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**Applied study in analysis,
development of archaeological ceramic with retreatment
of some selected objects**

Thesis for PhD degree in conservation department

Submitted by

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Summary ملخص رسالة الدكتوراه باللغة الانجليزية

From previous scientific and applied works the practice of conservation has primarily focused on cleaning and restoring objects to make them look attractive, this perspective limits the conservator to techniques based on modern aesthetic opinion that is biased to the style and training of the conservator, it also has the potential to prevent or impede further scientific studies or consider the aesthetics of a prior era. I suggest that it is the time to change this approach to conservation and rather to consider the preservation of earlier repair materials as documents of object history. For example, the illustrations and recorded history from Ancient Egypt identify that many raw materials were known and used for creating a wide range of cultural objects. Furthermore, these materials including animal glues, beeswax, Arabic gum, and bitumen were also used to repair and restore the archaeological objects.

The synthetic adhesives and consolidants used in conservation treatments today were not widely used until the mid 20th century. Museum scientists and excavators like Rathgen and Lucas, who were working in the late 19th and early 20th centuries, mentioned that these materials still used in many of the repair materials known to ancient craftsmen. All earlier repairs provide evidences of the era for their many uses, their systematic removal without research and evaluation represents a loss of information. Old repairs; ancient or historic, provide details of ancient history and technology that is important to preserve because they help us to understand how and why objects were preserved.

Old repairs provide an additional value for the cultural and archaeological objects, conservators now have the ability to examine, analyze, and interpret these repairs prior the removal and to the addition of important information to an object's history. Based on this study of retreatment of ceramics, it is evident that the materials and techniques used to repair ceramics in Egypt have a very long history. Cultural repairs hold the potential for further understanding of cultural technologies and for the uses of material culture, in which conservators should examine, analyze and evaluate repairs prior to retreating.

The thesis mainly focuses on the analysis and development of ancient ceramic with restoration of some selected objects. It contains 6 chapters and the contents of the thesis can be summarized as follows:

Chapter I: archaeological pottery and ceramics (compositions and properties)

This chapter focuses on the raw materials used in the pottery and ceramics manufacture as well as decoration materials and methods which play an important role in the re-treatment. The Egyptian pottery had various stages of developments in terms of raw materials, methods of manufacture and decoration methods which divided into ancient Egyptians Pottery, pottery with Coptic influences and Islamic

ceramic.

clay were used in the manufacture of archaeological ceramics with some additives in order to improve their properties during shaping and to get a good product, some of these materials in the clay are natural and others were added intentionally such as sand, limestone powder and pottery powder, these materials added to the clay were strictly intentional to improve the properties during shaping, drying, burning and for its function, additives which are added intentionally differ from what is called inclusions which exists in the clay naturally. The additives play an important role in determining the physical properties of ceramics such as hardness, porosity, and permeability, all of these properties are of great importance in restoration, For example, cleaning and consolidation. The chapter contains the ceramic properties.

Chapter II: Analytical study:

This chapter deals with analysis methods used in the study of some pottery samples from Al- Fustat site.

- Polarized microscope it used for identification of quartz grains and determine the rate of grains in the ground as well as size which refers to preparation processes, the importance of polarizing microscope in the study of inclusions through the grains which divided into sharp angles, angular or sub angular is granules that are circular, the shape reflects the internal orientation of the content and the degree of plasticity during shaping. The study points to the most important additive materials which used in the ceramic such as quartz, feldspars, mica, amphibole, pyroxene and calcite, Polarizing Microscope has been used in the analysis of glazed pottery samples from Al- Fustat shows that the samples raw materials were prepared in different ways as well as the use of various additives.
- Proton Induced X-ray Emission (PIXE) Characterized by several advantages for Archaeological Studies including its ability to surface analysis and PIXE method is very important for being non-destructive ,characterized also its ability to measure elements such as Si, P , Cu, Pb can't be measured by other methods . PIXE used in this study in analysis of glazed ceramic samples from Al-Fustat, PIXE gave elemental explanation for glaze compositions such as fluxes and pigments used as source for different colors.
- Laser-Induced Breakdown Spectroscopy LIBS :It is important to understand the basis of this technique as one of the laser methods used in the analysis of archaeological materials, this method has the ability for elemental analysis of the archaeological materials components depending on the basis of plasma emitted of the atomics by using high energetic laser on archaeological ceramic, LIBS is one of the most useful methods due to its advantages including its quick method ,the results are given immediately after the analysis and this method applied not only in laboratories but also in archaeological sites, in addition to that it is non-destructive

methods.

- *X-Ray Diffraction* XRD this method is used for identifying crystalline phases and additive materials in ceramic specially in homogeneous materials. The composition of ceramics depends on the clay components which were used, the firing temperature and additional factors such as the length of the burning and the amount of oxygen during the burning process.

Chapter III: Development of conservation materials
various materials were used in the restoration works of ceramic which cause salts as result of chemical cleaning with acidic materials. Physio-chemical transformations of consolidants and adhesives caused by deterioration factors temperature, light and relative humidity. Conservation materials divided into two categories based on the date use, first there are ancient materials which have been available since the Pharaonic dynasties and used for various purposes, second modern conservation materials (traditional) which have been used since the beginning of restoration of archeological finds.

Chapter IV: Conservation of pottery and ceramic
Documentation must be carried out before, during and after conservation cleaning is removing of foreign materials from various sources including air pollutants, as well as materials earlier restorations. Removing particles from the surface is a physio-chemical process between the body and detergent and therefore restorer must use caution during cleaning the surface depending on chemical interact of solutions and solvents with the surface to remove them

Chapter V: The experimental study
Different experiences were carried out during the study has been used in the first part of the experimental samples dedicated to the study at Arizona state museum, the samples in the museum since the fifties of last century and it refers to different periods from pre-dynastic up to the Coptic period , 11 samples were selected as following, some of the pre-dynastic period in samples (1-4) and some of the Middle Kingdom (5) and the era of the New Kingdom (5-9) or samples belonging to the Coptic period are (10-11). Several tests had conducted of the salts test, desalination before application of polymers. Ten polymers were applied on pottery sherds, microscope and UV used for diagnosis and evaluation of application and after removal.

Chapter VI: the applied study
1 – Arizona state museum; Arizona state museum has a small number of Egyptian pottery objects refering to pre-dynastic period seven objects refer to predynastic were selected the objects are black topped pottery and red on buff pottery , these objects had salt crusts , dirt's , one of these objects were restored before Cellulose

Nitrate, microscopic investigations were done in addition to UV examination during restoration.

2 - *Pottery at the Museum of Arizona* ; this museum contains a wide range exceed 20,000 pottery dates back mostly to the area of the southwestern United States and which was inhabited by Americans - Indian natives since before 1000 A.C, a survey project has begun to work to study the case of such a large number of pottery 10 years ago and finished the project on the study ended in 2008, after the completion of this project started a new project to re-treatment the group's most deteriorated and less stable, a number of 700 pieces Pottery will be treated over two years 2010-2012 and during the study from January 2011 until September 2011 was the restoration has been done and participate in the restoration of more than 200 pieces with the team concerned the restoration of pottery which have different deterioration phenomenon and conservation process.

3 - *Ceramics from the Italian – Egyptian center of the restoration* ; a ceramic dish was restored and completed with proper materials .