An experimental study for treatment and conservation of archaeological wood covered with a layer of black resin, applied on one of selected models

For The Fulfillment of MA in Conservation and Preservation of Antiquities

Submitted by

Abdelmoniem Mohammed
**Demonstrator at Conservation Department
Faculty of Archaeology, Fayoum University**

Supervised by

Prof.Dr.Naglaa Mahmoud Ali

**Professor of Conservation of organic materials(Restoration of Wood),
Faculty of Archaeology, Fayoum University**

Dr. Wael Sabry Mohamed

Assistant Professor, Polymer Department, National Research Centre, Egypt

2019

Summary

Chapter one:

This chapter theoretically covers the study of black resin, as follows: The theoretical study and definition of black resin layers and its Definition The black resin is called black varnish or black lacquer. It was probably used for funerary purposes to imitate and mimic ebony. The ancient Egyptians had the language of colour and the use of dark tones of colour was a sign of sorrow. That is, black represented the death and hereafter for the ancient Egyptians. Black resin was used in funerary collections such as coffins, oshabti boxes, oshabti statues, Canopian pots, human and animal statues, statue bases and other artefacts. Evolution of using black resin: Black resin was introduced in the New Kingdom due to the state of chaos that prevailed in the country. The ancient Egyptians used many methods in the application of black resin . The tools used in applying black resin: Soft bristles brushes were used in the application of black resin, The ancient Egyptians used brushing or casting for the application of black resin that was applied while being hot.

Chapter two:

The chapter covers the explanation of the devices used in the examination and analysis of pigments and the identification of the components and constituent proportions of black resin. It also tackles the studies that precede the restoration. The present study documents and records the current status of the coffin using photographic documentation, investigation, and analysis of the wooden coffin and pigments. Digital Microscope, Stereo Microscope (SM, Optical Microscopy: (OM) Multispectral Imaging (MSI) Microbiological Study. The device which was used in the analysis of the wooden coffin: Scanning electron microscopy (SEM -EDX was used to enlarge the surface of the painted layer. The painted layer was analyzed using X-ray diffraction, Fourier transform infrared spectroscopy (FTIR)

Using Gas chromatography-mass spectrometry (GC-MS): To know the composition of the black resin and the method which was used in the analysis of the samples (TSP) Thermal Separation Probe. And Fourier Transform Infra-Red of the black resin. The devices used to evaluate the efficiency of the conversation materials of the wooden

coffin: Using the color change device to measure the degree of reflection of black resin samples and The luster of the black resin-covered wooden samples was measured to select the best consolidation materials.

Chapter three:

This chapter includes the results of the investigation and analysis of pigments and the previous restoration materials and black resin and knowing of the proportions of the constituent materials Investigation and analysis of the pigments and wooden coffin: The coffin was made of *sycamore* wood, and the saplings were made of *Tamarix SP*. The stereomicroscopic examination showed that there was efflorescence on the surface of the red pigment and a glossy layer on the ground. Due to the previous restoration. Multi-spectral imaging showed that The Egyptian blue pigment is shown in white in the infrared fluorescence spectrum and the infrared false color (IRFC) appears in red. The presence of wax was identified in the previous restoration because of the green emissions from the head area of the coffin with UVF. The red pigment appears in dark in the ultraviolet light fluoridation spectrum. This is especially evident on the coffin, indicating that the red pigment material depends on iron oxides. Microbiological Study showed that Fungi: *Acremenium SP.- Aspergilllus niger- Penicillium SP.- Aspergillus flavus* Bacteria: *Micrococcus sp. (G+)- Micro Bacillus sp. (G+)- (Short Bacillus sp. (G+).*

Instruments used in the analysis of the wooden coffin: Scanning electron microscopy (SEM -EDX) was used to enlarge the surface of the painted layer and the EDX unit was used to identify the elements of the painted layer. The presence of al-Si aluminum is due to aluminum silicate in the dust or some impurities in the pigment. Additionally, the presence of sodium (Na) and chlorine (Cl) indicates the presence of sodium chloride salts because of the interaction between the coffin with the mummy and the burial environment. The black pigment resulted from the carbon. The painted layer was analyzed using X-ray diffraction and it was found that the yellow pigment particles were Goethite (FeOOH), while the yellow pigment was yellow ochre. The red pigment particles were calcite ($CaCO_3$) and cinnabar (HgS) that was evidence for red pigment consisting of cinnabar and hematite. The green pigment particles were Atacamite ($Cu_2Cl(OH)_3$) and Paratacamite ($(Cu,Zn)_2(OH)_3Cl$); evidence of copper pigment that

turned into Atacamite and Paratacamite due to moisture and salts. The blue pigment particles were cuprorivaite ($CaCuSi_4O_{10}$), Gypsum ($CaSO_4.2H_2O$) that was the evidence of Egyptian blue. Fourier transform infrared spectroscopy (FTIR) was used to identify the bending medium and the materials used in the previous restoration. The bending medium was the animal glue and the previous restoration materials were polyvinyl acetate and beeswax. Analysis of black resin by Gas chromatography-mass spectrometry (GC-MS) and Fourier transform infrared spectroscopy (FTIR) The results of the same analysis applied to black resin found out that it consists of: Mastic - Pine resin - Beeswax - Bitumen

Chapter four:

This chapter includes an empirical study of the materials and methods proposed for use in the restoration process. and the conservation process of the wooden coffin. Experimental study for selecting the best materials to consolidate the black resin layer and the wooden support: Preparation of black resin from The results of gas chromatography. The materials used for consolidating the black resin layer on the experimental samples: Nano Paraloid B-72 , paraloid B72 , Klucel G(Klucel G, hydroxyl propyl cellulose) and Klucel E (Klucel G, hydroxyl propyl cellulose) were used. Accelerated aging by Thermal and light aging and Measuring the chromatic variation of the experimental samples The lowest material in the degree of reflection was nano-paraloid B72 in xylene and Measuring the degree of gloss showed that the degree of gloss and the degree of reflection of nanoparaloid in xylene were the least likely to change for the experimental samples after aging. Therefore, nanoparloid was used in xylene to consolidate the black resin layer in the selected models. An applied study for the treatment and preservation of wooden coffin covered with a layer of black resin :Historical and archaeological study of the wooden coffin located in Sakkara area storage, and the interpretation of the texts inside the cover indicates that the coffin dates back to the Late Era. The name of the deceased was Basmatik - Sonb son of the army chief Psmatik. Treatment and maintenance operations of the wooden coffin: Mechanical cleaning and Chemical cleaning of the black resin layer. Reinforcement and completion of the painted layer: The ground layer was reattached from the wooden support

Consolidation of the black resin layer Nano Paraloid B-72 (1.5% concentration) in xylene was applied by using soft brushes.