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Investigation and Conservation of a Historical Woman's Coat Decorated with Fur Parts

Omar Abdel-Kareem
Conservation Department
Faculty of Archaeology
Cairo University
Omaa67@yahoo.com

ABSTRACT

Treatment, preservation, restoration, display and storage of composite objects such as historical costumes are not easy subjects. The type of materials such as fibers, dyes, finishes, leather, fur, paper and metal threads, and the complexity of structure make the risk of damage too great. Most of methods that are commonly used in the conservation of historical textile objects are designed for flat textiles. Many costume items can be safely conserved by using special conservation processes adapted and designed for historical three-dimension textile objects. This study aims to establish a strategic plan for the conservation of a historical outdoor woman's coat. Also to develop and adapt some textile conservation processes which could be applied to the conservation of historical costumes containing different materials. The coat was investigated using different methods such as SEM and HPLC. Examination of the woman's coat indicated that the object was very soiled with additional stains and extensive damage especially to the decoration and fur parts. Given the condition of the object some suggested cleaning methods were evaluated to predict the most suitable method that can be used for cleaning of this object from dirt and soils. A further study was carried out to evaluate some selected methods suggested to reinforce the coat. The study recommends that surface cleaning with suitable chemicals can be used locally to remove staining. After cleaning the object, the consolidation process can be adapted to mount the object on a new linen fabric with stitches. The woman's coat should be displayed according to standard methods that are recommended for displaying the three dimensional textiles. Finally guidelines are suggested for controlling and preventing the deterioration of the coat in a display showcase.

Keywords: Historical woman's coat, conservation processes, SEM, HPLC, surface cleaning, mounting, stitches, display

1. INTRODUCTION

Composite or mixed media objects which are made up of two or more materials are considered challenging for curators and conservators. This is because the composite or multi media objects are more sensitive to deterioration factors. Depending on their materials, composite objects may have characteristics of both organic and inorganic objects. The individual materials in the object will react with the environment in different ways. Also, different materials may react in opposition to each other, setting up physical stress and causing chemical interactions that cause deterioration (Abdel-Kareem, 2008).

The most common treatments of museum textile objects include cleaning, stabilization, exhibition and storage (Abdel-Kareem, 2002). Identification of the nature of the materials that constitute a textile object is an essential prior step for establishing effective conservation treatment (Timar-Balazsy and Eastop, 1998), and if possible should be carried out using non-destructive methods (Abdel-Kareem and Al-Saad, 2009). The conservation of historical textiles always involves a compromise between preservation of evidence and enhancement of the long-term preservation of the constituent materials (Timar-Balazsy and Eastop, 1998). We have to compare an effective treatment such as soil removal against the possible damage caused by cleaning (Timar-Balazsy, et al, 1993, Abdel-Kareem, et al, 2008). Conservation of composite or mixed media objects is a complex operation. This is because materials and methods that are suitable to treat one component may be harmful for other components. Therefore, it is essential to find a conservation process and materials that respect the integrity of the object and can preserve all components (Abdel-Kareem and Al-Saad, 2007).

This study is a case history which illustrates the wide range of materials that are present in this textile object, and demonstrates the importance of understanding the properties of these component materials when formulating conservation strategies for this object. The main aim of this study is to develop and establish a strategic plan for conservation of a historical outdoor woman's coat in the Museum of Jordanian Heritage. This case study will be a guide for the conservators who seek to investigate, treat, conserve, display and store historical dresses and costumes containing different materials similar to this object.

2. Methodology

2.1 Description of woman's coat: The studied object is an outdoor woman's coat in bluish green color dated to the late Ottoman period (see figure 1). It is displayed in the Museum of Jordanian Heritage at Yarmouk University. It is displayed in very poor condition in a showcase that has no climatic control.

Figure 1. The studied woman's coat

The coat became degraded and broken but it still in fair condition enough to allow it to be handled and investigated. The visual inspection of the coat shows that there is a large amount of dust and dirt accumulated on the coat. This may be mainly due to many years of exhibition in the museum under unsuitable and uncontrolled environment. The coat is extremely degraded especially the fur and in very poor condition. The coat suffered greatly from time and poor display conditions with various other objects in one showcase (Abdel-Kareem and Al-Saad, 2007). Nevertheless, the furs are relatively more brittle and covered by dust and various residues. The fur is in very poor condition. There are many missing parts in the fur and some signs of the biological infestations (see figures 2-3).

Figure 2. Details from figure 1 show an example of signs of biological infestations on the coat

Figure 3. Details from figure 1 show some examples of broken, degraded and looses parts

2.2 Scientific Examination of woman's coat:

2.2.1 Samples: Small samples were taken from both the fur and the textile fabric and subjected for further investigation using the following scientific techniques:

2.2.2 Scanning Electron Microscopy (SEM): All samples collected from both the fabric and the fur were investigated by Scanning Electron Microscope (SEM) with energy-dispersive x-ray analyzer (EDX). FEI Quanta 200 Netherlands Scanning Electron Microscope equipped with EDAX for x-ray microanalysis was used to study the surface morphology of all tested samples.

2.2.3 High Performance Liquid Chromatography (HPLC): Dyes on the tested samples were identified with HPLC Technique according the protocol used by Karapanagiotis, et al, 2009. The standard HCl extraction process, which is widely adopted to extract the organic colorants from a textile substrate (Wouters, et al, 2004), was employed to treat the samples.

The process is summarized as follows: (i) sample is immersed in H_2O: MeOH: 37 % HCl (1:1:2, v/v/v) at a ratio of 400 µL/1 mg sample at 100 °C for 15 min. (ii) The liquid phase is evaporated (60 °C) under a gentle nitrogen flow. (iii) The dry residue is dissolved in DMF at a ratio of 1 mL/1 mg sample. (iv) Sample is then centrifuged and 20 µl of the supernatant were injected into the HPLC column. Analysis was carried out with the aid of an HPLC system (GBC, Australia) which consists of pump, a Rheodyne Injector type 7125 with a 20 µl sample loop, a column oven type GBC (TC 300 Controller/Australia) and a Diode Array Detector (DAD) type Knauer 2800 (Germany). The column used was Hypersil Gold C18 (Phenomenex, USA) 250x 4.6 mm (5 µm particle size). The temperature of the column was 40 ºC. Isocratic elution was performed using a solvent mixture of Acetonitrile/water/methanol (40:38:22%) + 0.1% trifluoroacetic acid as eluent at a flow rate of 1.0 mL/min (Karapanagiotis, et al, 2009).

2.3 Evaluating the suggested cleaning process: Low powered vacuum suction and a soft brush are used on a small part of the fabric according to Abdel-Kareem, 2002. The cleaning with low suction cleaner is one of the most common and safe methods that can be used for removing accumulated dust on textile objects (Landi, 1998). The same process is carried out on a small part of the fur but further cleaning has been applied using cotton wool (cotton fiber) swabs moisten with industrial methylated spirit (IMS: 95% ethanol, 5% methanol). The efficiency of the suggested cleaning method on both the fur and fabric was evaluated visually and using a scanning electron microscope (SEM). The scanning electron microscope (SEM) investigation was carried out for all tested samples using SEM Model FEI Quanta 200 Netherlands Scanning Electron Microscope equipped with EDAX for x-ray microanalysis. SEM-EDX analysis was applied to samples to examine the composition of samples before and after cleaning.

2.4 Evaluating the suggested adhesive for stabilization process: The results of investigation methods showed that there is a necessity to reattach the very degraded and looses parts of the fur to the ground fabric using a suitable adhesive. So that in this study a modified formula of an adhesive commonly used in the conservation of leather and textile was tested. The tested adhesive is Klucel G which is confirmed to be very good polymer that can be used as an adhesive and to consolidate in textile conservation (Abdel-Kareem, 2000). Neo-Desogen (fungicide) was added to Klucel G to improve the resistance of the polymer against biological attack. This is because the results of the investigation showed that there is a noticeable biological infestation on the coat. It is confirmed that the suggested formula of Klucel G and Neo-Desogen is very effective for reinforcement the biodeteriorated textiles (Abdel-Kareem, 2009).

Cotton textile samples were treated with the suggested polymer by using impregnation method according to Abdel-Kareem, 2005. The treated and untreated (control) cotton samples were artificially aged by light. For ageing by exposure to light, tests were carried according to international standard tests for color fastness (ISO 105-B02:1994). The treated and untreated (control) cotton samples were mounted in standard specimen holders and were exposed to light irradiation for 80 hours. Irradiation of the samples was carried out using the Atlas Light Fastness Tester.

The type of Atlas Fade-Ometer used in this study is XENOTEST®150S^{+}). A light filter was used to simulate light in museums. Exposure conditions were 50ºC and 55% of RH. The effect of the suggested adhesive on the surface morphology of treated cotton fabric was investigated using SEM as mentioned before. Also the tensile strength and elongation of the treated and untreated cotton samples before and after ageing were measured by using a testing machine, type Zwick 1445. These tests were done according to ASTM (2000) D 5035-95). The initial jaw spacing was 50 mm and the test speed was 25 mm/min, temperature was 23 °C, and R.H. 65%.

3. RESULTS AND DISCUSSION

3.1 Scientific Examination of the woman's coat: The results of observation of the surface morphology of textile fibers reveal that the yarns of both warp and weft of the textile fabric are composed of cotton (see figure 4). The fibers are deteriorated and dirty. Some parts of the coat fabric especially in the selvages reveal a high degree of weakening and damaging. However the results showed that most of the whole fabric is in a fair condition. The results of EDX analysis show that there are intense accumulations of dust on the surface of fibers (see figure 5). This result confirms that the coat is too dirty.

Observation of the surface morphology of samples collected from the fur parts reveals a high degree of weakening, degradation and damage. Scanning electron microscopic (SEM) images show that the fur

surface is extremely rough, opaque and covered with a big layer of dust (see figures 6-8). The results of EDX analysis show that there are intense accumulations of dust on the surface of fibers (see figure 9). SEM images and EDX analysis results show that there is intense accumulation of dust on the surface of the fur. The results confirm that all parts of the coat especially the fur parts are subject to physical abrasion and damage by dust and gritty particles. These particles in combination with air pollutants may accelerate the rate of chemical reactions then accelerate its deterioration **(**National Park Service NPS, 1999). EDX analysis exhibits many of elements which come from the environment. Some of them have high wt% such as Si and Ca, these two elements and others Mg, Al, K and Cl cause damage to fibers if accumulated over a long time.

These results are in agreement with the results obtained by Khasawneh and Al-Saad, 2006, who showed that the environment of Museum of Jordanian Heritage is infected by soiling particulates. They mentioned the main components and minerals which were found in samples taken from the museum and examined under XRD are: (Calcite $CaCO_3$) the main components of Limestone used as building materials in the museum resulted by total dissolved solids presented in contaminated groundwater or enter to museum either by wind or by visitor clothes. (Quartz SiO_2) found in the air which is possibly a result of weathering of rocks transferred from their source by the wind or by rain falls to other places. (Gypsum $CaSO_4.2H2O$) as a contamination particles in the museum environment that resulted from chemical reactions between calcite as an essential building materials and SO_2 and SO_3 resulting from car exhausts and through the wastes and fume during cooking process from restaurants in nearby Gamaa street or may from the effects of microbiological factors especially that resulted from Sulphur oxidation which affect decomposition and disintegration of different building materials especially in humid environment through fixation of Carbon dioxide and oxidation Sulphur compounds. According to the obtained compounds in the dust especially calcite these accumulation dust may become attached to surfaces at high humidity (Brimblecombe, et al, 2008).

The results of dye analysis of the green color show that it is a mixed dye from indigo and yellow dye. Indigotin source is the main component of blue dye (see figure 10). Crocetin dyestuff is the main component of saffron as yellow dye. Also alizarin was identified used for red color in the lining fabric.

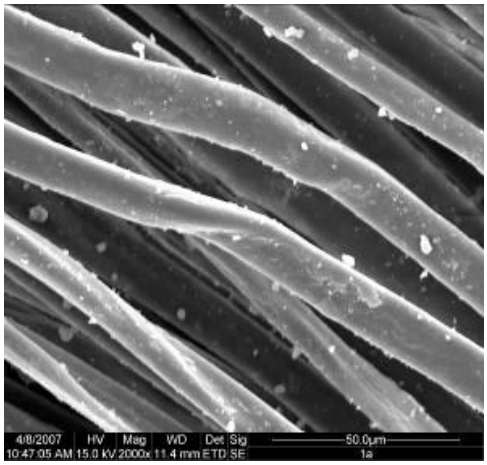

Figure 4. SEM Image shows that the fabric compose of cotton fibers

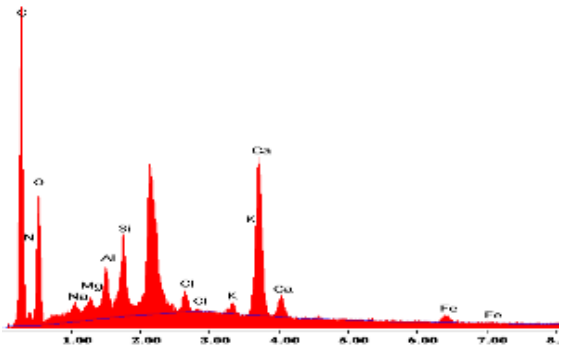

Figure 5. EDX analysis of the chemical composition (Wt %) of the cotton surface show that it is too dirty

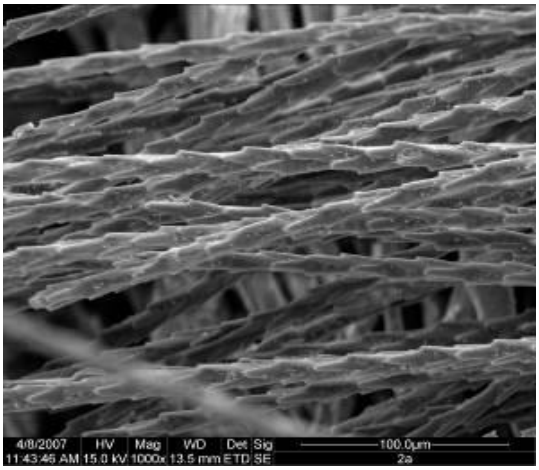

Figure 6. SEM Image show that the fur is too dirty

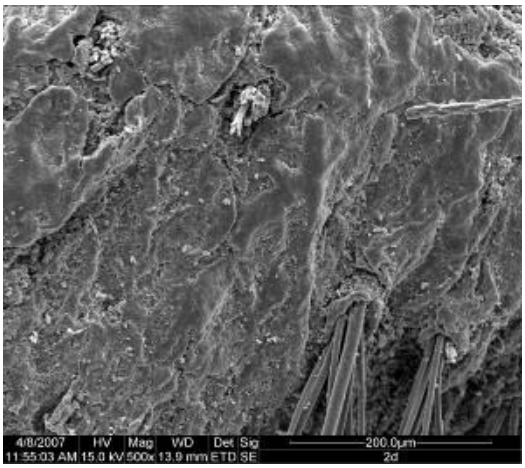

Figure 7. SEM Image show the abrasive surface of the fur and that the hair surface was lost

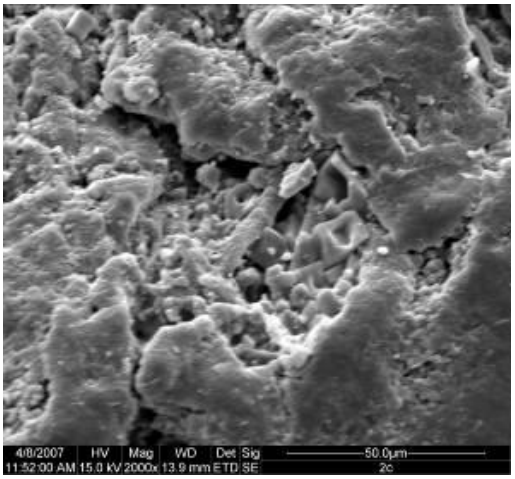

Figure 8. SEM Image show the damage in the lower surface of the fur

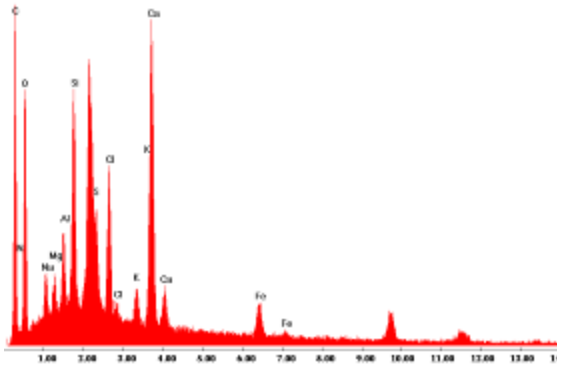

Figure 9. EDX analysis of the chemical composition (Wt %) of the fur surface show that it is too dirty

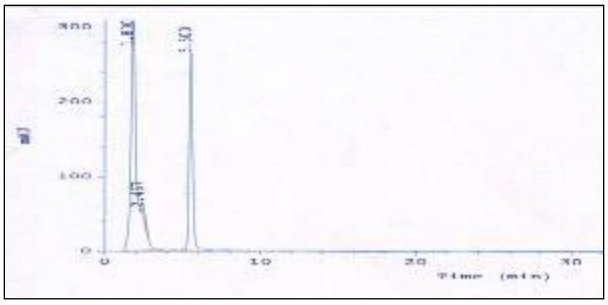

Figure 10. HPLC- PDA Chromatogram of the green dye

3.2 Evaluating the suggested cleaning process: The results of visual investigation of both the fur and the textile fabric after cleaning show that there is an obvious improvement in the appearance of the surface of both the fur and the textile fabric. Most of the dusts and dirt were removed from the surface of them. They became smooth and appeared in colors near to their original color. The results of the SEM investigation of both the fur and the textile fabric after cleaning show that there is an obvious improvement in the appearance of the surface of all tested samples (the fur and textile fabrics after cleaning (see figures 11-12). The results show that the dust product layers on the surface were removed successfully without any apparent damage.

The results of the EDX analysis of both the fur and the textile fabric after cleaning confirm that there is a noticeable reduction in contamination elements on the surface after the cleaning (see figures 13-

14). The results show that the wt% of the main components of the chemical composition of the fur such as C, N, and S were increased. Also the wt% of the main components of the chemical composition of the cotton fabric such as C and O were increased. In the other side all contaminating elements such as Ca, Si and Al were obviously decreased. These results confirm that all tested samples became very clean. These results confirm that the tested cleaning methods are suitable effective, safe and acceptable methods that can be applied to the cleaning of the studied coat.

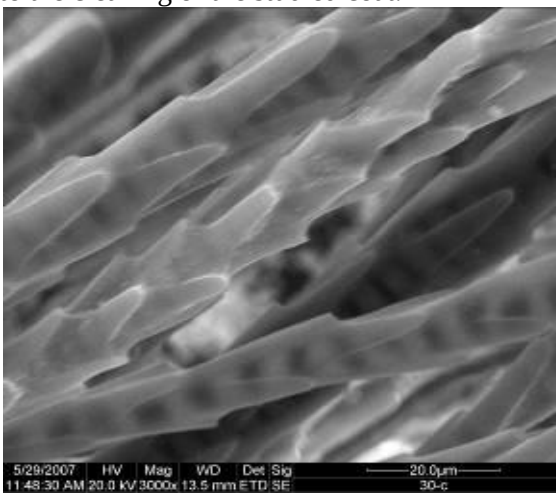

Figure 11. SEM Image of the fur after the clean test

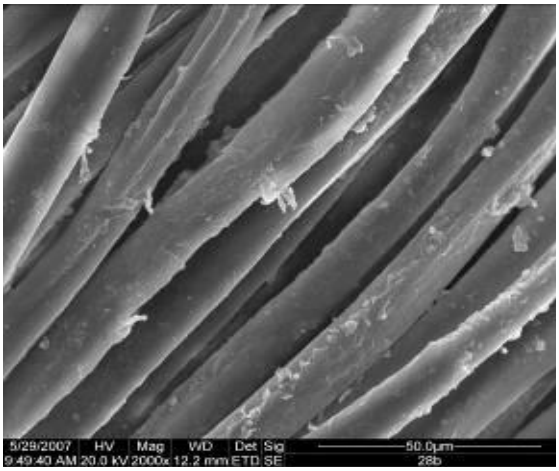

Figure 12. SEM Image of the fabric after the clean test

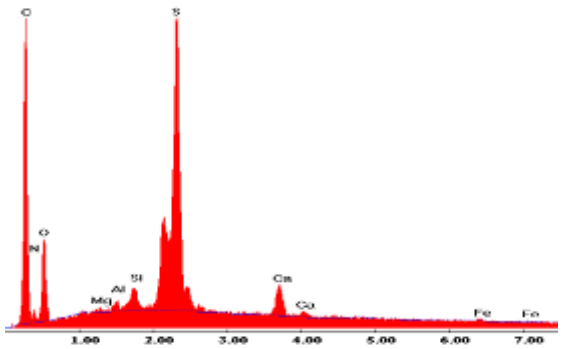

Figure 13. EDX analysis of the chemical composition (Wt %) of the fur surface after cleaning test

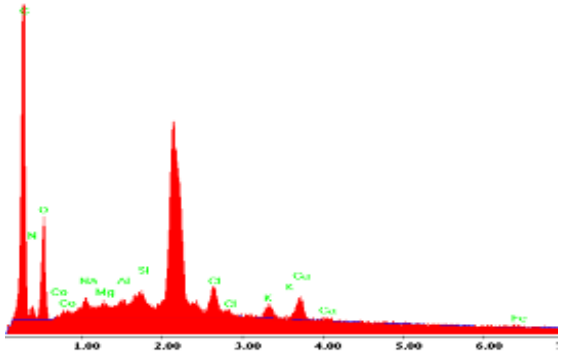

Figure 14. EDX analysis of the chemical composition (Wt %) of the cotton fabric surface after cleaning test

3.3 Evaluating the suggested adhesive for stabilization process: The results of visual investigation of the samples treated with the suggested formula of the tested adhesive showed that there is no change in the color of samples after the treatment and also after the light ageing. Also the results of SEM of the surface morphology of the treated cotton samples show that there is no damage or changes to the surface. The results show that there is a thin layer of coating of the adhesive cover the cotton fibers but at the same time the appearance of cotton fibers is still satisfactory (see figure15).

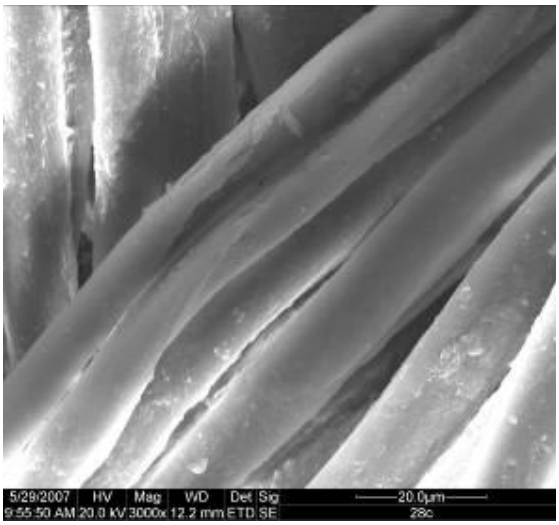

Figure 15. SEM Image of cotton textile sample after treated with the suggested adhesive

These results were confirmed by the results of tensile strength and elongation of the untreated and treated cotton textile samples that show that there are noticeable improvements in the cotton textile samples after the treatment with the suggested adhesive (see tables 1, 2). The results of the tensile strength and the elongation of cotton textile samples after the light ageing show that the samples have retained in good properties after the light ageing. These results indicate that the suggested adhesive is good on the long term. These results indicate that the suggested polymer is suitable, effective and acceptable for the use in conservation of the investigated coat.

Table 1. Tensile strength of consolidated samples

	Control		After Ageing	
	N/mm^2	S.D.	N/mm^2	S.D.
Untreated	76.04	2.34	52.40	2.06
Treated	87.68	2.25	64.40	3.07

Table 2. Elongation of consolidated samples

	Control		After Ageing	
	F max%	S.D.	F max%	S.D.
Untreated	19.80	1.17	16.40	1.74
Treated	22.40	1.85	18.80	1.60

4. STRATEGIC PLAN FOR CONSERVATION

The results of investigation methods show that the investigated coat is in poor condition. The usual problems of organic objects are illustrated on the coat: fading, dust, pollution damage and biological infestations and loss of parts. Both the textile fabric and the fur have extensive dirt deposition. The dirt accumulation is mainly due to air particulates and pollutants coming from the display case environment. The fur parts suffer from additional problems such as hair loss, damage to skin, biological infestations, and mechanical damage from wear. The main aim of any proposed treatments is to improve the long-term preservation of the coat by making it safe and pleasing for display. To achieve this aim the conservation plan has to include various conservation processes as follows: (1) Cleaning of the coat using methods not harmful to both textile fabrics and the fur parts. (2) Reinforcement of the coat by lining it on a new dress with needle work to improve its strength during display. (3) Stabilization of the weak, lost parts and missing areas of the fur and textile fabric. (4) Displaying the coat in proper showcases in controlled environmental conditions. The provision of a display mount would both show the object to advantage and give it full and safe support. Finally a conservation plan should be focused on the causes that led to the deterioration and damage of the coat. The long-term preservation of coat can be achieved by eliminating and/or monitoring and controlling the deterioration factors.

4.1 Cleaning: The aim of conservation cleaning is to remove harmful soils, which may be disfiguring or cause physical or chemical damage to the coat. Selection of the appropriate cleaning method depends on the nature of the soil present, materials, structure, and condition of the coat (Lister, 1996). The results of investigation methods show that the major problem on the coat is accumulation of dust on the surface of both the fur and the fabric. The accumulation of

dust on objects detracts from visual appearance and necessitates cleaning to maintain the artistic worth and public acceptability. It is observed that dust becomes more strongly bound to surfaces over time (Brimblecombe, et al, 2008). According to the results of this investigation of the condition of both the fabric and the fur, it is clear that the coat can be cleaned by low vacuum suction as most of dirt on the coat is loose dust that can be vacuumed to remove loose dust and insect frass. Also the results of this investigation suggested that the cleaning process that was carried out in this study on a small area on the surface of both the fur and the fabric confirmed that most of the dust can be cleaned safely using the suggested cleaning method. The outside has to be lightly brushed with a paintbrush and any loose dust will be vacuumed away. All particle soils should be removed from both the face and reverse the coat. This process should be applied through gauze or net fabrics under binocular microscope. The procedure should be repeated many times to ensure that all loose dust has been completely removed. The cleaning with low suction cleaner is one of the most common and safe methods that can be applied in cleaning of metal embroidered textile objects (Landi, 1998 and Timar-Balazsy and Eastop, 1998). However unregulated suction can be very dangerous, and must not be so strong so as to pick up the object by holding it against the nozzle (Landi, 1998).

4.2 Reinforcement of the coat: The results of the present study confirm that a complete lining attached to the back of the coat is required to stabilize the loose elements and to support the coat while its display. Careful and appropriate mounting provides the coat with additional overall support, reduces the tension on weakened areas, and enables it to be displayed and handled with the minimal amount of stress. The complete mounting carries the overall stress and strain of the weight of the coat while hanging during display. The study suggests that the coat has to be laid onto, a fine, tabby weave linen textile fabric (in its most natural state, with no added chemical substances) **(**Flury-Lemberg, 2009). The backing mounting dress has to be attached with the coat using fine needles and silk threads. The silk threads should be dyed with colors to match each area. The dyes should be natural dyes according to the results obtained by Abdel-Kareem, 2009). Different stitches can be used in this work. Running stitches can be used to join the linen fabric to the coat fabric. The damaged areas can be stitched using couching stitches. The edges of lost areas can be mounted and stitched on new linen patches using herringbone stitches (Landi, 1998).

4.3 Stabilization the weak, losses parts and missing areas of the fur: To stabilize damaged areas and to provide additional strength for the fur is an essential conservation step. This treatment involves placing a layer of new silk fabric behind damaged section and securing it in place with conservation stitching or selected adhesives. The fabrics and threads used should be sympathetic in appearance and color to the fur and the original fabric, and the support treatment should be unobtrusive while remaining apparent to an experienced eye (Lister, 1996). It is recommended to stabilize the lost parts of the fur using the suggested adhesives to avoid any damage can be done to the skin layer due to use the needle and stitching. The suggested adhesive can be applied using reactivation method (Takami, 2002, Abdel-Kareem, et al, 2008).

4.4 Display: All textile objects to be considered for display should be examined to determine that they are in good enough condition to be safely displayed. A textile object such as the carried coat which is so deteriorated that the fibers are brittle or fragile not be displayed unless it receives a mounting (Abdel-Kareem, 2002). The study suggests a complete appropriate mounting that provides the coat with additional overall support. Display of costume presents a range of curatorial and conservation challenges, often necessitating compromise to achieve an appropriate balance between presentation

and preservation. The vulnerability of costume means that damaging factors must be eliminated or reduced as far as possible. For this reason costumes are not kept on display for extended period (Museums & Galleries Commission, 1998). Three dimensional textiles can be supported on specially shaped forms made of soft inert materials (Kite, 1999). The study suggests displaying the coat on a mannequin. However, mounting a costume on mannequins requires skill and time (Museums & Galleries Commission, 1998). It is very important that the materials selected to prepare the mannequin should be good and do not cause any harm to the textile objects and the fur (Lee and Thickett, 1996). A mannequin can be constructed to the appropriate size to support and display the coat. The mannequin should be dressed with an unfinished molleton (thick, soft flannel). Its visible parts (neck, sides) should be covered with a fabric similar to fabric used in the ground of the display showcase. Finally the coat should be displayed in standard showcase with standard appropriate environmental conditions (Abdel-Kareem, 2002). The coat should be periodically inspected for any signs of physical or chemical deterioration (Museums & Galleries Commission, 1998).

5. CONCLUSIONS

The investigated coat is in poor condition. The usual problems of organic objects are illustrated on the coat: fading, dust, pollution damage and biological infestations and lost parts. Both the textile fabric and the fur have extensive dirt deposition. The coat fabric is made from cotton fabric dyed with green color composed of indigotin and saffron. The proper conservation approach for both fabric and the fur should be include various steps such as cleaning, reinforcement, stabilization and display methods. Both the cleaning method and the suggested adhesive investigated in this study are suitable, effective and acceptable for the use in conservation of the investigated Historical Woman's Coat.

6. REFERENCES

[1]. Abdel-Kareem, O., (2008): Laser Cleaning of the Museum Composite Objects, In: The Fourth International Conference of Scientific Research and its Applications, 16-18 December, 2008, Cairo University.

[2]. Abdel-Kareem, O., (2002): The Guid in Treatment Conservation of Ancient Textiles, Cairo, 2002.

[3]. Timar-Balazsy, A., and Eastop, D. (1998): Chemical Principles of Textile Conservation, Butterworth.

[4]. Abdel-Kareem, O., Al-Saad, Z., (2009): Application of Minimal Invasive Methods in Investigation and Estimating the Condition of Historical Textiles, in, ArtTech 09, 1-2 June 2009, Cairo, Egypt.

[5]. Timar-Balazsy, A., Matefy, G., Csanyi, S., (1993): Effect of Stains Removal on Historical Textiles, In: ICOM Committee for Conservation, pp.329 - 335.

[6]. Abdel-Kareem, O., Zidan, Y., Lokma, N., Ahmed, H., (2008): Conservation of A Rare Painted Ancient Egyptian Textile Object from the Egyptian Museum in Cairo, In: e-PRESERVATIONScience Journal, 2008, 5, pp. 1-9.

[7]. Abdel-Kareem, O., and Al-Saad, Z., (2007): Conservation Strategy of Metal Embroidery Threads in Textile Objects in Museum of Jordanian Heritage, In: The International Conference on Conservation Strategies for Saving Indoor Metallic Collections (CSSIM), With A One Day Satellite Meeting On Legal Issues In The Conservation Of Cultural Heritage (LIC – ICOM-CC), Cairo, 25 February–1 March, 2007, pp.1-8.

[8]. Karapanagiotis, I., Mantzouris, I., Chryssoulakis, I., Saadeh, H.A., Alawi, M.A., Mubarak, M.S., Karadag, R., Yurdun, T., AlSaad, Z., Abdel-Kareem, O., Puchinger, L., and Sauter, F., (2009): Inter-Laboratory Chemical Study of Natural Materials from the Historical Wiesner Collection, In: Jordan Journal of Chemistry Vol. 4 No.2, 2009, pp. 195-208

[9]. Wouters, J., Berghe, I., Devia, B., (2004): Understanding Historic Dyeing Technology: A Multifaceted Approach, Post prints of the First Annual Conference 13-15 July 2004, Scientific Analysis of ancient and Historic Textiles: Informing Preservation, Display and Interpretation, , Archetype Publications Ltd, 2005, pp.24-28.

[10]. Landi, S., (1998): The Textile Conservator's Manual, Butterworth & Heinemann.

[11]. Abdel-Kareem, O., (2000): Microbiological studies to evaluate polymers and resins used in consolidation of ancient Egyptian linen textiles. In: Czasopismo Techniczne 1A/2000, Krakow, Poland: Wydawnictwo Politechniki Krakowskiej; 2000. p. 202-211.

[12]. Abdel-Kareem, O., (2009): Fungal Deterioration of Historical Textiles and Approaches for Their Control in Egypt, In: Rozkladi Korozja Mikrobiologiczna Materialow Technicznych, Lodz 2009 Sesja II wyklady plenarne, p.74.

[13]. Abdel-Kareem, O., (2005): The Long-term Effect of Selected Conservation Materials used in Treatment of Museum Artefacts on some Properties of Textiles, In: Polymer Degradation and Stability 87 (2005) 121-130.

[14]. International Standard (ISO 105-B02: 1994), Textiles- Tests for color fastness- Part B02: Color fastness to artificial light: Xenon arc fading lamp test.

[15]. ASTM (2000): Standard test method for breaking force and elongation of textile fabrics (strip method), D 5035-95. In: Annual book of ASTM standards, USA, Vol. 07.02; 2000, pp. 682-688.

[16]. National Park Service (NPS), (1999): Museum Handbook, Part I: Museum Collections Environment. Museum Handbook, Chapter Four, In: http://www.cr.nps.gov/museum/publications/ MHI/CHAPTER4.pdf .

[17]. National Park Service (NPS), (1999): Museum Handbook, Part I: Museum Collections Environment. Museum Handbook, Chapter Four", In: http://www.cr.nps.gov/museum/publications/ MHI/CHAPTER4.pdf.

[18]. Al-Saad, Z., and Khasawneh, T.A., (2006): Museum Environmental Control as a Tool for Preventive Conservation Museum of Jordanian Heritage as Case Study" In: Inter Build 13th International Conference for Building and Construction, Cairo-Egypt, pp. 51-69.

[19]. Brimblecombe, P., Thickett, D., Yoon, Y.H., (2008): The cementation of coarse dust to indoor surfaces, In: Journal of Cultural Heritage 10 (2009) 410– 414.

[20]. Lister, A., (1996): "Guidelines for the Conservation of Textiles", English Heritage, London.

[21]. Flury-Lemberg, M., The Image of a Crucified Man on the Turin Shroud: Measures Taken for Conservation of Legibility of the Body Image, In: Conserving Textiles; Studies in Honour of Agnes Timer-Balazsy, ICCROM, 2009, pp.43-51.

[22]. Abdel-Kareem, O., (2009): Evaluation of the dyes used in conservation and restoration of Archaeological textiles, In: Adumatu Journal, Issue No. 20, pp. 21-36.

[23]. Takami, M., (2002): The Conservation of Korean Painted Silk Banner, C: 1800: Paint analysis and support Via solvent – reactivated acrylic adhesive, Preprints of the 13th Triennial Meeting of the ICOM Committee for Conservation, 2002, 747-751.

[24]. Museums & Galleries Commission, (1998): Standards in the Museum Care of Costume and Textile Collections, Museums & Galleries Commission, UK.

[25]. Kite, M., (1999): The Conservation of a 19th Century Salmon Skin Coat, In: ICOM Committee for Conservation, 1999, pp.691-696.

[26]. Lee, L.R., and Thickett, D., (1996): Selection of Materials for the Storage or Display of Museum Objects, Occasional Paper No.111, British Museum Press, London.

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