A new approach for conservation treatment of a silk textile in Islamic Art Museum, Cairo

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**Abstract**

The paper presents strategies for the conservation of historical textiles in Egypt that have been in uncontrolled storage and display. The silk textile is highly decorated, multicoloured and dates to the Ottoman period, and was exhibited in case # 12014. The textile has various types of deterioration. An examination and analysis of the textile was undertaken in order to develop a plan of conservation treatment. FTIR was used to identify the kinds of dyes and organic stains, and XR-D was used to identify mordants and dust. Light microscope and SEM were used to identify the kind of fibers, their condition and surface morphology. The effects of cleaning materials on the natural dyes were tested. The researcher designed a new metallic frame support system which has advantages over the wooden frames commonly used in Egypt. This presentation will review the conservation treatment step by step. Poultices were used to remove all the sticking cardboard and adhesive. Old conservation repairs were removed. Separated parts were supported. Cleaning included mechanical and wet cleaning. New silk fabrics dyed with natural dyes were used to complete the missing parts. The textile was supported on new linen fabric which was stretched on a metal frame. The method of exhibition will be discussed. Photographs are included to document the conservation process.

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1. Introduction

Archeological textiles in Egyptian Museums are exposed to many challenges such as oscillate relative humidity (RH), changing temperature, effect of light, effect of air pollution, non standard storage and display methods, old poor restoration and old type of adhesives such as starch adhesive, animal glue adhesive, and Arabic gum adhesive. All these factors cause damage and decay in both fibers and dyes which results in weakness in fibers and dye, hardness in fibers, separate parts, loss parts, stain and dust [1–5].

The paper aims to present the strategies for the conservation of historical textiles in Egypt. It shows new methods in the conservation of historic textiles, at least in Egypt. The paper aims at knowing the kinds of fibers and dyes, stain, dust, and different damages in this object through different ways of investigation. The paper reports the conservation treatment of the object such as cleaning, removing the old adhesive and old restorations, completing loss parts, fixing separate parts and making a new display.

2. Description of object

The textile object dates back to Ottoman age and was shown in cases no 12014 in the Islamic Art Museum, Cairo. Its measurements are 116 × 69.7 cm. Its contains many decorations such as plants decoration (flowers and leafs), written decorations inside lamp hang from arch, and geometric decorations (columns, arches). It also contains different colors such as red, blue, green and yellow. The object was kept under glass fixed on a plywood support lined by cotton fabric, a fixing support, and glass covered with a plastic sticker from the edges. There are many signs of damage on this object such as old adhesive, old cardboard stuck on the object’s back, many separate parts from the edges, loss parts, weakened fibers, and brittleness combined with old adhesives and other previous repairs, hardness, old restoration error (such as using paper sticker to fix separate parts), staining and dust. Figs. 1 and 2 illustrate the condition of the original.

3. Testing and analysis

3.1. Morphological study

The morphology of the surface of the fabrics was investigated using a Quanta 200 ESEM FEG from FEI Scanning Electron Micro-
Fig. 1. Textile object dates back to Ottoman age and shows cases no. 12014; one can see a lot of decorations, colors. The object was kept under glass fixing on a plywood support lined by cotton fabric, a fixing support, and glass covered with a plastic sticker from their edges (A). The plywood support lined by cotton fabric (B). The old glass plate over the object was removed by a researcher (C). The object from the back also, we can see the remnants of the old cardboard (D).

scope (SEM). Small samples were taken from the object from different parts and investigated under SEM, to show the quality of the fibers as well as the damage aspects on these fibers [6–8]. SEM Photos of examined Ottoman textile are illustrated in Fig. 3 showing the silk fibers that were identified from different parts of the object. The fibers are extremely roughened, damaged, broken with transverse cracking and longitudinal splitting characterized by small scratches, small slits and holes. Furthermore, one can see the dust, dirt and adhesive that covered the fiber as shown in Fig. 4.

3.2. X-ray diffraction analysis

X-ray diffraction of fabrics was carried out with a SIEMENS X-Ray Diffractometer–D 5000, given 40 Kv CU Ka, radiation of 30 mA.

Fig. 2. The figure shows different type of deteriorations such as dust, grease, losses, separated parts, weakened fibers, and brittleness combined with old adhesives, old cardboard support and other previous repairs.
Fig. 3. The figure shows SEM images of examined Ottoman textile. One can see that the fibers are extremely roughened, damaged, broken with transverse cracking and longitudinal splitting characterized by small scratches, small slits and holes.

The diffractograms were recorded over 2θ = 50 to 300 continuously at a scan rate of 20/min. to show the kinds of mordent (Alum) and dust (sand) [6,7].

3.3. Fourier Transform infrared spectral analysis (FTIR)

FTIR analysis of solid phase samples can be typically performed using two different methodologies. The first, more traditional and widely used approach, FTIR–KBr, utilises a pellet of potassium bromide (KBr) which is transparent in the mid-infrared region, as a support medium for the sample. The mixture is usually ground with an agate mortar and pestle and subjected to a pressure of about 10tonne in an evacuated die. This sinters the mixture and produces a clear transparent disc, which is then placed in the sample chamber of the spectrometer for direct absorption measurements. The second, more recent approach is termed FTIR–ATR. This utilises

Fig. 4. The figure shows SEM images of examined Ottoman textile, one can see different types of dirt and stain (A and B). Also, we can see old adhesive that covered the fibers (C and D).
an attenuated total reflection (ATR) accessory which operates by measuring the changes that occur in a totally internally reflected infrared beam when the beam comes into contact with a sample. An infrared beam is directed onto an optically dense crystal with a high refractive index at an angle greater than the critical angle for total internal reflection. This internal reflectance creates an evanescent wave that extends beyond the surface of the crystal into the sample held in contact with the crystal. This evanescent wave protrudes only a few microns beyond the crystal surface and into the sample [9,10]. These FTIR spectra were obtained using a BRUKER–FTIR- TENSOR 27 Spectrometer. An expanded spectrum in the 4000–400 cm⁻¹ range was used for measuring several factors with a spectral resolution of 4 cm⁻¹. Each spectrum was the result of an average of 16 scans.

We took small samples of different colors and investigated them. Then, we brought all the dyes which give this color and investigated them. After that, we compared the original samples with new dyes to find the following: (Red color is Cochineal dye–Yellow color is Safflower dye–Blue color is Indigo dye–Green color is a mixture between Indigo and Turmeric dye–the adhesive is the Arab gum adhesive) as shown in Fig. 5. Furthermore, no mordants were found with FTIR analyses.

3.4. Testing the stability of dyes

The dry fabric (the object) was softened by spraying distilled water, to counter its extremely dry condition. The next step was to test the stability of the colored parts to wet cleaning by immersing a piece of cotton wrapped round a wooden stick into the cleaning solutions and placing it in contact with the colorful parts of the ribbons, each color was individually tested. It was found that all the dyes were stable and did not bleed with the wet cleaning solution. The final step was to apply a primary support to the Ottoman textile by placing it between two webbed support fabrics, and stabilizing the fabric by fixing it to the support fabric, using appropriately thin needles and fine silk thread in order to protect the vulnerable part of the textile from disintegrating during the different cleaning processes [11,12].

4. Removal of the old restoration error

In the beginning, the old glass plate over the object was removed. The object in the case showed severe dryness. Hence, the water sprayed over the object to moisten it. Then, the old adhesive and old cardboard were removed. There are two methods to remove the old adhesive and the cardboard.

4.1. Traditional method

Wet the upper surface of cardboard by warm water, then leave it for 10 mins until water penetrates the cardboard and dissolve the adhesive. After that, remove wet parts carefully. This method does not remove all the sticking cardboard from the textile.
4.2. Using poultice to separate adhered cardboard

Application of a poultice locally on the textile within the pasted area, allows the moisture to migrate vertically through the poultice to cardboard. The acid free paper (blotter) is a multilayer paper that has been especially designed for poulticing. In order to achieve an even decomposition of the paste, it is necessary to guarantee undisturbed and homogenous migration of water. Firstly, place an acid paper free on the upper surface of cardboard. Then, wet it by warm water, and leave it for 10 mins to permit water to penetrate and dissolve the adhesive. Finally remove the poulticing from the cardboard, and that will remove the sticking cardboard and adhesive. The use of poultices would appear to be particularly suitable when a localized treatment is necessary to remove all the sticking cardboard and adhesive as shown in Fig. 6 [13].

5. Cleaning procedure

5.1. Mechanical cleaning

Various types of fine brushes are used to remove free dust and dirt (i.e., not attached to textile fibers). Aerobic aspiration of dust was done by using a vacuum cleaner [3].

5.2. The wet cleaning procedure

This cleaning procedure used water with other detergent agents, to assist the cleaning process. The ratio was one part detergent Symperonic N to 100 parts of distilled water. The water was agitated to allow it to penetrate between the fibers to release the dirt particles, for 15 mins. The bath temperature was 30 °C. Then a second cleaning bath with distilled water only was applied for 10 mins again with water agitation, and then a third bath with distilled water only, for 10 mins as shown in Fig. 7. The wet cleaning reduced the soiling, relaxed the fibers, removed the creasing and brightened the colors [3,14,15].

6. The drying process

To dry the object without distortions, we experimented with a Japanese tissue sandwich using different tissues (usugami or
Fig. 8. The figure shows the steps of fixing the linen support to the metallic frame. The metallic frame, one can see the rings were fixed on this perforation for easy stretching on the metallic frame (A). Thick cotton thread was used for fixing the linen support on the metallic frame (B and C). A linen support was used after supporting the edges which were perforated after fixing on the metallic frame (D).

8. Dying procedure of new parts

8.1. Blue color with indigo on silk

Stir 15 g of indigo powder with 75 ml of warm water in beaker glass until it forms a paste. In a second vessel, dissolve 30 g of soda in 120 ml of warm water. Pour 60–70 ml of this solution over the indigo paste and stir vigorously. Then add 30 g of sodium dithionite and stir again. Add one liter of warm water and stir carefully until the whole is thoroughly mixed. Heat this mixture to 55 °C. The liquid should now have a yellowish color. When it is left standing for 20 mins, the color will have turned yellow-green. Add 30 g of sodium dithionite to the solution.

Heats the 1 L dye bath to 55 °C. Immerse 30 g of silk fabric in warm water until the material is thoroughly wet, and then enter it into the dyeing liquor. Let the dye bath stand still, so that no oxygen can enter into the vat. Keep the silk fabric in the vat for 20 mins, and then take it out of the vat and squeeze the liquor out thoroughly. When the silk comes out of the vat, it will have a green-yellow color, which turns blue when the fabric is exposed to the air. After 20 mins, the silk is completely blue. Rinse thoroughly with water, but only after the fabric has dried completely. In order to obtain a deeper shade, dip the silk fabric into the liquor again and take it out...
8.1.2. Green color with indigo and turmeric dye on silk

Silk dyed fabric with indigo was immersed again in Turmeric dye. The dyeing with Turmeric dye was carried out according to the following steps:

- prepare a 10% dye in water solution;
- soak the dyes in the distilled water for 24 h to extract the color from the powder;
- heating the extract to the boiling temperature for 2 h with continuous stirring. It may require addition of water to compensate the evaporated water during the heating process;
- allow the extract to be cooled and then filtered many times to get a clear colored solution.

8.1.2.1. Dyeing procedures. The dyeings were performed by the exhaustion method using a liquor ratio (LR) of 1:20 (1 g of fabric per 20 ml of bath). The dyeing experiments were performed in glass beakers according to the temperature-dyeing diagram given in Fig. 9. In the experiments mordant (alum), was added as concen-
8.2. Completion of the separate parts

The margins were weak and stiff. The stiffness was removed by water and the back of these margins were lined from four sides by a linen band of 5 cm width fixed under the margins including the separated edge and the rest of the textile. Fine silky stitches, which have the same color of the part we wanted to support, were used. At first, a piece of the linen band is fixed under the textile, and then the separated edge is moved to the textile and fixed to the linen band. Small stitches are used to stitch the edge and textile together.

8.3. Completion of the lost parts

The lost parts were completed using silk parts of similar color which were slightly lighter. These added dyed parts should be between the linen band (used to support the edges) and the body of the textile, i.e., below the lost part where the dyed parts are slightly larger in size than the lost parts.

The added parts have been fixed by fine stitches of silk dyed by the same color. When the lost part is free, i.e., present at the textile margin to the outside, the silky parts are fixed at first to the linen band by fine stitches followed by adjustment of the band under the lost part to be fixed by fine stitches in the back using silk thread that has the same color of lost part a shown in Figs. 10 and 11 [3,16].

8.4. Fixing the linen support to the metallic frame

A linen support was used after supporting the edges which were perforated. Then, rings were fixed on this perforation for easy stretching on the metallic frame. Thick cotton thread was used for fixing the linen support on the metallic frame (Fig. 8).

8.5. The final support process

After completion of the object treatment, tacking stitches were used with a very fine needle and fine silk thread to fix it into the object. In the beginning of the final stage, the edges of the object all around were attached by sewing with a small stitch technique (blanket stitch) and afterwards the edges of the missing and vulnerable parts were attached by small stitches. Similarly, sized stitches were used to attach the body of the object. The sleeves were supported by attaching them to new linen fabric. After completing the cleaning process and fixing the object, it could be displayed in a suitable manner according to the museum requirements. One can see the object in final stage in Fig. 12 [21].

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References