

## **Develop new, sustainable treatments for the tears and missing parts of Pharaonic shroud from Ahensia excavation**

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### **Abstract**

This paper deals with a new methodology for consolidation of crumbling archaeological shroud by adding inner layer within the missing parts which is weakening the whole structure of the shroud as time goes by, so this layer was suggested to be a hardener piece, to support the brittle edges of these holes, and prevent the bleeding of yarns from cutting warp threads. This layer was made of meanless yarns separeated obviously from the object. The fragments of the pharoanic shroud were found in "magna" one of the excavation sites in ahensia beni suef, Egypt.. we have no specific date for manufacturing, but it may be dated to the first intermediate period " nine and ten dynasty"during which Ahensia was the capital of Egypt, and lots of tombs were discovered there related to this period, many mummy shrouds were studied theoretically, as small pieces can carry meaningful information and technical point of views by which the shroud performed.

Scientific procedure was followed for treatment of the piece, beginning with identification of raw material and its state of deterioration which performed by stereo microscope ,SEM and colorimetry measurements, to get primary view about the nature of the object, way of performance , and the state of damage. The results reaveal that the object was made of raw linen, indicated to its bad state of damage, dryness yarns and physical changes in its properties, color measurments refer to the dark regions existed all over the pieces as a result of mummificaiton materials,and the yellowish color of the whole linen fiber and the progress achieved after cleaning. Mechanical, chemical cleaning by appropriate brushes and organic solvents were made, results were acceptable especially after washing the piece with moderate soap and distilled water, finally completing the missing part with adding layer of grinding natural fibre, mixing with paraloid B72 dissolving in tuluine 10% was evaluated. Then Fixation on natural linen stretched on wooden frame was done carefully by zigzag stitches. Archeological and a technical study was discussed.

### **Keywords**

linen, analysis, examination, restoration, consolidation.

## Introduction:

Very little monumental evidence survives from first intermediate period, it was a dynamic time where rule of Egypt was roughly equally divided between two competing power bases. One of those bases was at Heracleopolis, a city just south of the Fayoum region called ahensia el-Medina<sup>1,2,3</sup>. This town was a capital of Lower Egypt in the First Intermediate Period.<sup>4</sup> The features of art in the 1st Intermediate Period are often characterized as chaotic and miserable, with degraded art—a dark age<sup>5</sup>, and that interpreted the simplicity of the historical artifacts including textiles which belong to this period. It is known that linen was the most widely used fiber in burial shrouds, according to their believes in the holyness of linen fibers<sup>6</sup>, the majority of linen fibers were made from the plant *Linum Usitatissimum flax*<sup>7</sup>. The most popular technique used for manufacturing the funerary fibers was the tabby weave, extended tabby weave, the basket and half-basket weave<sup>8</sup>. So finding any decoration regions in Funery linen which were used as body packing for carelessly unwrapped mummies was rarely during this period especially for unroyal tombs.<sup>9</sup> Tears and holes are the most dangerous phenomenon existed in archaeological textile, which is causing weakness of the main body, disfigurement of the morphology appearance of linen textile<sup>1</sup>. And attempts to induce consolidation of the whole piece by chemicals doesn't solve the problem<sup>1</sup>, in addition to side effects on the fibers and dyes in future<sup>1</sup>. New technique by using<sup>2</sup> traditional natural material in a new procedures is evaluated by scientists in conservation sciene, stereo microscope, SEM and colorimetry are so important to measures the physical changes in colours and dimension<sup>1</sup>, and illustrate the deformation of the morphology appearance of raw linen and the homogenous layer existed in missing parts<sup>1 1</sup>. It's necessary to prove that this procedure of consolidation by using baralloid B 72 didn't have a bad effects on the original one by the time<sup>1</sup>.

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## 1. Description of archaeological object:

The piece of shroud was found in Magna excavation, ahensia city and was kept at Antiquities Authority stores, Beni Suef, its name was taken from the old greek name " Heracleopolis Magna". The object is considered as evidence for unique type of pharoanic shrouds during the second intermediate period" nine and ten dynasty" in ahensia, during which the features of art was so bad as a result of political corpution. The fragment was made of raw crumping undyed linen. Weaven in plain wave 1/1 technique. its yarns were varied in thickness from 0.5 cm, to the 1.5 cm and direction of manual spinning yarns is toward left side like letter " S" .. the number of Linen threads was 10 in warp and weft. Furthermore five weft yarns were weaved in every one cm, measured by special lens. One can see from the morphology examination that tabby weave was used in manufacturing of shroud ending with selvages at one side of the object, in which the warp yarns are appearing.

These transverse edges were existed in some textiles from this type of textile. It is possible to start and finish with non open fringes made from loose warps(thickened cords), which characterize the Egyptian textiles, in addition to interwoven yarn which are tied to the breast beam, and permanently incorporated into the cloth strands which create a decorative effect and resemble self-bands grouped as shown in fig.1.



Fig.1 shows the characteristic appearance of funerary fragments of shroud

## 2. Documentation of object:

Comparison between the selected object and known ones were excavated from the same site in their morphological properties, kind of material, technique, and state of damage indicated to that piece probably dated to the first intermediate period according to the similarity in site of excavation and features of tabby weave as shown is fig.2.



Fig.2 show the assembling between the selected object and the archaeological collection, which included the textile, was donated to Norwich Castle Museum in 1921.

## 3. State of deterioration:

The piece is suffered from many signs of damage such as holes all over the objects, stains, darkness and fading in natural color of linen, weakened fibers, and hardness, as shown in fig 3



fig 3. Show loose parts, tears, missing parts and darkness

## 4. Materials and methods:

### 4.1 materials:

- Grinding fabric<sup>1</sup>

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- Baraloid B 72 crystal dissolve in acetone<sup>1</sup> .<sup>1</sup>

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### 4.2 Preparing the material:

There are many parts separated obviously from the fragment especially in excavation sites, these small fragments were preparing through many steps:

1. Collect these fragments and washing it carefully by distilled water to emphasis that the fibers is clear from any impurities.
2. Drying them in the normal temperature to avoide shrinkage of fibers.
3. Grinding the drying samples carefully to turn them into soft powder .
4. Mixing 10 gm of fibers powder with 10% of Baraloid B 72 dissolve in acetone.
5. Putting the mixture into holes and spread it carefully on free acidic sheets to obtain small thickness layer as much as possible, then let it drying .
6. The layer stuck with the inside edges of holes and become one unit, taking into consideration difference in color, thickness and touching between the original piece and added one.



fig 4. Show separated part, after grinding and powder sample with Baraloid B72

## 5. Testing and analysis

### 5.1. Morphological study

Three samples were examined, first one was taken of the archeological linen textile , secondly of new linen fibers, the last one of the new layer used in consolidation . All of them were examined using Carl Zeiss c-2000 stereomicroscope(germany)<sup>2</sup> to evaluation state of damage, the mechanism of damage existed in surface, and the homogenous of the material joined to the texture of original objects

### 5.2 Scanning electron microscope:

The same sample was defined by using Scanning Electron Microscope (SEM), Philips XL30,<sup>2</sup> , to determine the kind of fiber and prove the bad condition in which the fragment existed.

### 5.3 Colorimetry measurements:

Colorimetry measurement according to commission internationale de l'Eclairage (CIE) LAB<sup>2</sup> was used to show various coloring shades of linen samples.



## 6. Result and disscussion:

### 6.1 Historical object:

#### 6.1.1 Morphological study

The photos taken by stereo microscope show the fading and brittleness of fibers, in addition to darkeness in many parts of linen, and white deposits between the yarns as shown in fig 5,6 .



fig.5 microscopic photos shows the difference between the new natural linen and the aged one

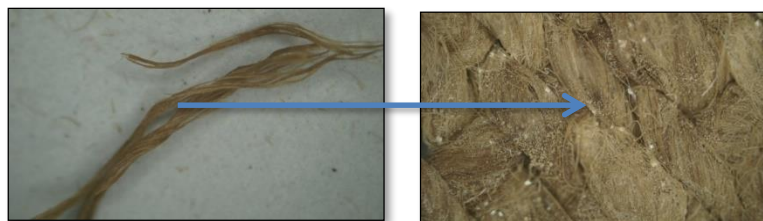


fig.6 shows damage existed in the morphological apperance of archaeological textile

#### 6.1.2 Scanning electron microscope:

The SEM photos prove that the fiber was made of raw linen in its natural color with it morphological properties. The fibers are extremely damaged, there are many longitudinal scratches and holes all over the object, dust and dirt existed above and between yarns as shown in fig.7,8.

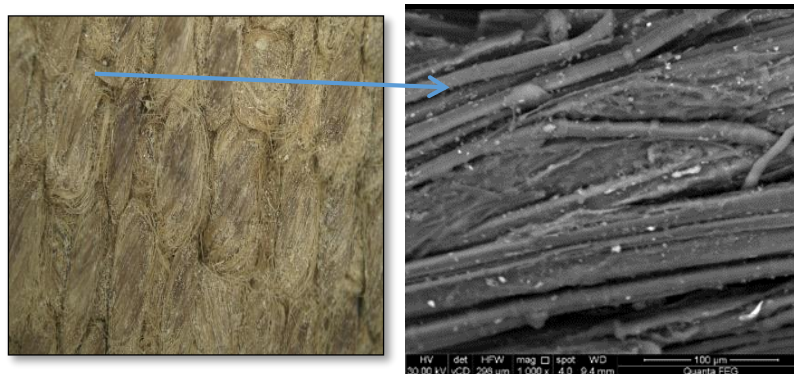


fig.7 microscopic photos show brittleness and absence of morphological appearance of linen fibre

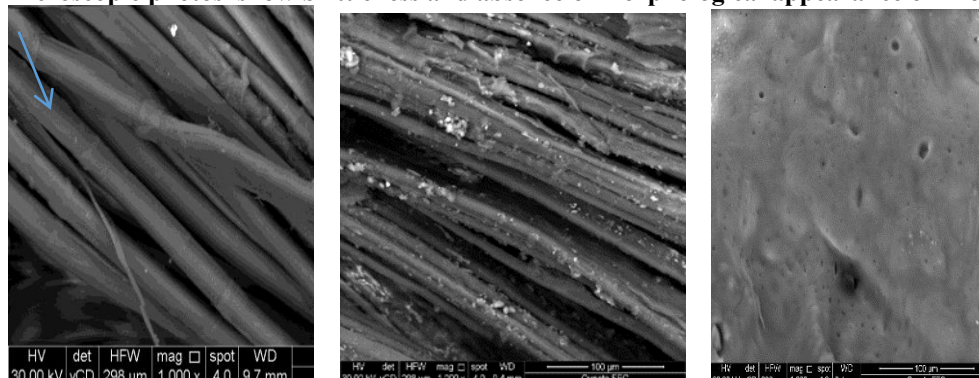


fig.8 microscopic photos show comparison between new, ageing samples and adding layer

### 6.1.3 Colorimetry measurements:

Many measures were taken for obvious three samples: new one, ageing one and adding layer. The readings emphasis the existence of darkness parts in ageing archaeological linen, and proved the efficiency of adding layer, as lightness readings L refer to the little difference between this layer and the ageing one. Furthermore, the readings of A and B of this layer is close to the original parts of the linen textile. This means that the adding layer is similar in appearance to the original one.

**Table.1 colormeasurement readings of new, ageing samples and adding layer**

No. of samples	Kind of samples	L	A	b
1	new linen	70.20	2.81	12.10
2	ageing one	43.88	12.93	24.85
3	adding layer	35.48	2.16	8.65

### 6.2. Treatment methodology:

The aging linen fragments (the object) were softened by spraying distilled water, for three times every 30 m. to get back its moisture content slowly, then covering them with sheets of polyethylene .

#### 6.2.1 Mechanical cleanning:

Different kind of fine brushes were used for removing free dust and dirt (i.e., not attached to textile fibers) professionally, as the fragment was very brittle and crumped, as shown in fig.9.



**fig.9 show chemical cleaning by brushes for removal of the dust and coil**

#### 6.2.2 Chemical cleaning:

Many kind of light solvent were used to remove the darken stains, such as acetone, ethyl alcohol and tolowen, the results were acceptable, as stains were removed partly.

#### 6.2.3Wet cleaning:

Washing procedure were performed by many steps:

1. Prepare a bath for washing the fragment, free acidic sheets for drying process, Net support for keeping the object save during washing step stitched by thin curved needle.

2. Filling the bath with water and detergent agents"(Synperonic N), ". The ratio was very little of detergent one part of saponin to 100 parts of distilled water. Then left it for 20 minutes and rinsed several times to remove the residues of chemicals and detergent used previously.
3. Removing the rest of water existed in textile by paper sheets to prevent any future damage caused by the moisture.

#### 6.2.4 Treatment holes and missing parts:

Filling holes with adding layer was done through many steps beginning with preparing this matrix, which consist of grinding fibres mixed with baraloid B72 in 10% in acetone. The layer completely filled the hole and strengthened its edges as shown in fig 10.



fig.10 shows filling the holes by grinding fibers mixed with baraloid B 72

#### 6.2.5 Permanent consolidation:

Fixing on support of linen is the last important stage of restoration process, as it is necessary for safe transportation of weakened object, display of textile in acceptable way, and support "back" to the original fragment.

Threads of silk and cotton, needles, foam support and natural dyes were used to fix the object, taking into account the visual and chemical compatibility with the original one.

#### There are many steps were performed as following:

1. Sewing the original object temporarily by loose stitches to keep the object stable during fixing process.
2. Couching stitches were used to fix edges of the fragment all around and the edges of the missing parts with a very fine needle and fine undyed silk yarn, afterwards the loose parts were attached by small stitches. The separating threads were fixed in true place with couching stitches after they get wet. It is important to deal with the fabric carefully without any tension on fibres, to avoid breaking old yarns as shown in fig.11.



fig.11 shows preparation of consolidation by fixing on linen support



### 6.2.6 Display of fragments:

Display or storage of the object in an appropriate manner according to their requirements in the museum. Firstly, cutting foam sheets with size of the longest length and width of the fragments. Then adhered the linen support to the foam sheet, prepared obviously with appropriate size to the dimension of linen support, by Baraloid B 72 in concentration 10% as shown in fig.12.



fig.12 shows procedure for final exhibition of the object after treatment

## 7. Discussion and conclusion:

New approach for consolidation and treatment of weaken parts is discussed. Efficiency of reusing useless separated original fibers in completing the missing part of the textile was experimented by many scientific analyses, which prove the possibility of treatment tears and missing part by good manner and natural material. Scientific procedure was followed carefully as we deal with very brittle yarns, beginning with examination and analysis of samples taken from the object by stereo-microscope and SEM, which reveal the weakness and dryness of the yarns. In addition to the difference found in the morphology appearance of raw linen. These results indicated to the high rate of damage and the damage which needed to be restored, also gave us expectations about the date of the archaeological piece. Color measurements results show the darkness of the archaeological textile by ageing, comparing with the new one, and how adding layer is close in color to the original object. Finally, Consolidation by fixing the object on linen support is performed to conserve the fragments of the piece safely.

## References:

1. Kathryn A, an Introduction to the Archaeology of Ancient Egypt (Malden: Blackwell Publishing, 2008), 41.
2. Shaw. I, Oxford history of ancient Egyptian, Oxford University press, New York, 2003, p.108.
3. It is located approximately 15 km (9.3 mi) west of the modern city of Beni Suef, in the Beni Suef Governorate of Egypt
4. I hnasya el-Medina (Herakleopolis Magna), hypo-style hall of temple. 1903-1904: excavated by William Matthew Flinders Petrie for the Egypt Exploration Fund, assigned to the EEF by the Egyptian government; 190.
5. Barbara, B "The Dark Ages in Ancient History. I. The First Dark Age in Ancient Egypt." AJA 75:1-26.
6. Elsharnouby, R, Linen in Ancient Egypt, General Union of Arab Archeologist & Federation of Arab University, 2014 VOL 15, P.1-18.



7. Kathryn A., *An Introduction to the Archaeology of Ancient Egypt* (Malden: Blackwell Publishing, 2008), 41.
8. B. Szafrński, More items of funerary linen from the Deir el-Bahari burial assemblages  
Author(s): Aleksandra Hallmann Journal: Polish Archaeology in the Mediterranean 24/2,  
Special Studies: Deir el-Bahari Studies, 2015.
9. Xia, N, *The First Intermediate Period*, © Social Sciences Academic Press(China) and Springer-Verlag Berlin Heidelberg 2014, p 97-101.
10. E, Amin, technical investigation and conservation of a tapestry textile from the Egyptian textile museum. Cairo, SCIENTIFIC CULTURE, Vol. 4, No 3, (2018), pp. 35-46.
11. H, Ahmed, restoration and storage procedure of a rare historical textile in the museum of faculty of applied art of Helwan university, Egypt, *Egyptian Journal of Archaeological and Restoration Studies*, 2018, vol. 8. P.35-43.
12. P. Lazzaro, D. Murra, A. Santoni, E. Nichelatt ,*The Conservation of the Shroud of Turin: Optical Studies*, EAI Speciale II-2012 Knowledge, Diagnostics and Preservation of Cultural Heritage.89-94.
13. Fanti .G , Matricciani, E, (2018), imaging Analysis and Digital Restoration of the Holy Face of Manoppello—Part II, *heritage journal*, vol. 1(2), 289-305.
14. G. Fanti, Mechanical Characterization of Linen Fibers: The Turin Shroud Dating, *International Journal of Reliability Quality and Safety Engineering*, (2016) ,vol. 24.
15. P. Lazzaro, D. Murra, *The Conservation of the Shroud of Turin: Optical Studies*, CONSERVATION OF CULTURAL HERITAGE, EAI, (2012) p.89-93.
16. E. Ntelia and I. Karapanagiotis, Super hydrophobic Paraloid B72, *Progress in Organic Coatings* , 2019, 139.
17. A. Traistaru, M. Timar, M. Campean, Paraloid B72 Versus Paraloid B72 with Nano-ZnO Additive as Consolidates for Wooden Artefacts, 2013, *MATERIALE PLASTICE* 49(4).
18. M. Todor, C Bulei, T Heput, and Imre Kiss, Consolidated Composites with Natural Textile Fabrics  
*IOP Conference Series Materials Science and Engineering*, 2018, p. 416

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<sup>1</sup> Kathryn A, *An Introduction to the Archaeology of Ancient Egypt* (Malden: Blackwell Publishing, 2008), 41.

<sup>2</sup> Shaw. I, *Oxford history of ancient Egyptian*, Oxford University press, New York, 2003, p.108.

<sup>3</sup> it is located approximately 15 km (9.3 mi) west of the modern city of Beni Suef, in the Beni Suef Governorate of Egypt

<sup>4</sup>Thnasya el-Medina (Herakleopolis Magna), hypo-style hall of temple. 1903-1904: excavated by William Matthew Flinders Petrie for the Egypt Exploration Fund, assigned to the EEF by the Egyptian government; 190

<sup>5</sup>Barbara, B "The Dark Ages in Ancient History. I. The First Dark Age in Ancient Egypt." *AJA* 75:1-26.

<sup>6</sup> Elsharnouby, R, *Linen in Ancient Egypt*, General Union of Arab Archeologist & Federation of Arab University, 2014 VOL 15, P.1-18.

<sup>7</sup> Kathryn A., *An Introduction to the Archaeology of Ancient Egypt* (Malden: Blackwell Publishing, 2008), 41.

<sup>8</sup> B. Szafranski, More items of funerary linen from the Deir el-Bahari burial assemblages Author(s): Aleksandra Hallmann Journal: Polish Archaeology in the Mediterranean 24/2, Special Studies: Deir el-Bahari Studies, 2015.

<sup>9</sup> Xia, N, The First Intermediate Period, © Social Sciences Academic Press(China) and Springer-Verlag Berlin Heidelberg 2014, pp 97-101.

<sup>1</sup> E, Amin, technical investigation and conservation of a tapestry textile from the Egyptian textile museum. Cairo, SCIENTIFIC CULTURE, Vol. 4, No 3, (2018), pp. 35-46

<sup>1</sup> H, Ahmed, restoration and storage procedure of a rare historical textile in the museum of faculty of applied art of Helwan university, Egypt, Egyptian Journal of Archaeological and Restoration Studies, 2018, vol. 8. P.35-43.

<sup>1</sup> P. Lazzaro, D. Murra, A. Santoni, E. Nichelatt, The Conservation of the Shroud of Turin: Optical Studies, EAI Special II-2012 Knowledge, Diagnostics and Preservation of Cultural Heritage.89-94.

<sup>1</sup> Fanti .G , Matricciani, E<sup>3</sup> (2018), imaging Analysis and Digital Restoration of the Holy Face of Manoppello—Part II, heritage journal, vol. 1(2), 289-305.

<sup>1</sup> G. Fanti, Mechanical Characterization of Linen Fibers: The Turin Shroud Dating, International Journal of Reliability Quality and Safety Engineering, (2016) , vol. 24.

<sup>1</sup> P. Lazzaro, D. Murra, The Conservation of the Shroud of Turin: Optical Studies, CONSERVATION OF CULTURAL HERITAGE, EAI, (2012) p.89-93.

<sup>1</sup> E. Ntelia and I. Karapanagiotis, Super hydrophobic Paraloid B72, Progress in Organic Coatings , 2019, 139.

<sup>1</sup> Archaeological fabric separated from the object.

<sup>1</sup> A. Traistaru, M. Timar, M. Campean, Paraloid B72 Versus Paraloid B72 with Nano-ZnO Additive as Consolidates for Wooden Artefacts, 2013, MATERIALE PLASTICE 49(4)

<sup>1</sup> M. Todor, C Bulei, T Hepuț, and Imre Kiss, Consolidated Composites with Natural Textile Fabrics IOP Conference Series Materials Science and Engineering, 2018, p. 416.

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