

Abstract

This study discusses the re-documentation and identifying of materials used in manufacturing of the only war armor left from the collection of King Tutankhamun in order to prepare it for future conservation. Besides, some investigation and analysis were performed to identify the previous conservation materials which were applied after the discovery of the tomb such as: Fourier transform infrared spectroscopy (FTIR), microbiological investigations, Ultra Violet (UV) and Infrared (IR) imaging. The documentation of the cuirass was by digital photography and the assessment of state of conservation. All mentioned procedures were executed to determine the suitable conservation methodology of the cuirass.



The cuirass after discovery, photo by Harry Burton

Introduction

The cuirass was found in the clearance of King Tutankhamun's tomb in 1923 by Howard Carter in a wooden box numbered 587, Mace and Carter applied some conservation procedures on the cuirass as follow: A solution of celluloid 2.5% dissolved in equal quantities of Amyl Acetate and Acetone then adding Castor oil to the solution and finally the cuirass was washed with Celluloid solution.

Nowadays, the cuirass suffers from the following deterioration aspects:

- 1- Dust.
- 2- Dryness.
- 3- Fragmentation
- 3- Deformation.
- 4- Missing parts.
- 5- Microbiology infection.
- 6- insects damage.
- 7- previous conservation materials.
- 8- carbonization.



Dust



Dryness



Deformation



Missing parts



Insect damage



Previous conservation materials

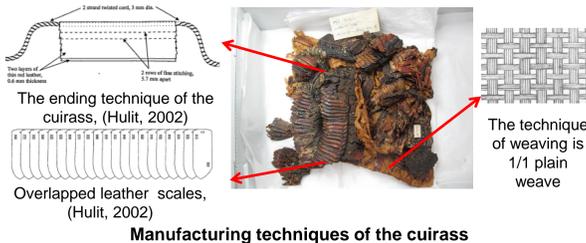
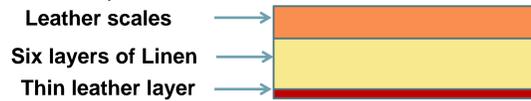


Carbonization

Methods and Materials

The cuirass Stratigraphy

The cuirass consists of three layers: starting from the top to the bottom:
1. leather scales.
2. Six layers of linen approximately 25 string/ cm.
3. Thin leather layer.



Manufacturing techniques of the cuirass

Investigations

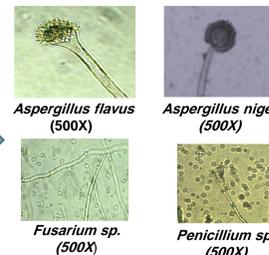
Microbiological investigation:

Performed in the microbiology laboratory of the Grand Egyptian museum – conservation center.

Swap (1): from linen



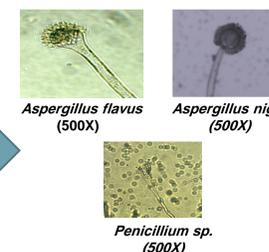
results



Swap (2): from leather



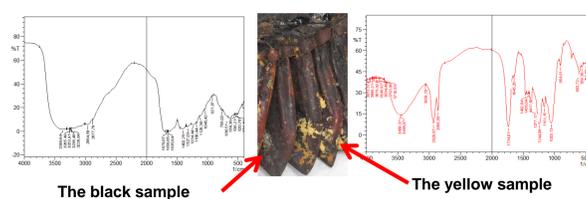
results



The results reveal positive strong microbial infection. Fungal infection present in all tested swaps represented by three fungal genera; *Aspergillus*, *Fusarium* and *Penicillium*. Bacterial infection represented by gram +ve cocci and gram -ve bacilli. The object need to be firstly cleaned mechanically to decrease microbial load then treated.

Fourier transform infrared (FTIR) spectrum

KBr technique was used for sample preparation. Spectrum was measured at a resolution of 4 Cm^{-1} and 20 scans were recorded per sample. IRPrestige-21 FTIR Spectrometer and the IR solution software were used. Spectrum in the range 4000-400 Cm^{-1} was baseline corrected and atmospheric compensation was done.



The black sample

The yellow sample

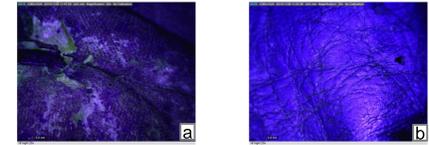
The black sample from the scales surface indicated the presence of Celluloid which was used in the previous conservation and in a brittle condition, the yellow sample from the scales indicates that the used leather is raw hide and not treated and the leather is deteriorated.

Infrared Imaging (IR)



This investigation was applied in order to study the surface morphology and assessment for the current state of preservation, (a) the cord used in the ending of the cuirass which contains traces of previous conservation materials shown in black area, (b) the leather surface which identified as goat leather.

UV imaging



to study the surface morphology and assessment for the current state of preservation, in (a) traces of a thin layer of leather can be found on the linen. (b) The surface lines indicates the bad condition of leather as it suffers from dryness.

Conservation procedures

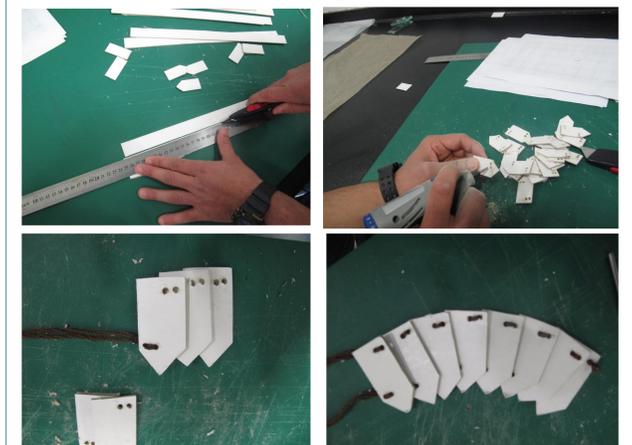
Mechanical cleaning:

By using soft brushes to remove fine dust.



Constructing a replica:

Making replica made of acid free cardboard in order to facilitate the future reconstruction of the original cuirass



Conclusions

There are some notes regarding to manufacturing and they are as follow:

1. The war cuirass is consists of three main layers arranged from top to bottom:
 - Overlapped Leather scales.
 - 6 layers of linen with cross weaves.
 - Thin layer of leather
2. The endings of the cuirass consists of a 3mm thin leather folded over a cord of 3mm diameter and stitched with two rows of stitches.
3. The leather scales were found in three sizes and connected with each other with a leather lace.

And for the current state of the cuirass it was noticed the following:

1. The cuirass is in a very poor condition, suffers from surface losses and dryness besides the presence of microbiological infection.
2. The shining layer on the scales is due to using Celluloid mixtures in previous treatment which also caused darkness in some parts of the leather scales.
3. Using Ultra Violet and Infrared imaging reveals the presence of a very thin skin beneath Linen layers to prevent the feeling of annoying while wearing the cuirass.

Future studies

1. Evaluation treatment of some of the anti fungi for treating the biological infection in the cuirass.
2. Cleaning and consolidation of the cuirass.
3. Reconstruction of the cuirass.

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