings:

- **Conservation methods:**

  To counter or mitigate degraded paper material,

  To remove acids contaminants, bio- organism,

  To preserve the legibility of the feature (written & printed) ink,

  To strengthen the paper materials.

Before we discuss about these methodologies for preventive and curative conservation, we must review the following.

- **Paper manuscripts**
- **Inks: –** *written & printed*
- **Ageing of paper material & inks:**

  Oxidation of paper material & degradation, smudging of inks-absorption of moisture, interaction of paper and ink on aging.

PAPER MANUSCRIPTS

Manuscripts are based on written material. In ancient days to convey message they used drawings and symbols which became a language and lead to develop manuscripts. They were written in mud clay, stone, metal, wood, cloth, leaves of trees and finally on paper. In India different type of material were used for writing. Now a day's only palm leaves and paper manuscripts are available largely. These manuscripts are described as miniature painting and glittering based on its writing. It is also described by its pattern i.e., big and short. In the following section, the paper manuscripts in particular are reviewed.

Paper is undoubtedly the most common base material for documents in archives and libraries. It is a thin material used for writing upon, printing upon or packaging. It is produced by the amalgamation of fibers, typically vegetable fibers composed of cellulose, which are subsequently held together by hydrogen bonding. While the fibers are usually natural in origin, a wide variety of synthetic fibers, such as polypropylene and polyethylene, may be incorporated into paper as a way of imparting desirable physical

properties. The most common source of these kinds of fibers is wood pulp from pulpwood trees. Vegetable fiber materials such as cotton, hemp, linen, and rice are also used.

Paper can be classified into types based on the type of manufacturing:

a. Hand-made paper
b. Machine-made paper

Hand-made paper is considered to be better than the latter because the machine-made paper is made out of wood pulp. Wood based papers have low permanence and service life due to the presence of lignin which causes degradation by forming acidic substances.

To give paper strength and to enable it to receive writing ink without feathering, the cellulose is treated with sizes and fillers. In early period, gelatin was used as size material. But in modern papers, the sizing agent is alum rosin, which is acidic and will contribute to the deterioration of paper. The fillers normally added are china clay, chalk and certain alkaline material. A **document** is a bounded physical representation of body of information designed with intent to communicate. The documents are created with the aid of paper, media/ink and the sizing layer on the paper. The chief constituent of paper is cellulose.

INKS:

Ink is the most important common material for documents. A paper without printing or writing by an ink is an invalid document. Based on the chemical components, inks have varied physical properties. Ink has been a dye since the dawn of man; early examples were a mixture of soot from wood smoke and oil, thickened with gelatin from animal skins and musk. Ink is everywhere, though we often do not notice it, it has been used to print the labels of the food in the supermarket; it drips, leaks, splodges and spurts from the faulty ballpoint pen in your pocket. Yet it has a direct impact on our everyday life, it is not possible to function without touching ink at least a couple of hundred times a day.

All ink has the same basic task of pigmentation or colorant to fill the spaces between lines but ink has evolved and there are more than one type of ink. The contents of ink depend where it comes from; the main types of ink are India, Chinese and Sepia ink. Despite the various types and textures of ink, they are all comprised of two components;

a vehicle and a colorant. Usually, oil and water was the vehicle while the dye contributed to the colorant. Ink and its production has always been to a certain extent problematic, it has always had issues regarding durability, it fades when exposed to sunlight and different types of paper absorb different amounts of ink. Between the eighth and eleventh century, a chemical ink – iron gall ink developed from tannic acid and iron salt; became a popular colorant bound by resin. To understand the degradation/durability of ink on paper, it is necessary to understand the properties of the chemicals that have gone into ink production, and why certain chemicals improve or debase its durability.

Water based inks have humectants added so that the resultant ink does not dry out too quickly. At the same time, ink must have the correct consistency for its purpose and added biocides ensure the consistency. Sometimes a pH level is necessary and buffer in additives stabilize the level.

There are three basic types of ink based on the chemical constituents:

1. Inks using a pigment plus a binder (Chinese inks – Soot as pigment and Gouache as binder)
2. Inks with a dye stuff added such as fountain pen ink.
3. Inks with a chemical precipitation added such as Ferro Gallic or Iron gall inks.

Based on the period of manuscripts, the following can be a generalized classification of inks.

1. Carbon inks or Chinnabar based inks (3rd Century B.C. to A.D. 68)
2. Arabs ink or Egyptians based inks – burnt tar or oil + honey or gum as binder – (2500 B.C.)
3. Early medieval ink – gall inks (8th Century)

AGEING OF PAPER AND INKS:

Degradation of paper and ink are due to factors : poor temperature and humidity conditions, moisture entrapment, biological organisms eating away paper; chemical processes, etc., The key factor in ageing of paper is the hydrolysis and oxidation of cellulose backbone in the paper material. These processes breakdown the long cellulose chains into smaller ones and induce poor mechanical properties of paper, finally resulting in brittle nature. The chemical constituent of paper consists of an acid component which on ageing would lead to increase in acidity of paper – adding to the woes of degradation.

As far as the ink is concerned, smudging & bleeding are two key problems frequently encountered. These problems are based on atmospheric pollutants, temperature variation, moisture and solvent action. Inks with carbonyl group have high life properties. Iron-Gall ink has Ferric group which will corrode the paper due to moisture.

One can generalize the factors that are responsible for ageing of paper and ink as follows:

1. Environmental factors like light, temperature and humidity, dust and dirt, pollution, water and fire.
2. Biological factors like microorganisms like fungi, bacterial insects,silver fish, cockroaches, bookworms, book lice, termites, rodents
3. Chemical factors like formation of acids in paper.
4. Human factors like handling and improper stacking, theft, etc.
5. Natural disasters like flood, earthquake, etc.

CONSERVATION METHODS:

While perform any conservation treatment it should safe guard our object from all kind of degradation factors mention above and should be coincide with most of the ethics of conservation.

PREVENTIVE MEASURES TO FOLLOW:

1. To protect from light, heat, fire, etc. The library building architecture should be drawn and built accordingly.
2. To maintain relative humidity as 50% and temperature @ 25*C, Light as 50Lux inside the storage room. LED lighting is recommended.
3. The control of dust, air, dirt and moisture inside the store (library or stack room) should be properly maintained and periodical housekeeping and cleaning is necessary.
4. If any tear noticed on the leaves of the documents or books cello tapes should not be used only acid free tissue papers should be used.
5. No stapler pin to be used only cotton thread to tag multiple papers.

6. Do not allow pen, blade etc inside the reading hall of the library. Only pencil and paper for making notes is to be allowed.
7. Use V cradle for books at reading hall. So as to books should not open 180.

While failing with any part of preventive measure and also due to environmental changes it lead the concerned object (documents) to curative treatment.

CURATIVE MEASURES :

Curative measure includes the following.

a) Washing and Cleaning
a) Deacidification
b) Fumigation
c) Encapsulation
d) Lamination
e) Binding & Filing.

Following are to be ensured while executing a curative measure.

1. Prolong life expectancy of the objects after conservation treatments.

2. Treatment should safe guard the objects from further decaying from all kind of deteriorating factors.

3. All the treatments should be with minimum intervention to the object.

4. Treatment should not spoil the aesthetic appearance of the object.

5. Reversibility is to authenticate and to undo any wrong treatments.

The point of reversibility would render a conservator and the recipient of conservation happy on the note that the life-cycle of the paper is prolonged alongside the guarantee of the original being retrieved as such in the same condition

There are many existing methods being employed for curative conservation of archival papers. Lamination is one of the most widely used methods for paper material and hence will be reviewed in detail. Recent emergence of polymers has made a greater impact in the field of conservation of paper material. The point of increased life cycle of paper has

been given a thought right from the paper manufacturing industry. The use of synthetic polymers with cellulose and its derivatives have been tried by many researchers for manufacturing improved paper material. The advent of new and novel materials may have revolutionized the paper industry in the manufacturing stage but sufficient thought need to be given for the billions of archival papers that lie on the shelves of good old archival buildings, museums, libraries and personal holdings. Based on these requirements, many attempts have been made to develop new materials and methodologies for conservation of archival paper materials.

Materials Used for Conservation of Paper

The different lamination methods employ different kinds of material depending on the requirement. These methods can be drawn analogy from the composite industry. Composites are engineered materials made from two or more constituent materials with significantly different properties and which remain separate and distinct within the finished structure. Generally a composite material consists of two main components viz. a reinforcement layer and a matrix. This is in coherence with the lamination process. Technically speaking the only difference is that in a composite material the reinforcement is impregnated with the matrix whereas in the conservation process, both the components are distinct and a coating of matrix is applied over the reinforcement layer.

Reinforcement Material

The reinforcement is a member or a material which gives additional strength or support for an object.

In context with paper conservation, the reinforcement material must satisfy the following characteristics:

1) Must provide mechanical strength to paper objects.
2) Must protect the paper objects from environmental factors such as light, temperature, humidity, dust, dirt, pollution, water, fire, etc.
3) Must be resistant to chemicals, acids and other solvents.
4) Must be able to resist the attack of biological microorganisms such as fungi, bacterial insects, silver fish, cockroaches, bookworms, book lice, termites, rodents, etc.

5) Should not produce any acidic, toxic products during service life.
6) Should provide an aesthetic look and high optical resolution while reformatting through digitalizing, microfilming and photocopying.
7) Should not crumble after lamination.
8) Should not produce any change in color during service life.
9) Should have long term mechanical properties and must be durable for a very long period.

Matrix Material

The matrix material is generally the adhesive/glue applied on surface of the reinforcement or in some case the paper object. Utmost care has to be taken in selecting the matrix material because it is this material which is in direct contact with the paper object.

In context with paper conservation, the factors considered for the selection of the matrix (adhesive/glue) are as follows:

1. An adhesive should never develop wrinkles or shrink after setting.
2. It should not be hydrophilic and reactive to the environment gases.
3. It should be characterized by forming stable and flexible film.
4. Stability, durability and reversibility are the desired characteristics of a quality adhesive.
5. It should be colorless and not change its color after setting.
6. It should be free from acidity.
7. It must provide an aesthetic look.

Existing Lamination Methods:

1. **Cellulose acetate lamination**: In this method cellulose acetate foil, Japanese tissue paper and acetone are used. This method is still used by **National Archives of India** even though its usage discarded in 1980 by research results due to lake of alternative method.. There have been extensive research made on this method and its disadvantages were highlighted very recently.

2. **Machine lamination (Commercial):** The three categories of polymers; polyethylene, polypropylene and polyvinyl chloride play a major role in thermal lamination and cold lamination processes. These polymers are generally categorized under *Commodity plastics or Low temperature thermoplastics.*

a. **In thermal lamination**, these materials can be used as both reinforcement (film) and matrix (hot melt gum). The outer layer of the film has a heat activated resin coating - hence the term Thermal Lamination. The film is coated with the polyethylene coating which on a certain temperature melts and fuses the document together. These films are also known as Heat set laminating films. This method is very famous with students. Educational Institutions and universities are adapting this methods without knowing its drawbacks.

b. **Cold laminating film** sometimes called tape laminating uses pressure sensitive adhesives to bind the film to the material being laminated. This film is most important for the documents that are heat sensitive. The surface of the document is flooded with a water-soluble adhesive. It is then sent through a set of rollers with the laminating film rolled onto the top of the adhesive and the document. Pressure is applied to bond the film to the document. The application of acetone on cellulose acetate foil and tissue paper sandwich also comes under cold lamination technique.

The commercial lamination methods, though used by common public without the knowledge of its disadvantages, are not considered. The reason is due to the fact that these methods are irreversible and violate the ethics of conservation.

3. **Tissue lamination:** In this method tissue paper is pasted over the paper object either with STARCH paste or CMC paste. Tissue is used in the conservation of books and manuscripts. Alkaline buffered Tissue is used as a reinforcement material and CMC dissolved in Ethyl Alcohol as paste in lamination processes. This method is evolved by **National Research Laboratory for conservation of Cultural Property in India Lucknow** during 1996 and modified by **Regional Conservation Laboratory Mysore** during 2008 and recommended by them nowadays in practice. Because the paste in this

method is water based utmost care has to be taken while laminating water soluble ink written documents. Ink bleeding is also noticed even if paraloid coating is applied.

4. **Chiffon Lamination:** Chiffon, from the French word for cloth, is a lightweight, balanced plain-woven sheer fabric. Chiffon can be made from cotton, silk or synthetic fibers, but is usually associated with silk or nylon. This is a reinforcement material used in the chiffon lamination process. This process was extensively used between about 1920 and 1960. In this process, aqueous adhesives Wheat, rice, starch paste was used. During 1930s, there was practice of using transparent silk on both sides of a paper. But later in the 1950s the silking became obsolete because the silk became chemically unstable over time. Also reversibility was a problem when silk was used. Chiffon based reinforcements were popular in the early period of conservation. In this modern era, the chiffon based materials became obsolete due to the advent of new materials. Tamilnadu State Archives is using this method still now. *"The Hindu"* India's National newspaper has used this method differently.

5. **Photolam Lamino-Encapsulation:** This is an improved method to **Indian Patent No: 214408**. This is a combined method of lamination and encapsulation. In this method **four** types of materials are used.

a. Specially processed polyester film of natural finish processed specifically for paper conservation purposes as reinforcing material. Special coatings like waterproof, antiglare, anti-reflective, heat retardant, non sticky coating are done on one side of the film. Research is on the way to produce **fire retardant** coatings also. It has very low air permeability, rich in elongation, good heat barring property, **water resistant, tear resistant, non absorbent to dust and non-evasiv**e material. It has high bonding molecules and has very low degradation property than paper.

b. Special Adhesive: Acrylic cellulose-co polymer which is acid free.

- Adhesive with very less adhesion strength.
- Adhesive is used only to remove air in between document and polyester film.
- Adhesive will provide only temporary tack between document and polyester film.
- Polyester film will safeguard the document from all environmental & deterioration factor.

Easy reversible in benzene bath.

c… Adhesive of acid free with **high strength & Strong tagging facility.**

d. Handmade acid free paper tags both side coated with acrylic cellulose-co polymer adhesive of acid free nature with **high strength & Strong tagging facility**. These paper tags protect the documents from water, air & other environmental pollutants.

In this method all the four is converted into two kind of material and used. One is specially processed *polyester film* of natural finish and its one side is coated with antiglare, anti-reflectance, heat retardant, moisture proof and non sticky coating. Another side of this film is coated with *special adhesive of acid free nature, with less strength & low tagging facility.* The low tagging adhesive facilitates easy reversibility by benzene bath. Second is *hand made acid free paper tags* both side coated *with adhesive of acid free nature with high strength & Strong tagging facility.* These paper tags protect the documents from water & environmental pollutants.

Reversibility**:** Simply cut the guard portion then remove the film layer by hand. For conservation point of view, and to ensure 100% safe reversibility it is advisable to provide with *benzene bath* for 3 to 4 Hrs then do the reversing exercise which will be a safe reversibility.

FACING THE FUTURE:

Different conservation methods for preserving original paper manuscripts have been discussed. Each method has its own pros and cons while there are few methods like Tissue lamination, Lamino-encapsulation were widely used by conservators in India. Although these methods are curative in nature, it is in the hands of the librarian, custodians and the care-takers of the original manuscripts to take the first step in preserving them. The ways of doing so are by preventive means; storage of paper manuscripts in ideal atmospheric conditions (temperature and humidity conditions), neatly bound and wrapped in an acid-free container and above all periodic monitoring of the status of the manuscripts. If at all these preventive measures are in place, there would not be a reason for the curative methods to arise.

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