STUDY THE EFFECT OF DETERIORATION FACTORS ON CHEMICAL AND PHYSICAL PROPERTIES OF SOME NATURAL DYES ON ARCHAEOLOGICAL FIBERS AND METHODS OF TREATMENT AND CONSERVATION APPLIED ON A SELECTED MODEL

By

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Summary

This thesis is about the effect of deterioration factors on chemical and physical properties of some natural dyes on archaeological fibers and methods

of treatment and conservation applied on a selected model. The purpose of the thesis is observation the physical and chemical changes occurring to the deteriorated and aged natural dyes to reach results that help determine the appropriate preservation environment for the dyed archaeological fibers, especially since the damage of dyes is not recovered .

This thesis abstracts in four chapters as the following:

Chapter I is a Literature Review that includes the history of using natural dyes with fibers in Egypt. It also deals with some important concepts for distinguishing between types of colorants. The different methods of classifying natural dyes and the most famous natural dyes used in the past were also clarified. It also includes the advantages and disadvantages of natural dyes and how to fix them with fibers. Then clarify the main problem of natural dyes, which is the fading and the various factors that cause it. It was also necessary to clarify the modern analysis techniques used in identifying natural dyes because of their great importance. Finally, mention was made of the conservation methods used to preserve the dyed fibers.

Chapter II is the Materials and Methods used in the experimental study. It includes preparing samples largely simulating the applied model. Five groups of dyed wool were prepared (wool dyed with madder and mordanted with alum - wool dyed with madder and mordanted with copper - wool dyed with madder and mordanted with iron - wool dyed with indigo without mordanting - wool dyed with Iranian saffron without mordanting). The dyed wool samples were subjected to light aging (for different exposure times of 25, 50, and 100 hours) and thermal aging (at different temperatures 40°, 60°, and 80°C each temperature for 4 hours) taking into consideration that each sample was subjected to the influence of only one of the aging factors so that the effect of each variable alone could be observed on each sample without overlapping the effects. To study the effect of both light and thermal aging on the chemical and physical properties of dyed wool fibers, several analytical techniques (FTIR – HPLC – XRD - color measurement) were used**.**

Chapter III is the Results and discussion of the experimental part .The untreated and treated samples were characterized using different spectrometric

techniques (FTIR, HPLC, XRD, and Colorimeter). The obtained results of each technique are listed and discussed in this chapter.

Due to the climatic changes that the planet is exposed to as a result of global warming and the depletion of the ozone layer, it has not become accurate to determine accelerated aging according to a certain number of years, but it is preferable to calculate the amount of energy that the object is exposed to. So to facilitate the process of comparing samples, we decided to standardize the units used in both kinds of aging techniques and convert each aging factor (temperature or light exposure time) into watts-hour and calculate the amount of energy emitted from each aging source that the samples were exposed to after the total time of exposure.

The most important results are the following:

• The most significant change that occurred to the samples was pronounced in the first interval of light and thermal aging and then tended to vary by prolonging the exposure hours or temperature.

• After 100 hours of exposure to light or 80 ºC all the dyed samples deteriorated but by different levels according to the sort of the dye and the mordant used.

• Although some samples may appear to have been stable when exposed to different degrees of aging they suffer from internal damage that appears clearly in their chemical structure when analyzing with different techniques, which indicates that these samples continued to be sever damaged when they are subjected to long term of aging.

• Color measurement is not precise proof that the aged samples are stable or not when subjecting them to different aging factors.

• The effect of light aging was most influential than the effect of thermal aging.

• The global climatic change in the recent few years led to the inability to have fixed limits or references to refer to when dealing with aging hours or temperatures. For example, determining the number of exposure hours to light aging mimics a specific number of aging years, since we have several weather variances on the same day regardless of the season we are going through.

• It is preferable to explain or discuss the changes -related to different aging parameters- to the amount of energy that the samples were subjected to. So we standardized the units used in both kinds of aging techniques and converted each aging factor (temperature or light exposure time) into watts-hour and calculated the amount of energy emitted from each aging source that the samples were exposed to after the total time of exposure.

Chapter IV is the applied part. It includes an introduction about the oriental carpets, then a description (of the decorative and weaving technique) of the Archaeological Carpet (Applied object). It also includes samples taken from the carpet for examination using (Visual Examination - Stereo Microscope - Scanning Electron Microscope) and analysis using (FTIR – XRD – HPLC) to assess the condition of the carpet and identify Its materials. Comparison tables had been made between archaeological samples and aged experimental samples. Based on the results of the examinations and analyzes, an appropriate treatment plan was developed for the state of the antique carpet. The restoration and conservation process was carried out with these steps (Removing old erroneous restoration works, cleaning, sterilizing the object for future protection, and finally consolidating the object by fixing it on a new linen Supporter which was stretched on a wooden frame according to the Safety requirements).

The study finished with a conclusion, recommendations, and references.