The conservation of a pair of sandals from King Tutankhamen collection.
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Abstract
Study case of one pair sandals of 32 pair property of King Tutankhamen with different sizes. Sandals were manufactured in ancient Egypt from different types of materials such as halfa grass, Dom palm leaf, papyrus or straw, etc. The documentation of the sandal was by digital photography & AutoCAD 2D for the dimensions & deterioration aspects. Additional investigation and analysis were applied in order to identify the types of fibers used in the sandal, assessment for the cell wall of the fibers, imaging with SEM and recognizing for the previous conservation materials by FTIR. The condition of the sandals was bad it suffered from: fragmentation, previous conservation materials such as Paraffin Wax, deformation, missing parts and stains. The conservation stages of the sandal included: Mechanical cleaning-removing previous conservation, consolidation of fibers- making a model replica to facilitate the reconstruction of the sandal.

Methods and Materials

Techniques of manufacturing
Open coiling
Zigzag binding
Sewing
Types of plants used in the sandals
Halfa grass Dom palm leaf Papyrus

Sandal varied in form as there were plenty of fibers and techniques used in the manufacturing. All of Tutankhamen’s sandals are made of transverse bundles of halfa grass. Dom palm leaf is used for sewing with strips of the back strap and the clothing of the pre-strap and back strap attachments are made of papyrus. The pre-strap is made of palm leaf.

Investigations

Imaging with SEM
a. papyrus, b. halfa plant and c. dom palm leaves.

Imaging with light optical microscope 200x

FTIR spectrum
Three samples of papyrus, Halfa grass and dom palm leaves were tested in order to identify the material was treated with, the result: all samples contain paraffin wax.

UV Imaging for the sandals
(360-400 nm)

The main purpose of this investigation is to identify and track traces of previous conservation materials on the sandals. Traces of paraffin wax appeared in large parts of the sandals.

Conservation procedures
Mechanical and chemical Cleaning
Removing the dust using soft brushes and removing Paraffin wax by using Cotton swabs with white spirit - ethyl alcohol 70:30

Mechanical cleaning Chemical cleaning before After

Reconstruction

A model Replica was made by using acid free foam to facilitate the reconstruction of the sandal with the same curves and angles of the manufacturing. The aim, Reconstructing the original shape of the sandal the reconstruction of the sandal was by paraffin B66 dissolved in acetone 15% applied by brushes.

Consolidation
Fixing the inner separated fibers by injection, and final shape on plexi glass holder

Results

The results of conservation actions were convenient and appropriate the sandal returns its original shape by the reconstruction process and the Paraffin Wax was successfully removed by Turpenline oil. Paraffin B66 had proven good adhesion properties and stability. The new technique in reconstruction by using a replica of acid free foam extremely helped in the fragments binding and enhanced the reconstruction process without any side effects.

The exhibiting by using plexi glass is suitable for the sandal as it prevent any mechanical contact in handling besides its consider an ideal method of exhibiting as it does not distract the visitors and give all the attraction to the artifact itself.

It is recommended to perform more studies & analysis about the previous conservation materials that were used in the last decade to facilitate the further conservation actions.

Conclusions

The action of using Paraffin Wax prevented the fibers from smashing during transporting the sandals to the museum after the discovery of the tomb but unfortunately did not success in stabilization of the condition of the sandals but caused contamination of some fibers and extracted duct. The cleaning of sandals was applied after executing suitable investigations to identify the previous conservation materials. The technique of using a replica in the reconstruction was very successful and gave guidelines for this action. Using tissue paper as a temporary support was successful for the easy removing with no damage at all.

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References
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Documentation
Several methods of documentation were applied as Description of the sandals (dimensions and deterioration aspects, type of fibers), Digital photographing for the sandals as whole and in details with canon 16 mega pixels programs were used to design a deterioration map for the sandals such as (AutoCAD 2D).

Conclusions

Before After Before After Before After
B

Fragments Delamination Deformation Deterioration
Deterioration map with AutoCAD 2D.