

Visual Assessment of Coptic tapestry fragments, red monastery excavation, Upper Egypt.

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Abstract:

This study presents visual measurements for dye fading of archaeological tapestry fragments dated to the 4th century of Coptic period. The objects were discovered at the red monastery of Anba Bishoi and Anba Bigo, Sohag, Upper Egypt. They are suffered from many physical deterioration aspects, such as fading, weakness, dryness and staining. So the need to estimate the rate of damage visually becomes argent. The International Organization for Standardization (ISO) and Japanese Industrial Standards (JIS) introduced visual and instrumental color fastness evaluation methods. Instrumental methods aren't preferable to be used in our study, because taking samples is not always acceptable. So, the challenge for any conservator is how to visually measure the rates of dyes fading, which is happen ,due to thermal and light degradation. This paper deals with a physical method for determine the changes of the dyes colour in archaeological textiles by creating standard symbols, referred to different forms of the dyed textile fading. As it was sufficient to represent the degree of fading of dyed textiles by arbitrary steps, which represent the change in shades of dyes and coded

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with symbols characterized the rate of fading in a simple way. Furthermore, coding the direction of change is noted. and the extent of change is estimated subjectively by adding numerical value and Chroma through munsell book of colour. By all these visual estimation methods of morphological appearance, the conservator could document the state of damage safely.

Key words:

Fading, physical, dyes, red monastery, munsell book.

Introduction:

The Red Monastery is located 21 kilometers west of the province of Sohag, Upper Egypt. It was named under Deir al-Anba Bigol & Anba Bishay [Bolman 2016]. The monastery has a significant value among the important monasteries in Sohag. Its importance is coming from its historic, artistic and religious values to Coptic people. It is known as the Red Monastery because of the red bricks that make up the majority of its masonry, as well as pink and black granite columns, were used in the building's construction. Since 2002, the American Research Center in Egypt, with funding from the USA Agency for (USAID) carried many excavations and conservation works at the Red Monastery's historic church [Bakhom.D, 2015-2018]. Saint Bishoy founded the monastery in the early fourth century AD, but it was destroyed by two fires, the first during the Roman period and the second as a result of Berber attacks [Brakke & Crislip 2015]. Coptic textile is one of the most intriguing artefacts from the Coptic period, as it documented aspects of Egyptian

daily life from the end of the Greco-Roman period to the Islamic period [Thomson 1977]. Tapestry is one of the most important decorated techniques; with the weft thread used not extending through the loom [Allane 1995& Harris 2004]. Analyzing the materials used in textile dyeing may be a useful tool for determining how an object originally appeared, where it came from, and how old it is. This knowledge also enables conservators to select appropriate restoration procedures [Colombini 2007]. Organic dyes used in textiles are among the most elusive materials used in works of art. Identifying dyes in old textiles is especially difficult, due to the complexity of the degradation processes undergone by organic molecules, which are especially sensitive to light [kreem 2009]. Recognizing the pattern of changes in the dye structure could aid in the selection of museum conditions such as light levels and the exclusion of ultra-violet radiation, thereby lowering the risk of degradation in conservation [AL-Gaoudi & Iannaccone 2022]. All dyed textiles were faded, due to exposure to light. And, the optical appearance is strongly altered [Tera 2016].

The paper describes four physical techniques for evaluating the light fastness of dyed textiles. The 1st explains sample fading using symbols. The 2nd technique is to code the direction of change, such as: /R red, /O orange and so on. the 3th one shows the degree of fading in arbitrary steps[Fahim 2015].

The fourth method is called munsell book of color [Gerharz et al 1988] , in which the fading of natural dyes was evaluated according to numerical value refer to the hue and Chroma of color [Ruck & Brown 2015]. To achieve the best

light-fastness for each colour, we divided the Munsell colour space into an inner and outer core of colours. The inner core is made up of neutrals and colours with as much chroma as possible using very light-fast dyes [Ferguson 2014]. The outer core is made up of higher Chroma colours that can only be obtained with less light-fast colours [Gerharz et al 1988& Davidson 1951].

1- Materials and methods:

1.1 description of tapestry techniques:

There were three tapestry technique fragments in the Coptic museum, numbered 4/127/4,152/2, and 83/2. They are made of raw linen for the ground and dyed wool for the decorative parts (fig.1).The weavers completed the decoration in a non-extended manner, which was given several names, such as tapestry [Smith, 2012], woven decoration, painted textiles, and weft faced textiles, but the precise designation is the textile of non-extended weft [Satyajeet B, et al 2008]. Because, it best describes the texture composition of this technique and not tapestry, included a general concept of Egyptian textiles rather than a specific technique [Boersma 1997]. Colored wefts, weaved in a non-extended manner across the woven piece, were used to create such decorations [Ammayappan et al 2006]. A weaver begins by inserting the colored weft yarn into the decorated part of the harness among wraps within an opening. Single yarns are separated from two fold yarns. Then he passes the second weft yarn in the same area, and so on [Cheema S, et al 2018].

1.2 visual assessment:

Three techniques were used to visually measure Coptic tapestries, which were excavated at the red monastery; three of them used symbols to measure colour fading:

- The first explains the fading in samples using symbols that refer to changes in shade of greater, equal, and depth with the original one, and coded: OTS off tone slight, OTD off tone marked, OTB off tone considerable.
- The second method is coding the direction of change is noted for example: /R red, /O orange, /Y yellow, /G green, /B blue, /B black, /BR brown, /Z grey.
- The third one is present the degree of fading by arbitrary steps: O unchanged, FS slight fading, FD marked fading, FB extensive fading, BI bleached one.

1.3 Color measurement of tapestry fragments" munsell color of book":

The last one measured the fading numerically, according to Munsell book of color (fig.2). The Munsell Color System is divided into two parts: color charts or "atlases," which are downloadable color samples, and the theoretical system, which describes the human experience of color, also known as the perceptual "color space." Munsell published the first colored paper samples in the Atlas of the Munsell Color System in 1915, after explaining the theoretical structure in A Color Notation in 1905. Though the samples have evolved over time as a result of additional research and refinement, the theoretical structure of the system has remained constant [Cochrane 2014].

Every possible color percept in the Munsell System can be described by three variables: hue (the color name: red, blue, green, etc.), value (lightness or darkness), and Chroma

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(purity, or difference from neutral gray). Each color is labelled alpha-numerically, with a letter for the hue, a number for the value, and a number for the Chroma. If two Munsell Color samples are equal on one variable, they will have the same appearance in that attribute even if the other two variables are different. The Munsell System's independence of these variables was a novel feature (fig.2).



Fig.1 Coptic tapestry fragments, the red monastery excavation, Sohag, Upper Egypt

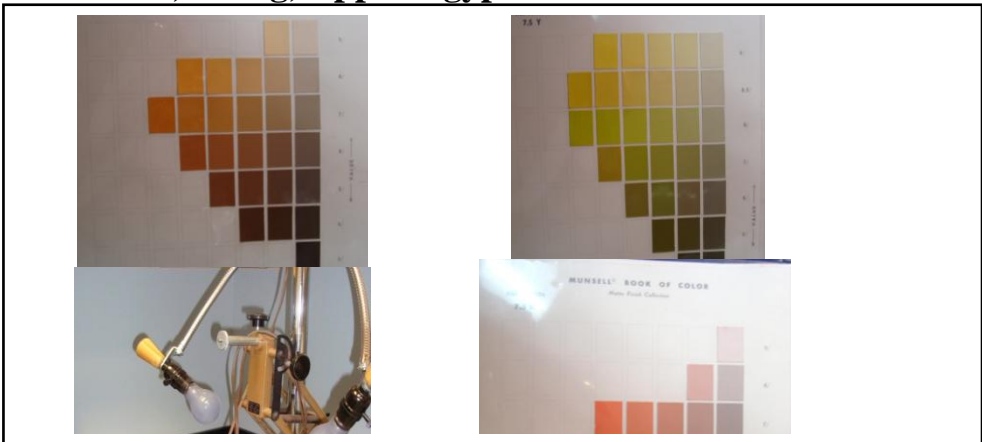


Fig.2 the munsell book of color, examples of the evaluation process

1. The results:

1.1. characterization of fragment no.1:


	Kind of color	Direction of color	Depth of color	Rate of color
	brown	D/B	OTB	FS
	Bright brown	D/B	OTB	FS
	Yellow	D/Y	OTS	FB
Description	A rectangular tapestry fragment; a rectangular decorative area divided into many half circular areas decorated alternately with a human drawn (4-6 century) made of brown and yellow raw woolen threads, performed by plain weave 1/1.[Elnmer& abdel wahab 2021]			
State of damage	The object is in poor condition. There are partial and total threading losses in the outer parts or edges.			

Table .1 physical evaluations the fading of dyed tapestry fragment .1

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1.2. characterization of fragment No.2:

	Kind of threads color	Direction of color	Depth of color	Rate of color
	Red	D/O	OTB	FS
	Beige	D/Y	OTD	FS
	Yellow	D/BR	OTS	FB
	Grey	D/G	OTS	FS
	Green	D/B	OTD	FS
	Dark brown	D/B	OTD	FB


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Description	A circular tapestry fragment; a medallion shape motif decorated by animal and plant figures. The object was ornamented with botanical motifs such as wavy plant branches, and a single leaf, which were modified and close to nature. In addition to a drawn lion surrounded by two decorative circular strips, divided into many small decorative areas (4-6 century). The floor of the fragment was made of dark brown and yellow raw woolen threads dyed .performed by plain weave 1/1.and the decorative area was made of green, blue, red, and yellow yarns.
State of damage	The object is a bad state of preservation, due to the photo degradation and high dehydration of dyed yarn. Furthermore, the continuity of threads bleeding in the outer parts or edges.

Table.2 physical evaluations the fading of dyed tapestry fragment no.2

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1.3. characterization of fragment no.3:

	Kind of color	Direction of color	Depth of color	Rate of color
	Slight red	D/R	OTS	FS
	green	D/G	OTS	O
	Deep red	D/R	OTB	FB
	beige	D/B	OTB	FD
	Dark brown	D/B	OTS	O
Description	It is a square-shaped fragment surrounded by a narrow decorative frame, in which circular decorated area with animal, plant, and cross			

	motifs. In the middle, there is a drawing of a wavy tree containing a repeated shape of a cross motif, (4-6 centuries), it was made of dyed woolen threads, performed by plain weave 1/1.
State of damage	The fragment was discovered in a very poor condition, with stains, dirt, missing parts, and loose yarns all over the object's surface.

Table.3 physical evaluations the fading of dyed tapestry fragment no.2

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2. munsell color measurement:

3.1 color measurement of tapestry fragment No.1:

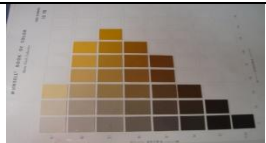
color	Hue symbol	value	charts
brown	10YR	4/2	
Bright brown	10YR	7/6	
Yellow	10YR	7/12	

Table .4 munsell book of color for assessment the fading of first dyed tapestry fragment

3.2 color measurement of tapestry fragment No.2:

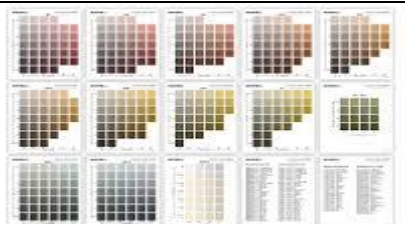
color	Hue symbol	value	charts
red	10YR	4/2	
beige	10YR	7/6	
Yellow	10YR	7/12	
green	10YR	7/6	
grey	10BG	6/1	
Dark brown	7.5 BG	3/2	

Table .5 munsell book of color for assessment the fading of second dyed tapestry fragment

3.3 color measurement of tapestry fragment No.3:

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color	Hue symbol	value	charts
Slight red	5R	7/6	
Deep red	7.5YR	3/6	
green	2.5GY	5/6	
beige	5YR	7/2	
Dark brown	7.5 RP	4/2	

Table .6 munsell book of color for assessment the fading of third dyed tapestry fragment

Discussion:

The results shed more light on visual assessment of color degradation of dyed archaeological textiles [Tamburini,D, et al 2019] and allowed some hypotheses on dyes deterioration mechanism and expected lightfastness of the colors [Morton.M, 2008]. because organic dyes may be more difficult to be studied, due to the fact that a single plant or animal source may provide multiple components, as well as the fact that these components break down into many different components [Gaoudi 2021].

The researchers tried to experiment many ways to evaluate the state of damage of dyed textile [Guthrie et al, 2008]. A comprehensive symbolic description of the dyed textiles' appearance is used, in addition to munsell coloring system [Harris 2019]. Three fragments of tapestry techniques were studied (fig.1). and the results of visual examination emphasize the physical deterioration of dyed decorative areas,

as a result of photo and thermal degradation. The green and yellow dyed areas are observed to be the most fastness dyes to natural ageing (fig 2). While red and brown ones are faded (fig.3). this can be explained by the fact that photo radiation increases oxidation. When amino acid side groups are oxidized, they transform into chromophoric groups, causing the material to turn yellow, brown, grey, or light pink [Darwish & Ahmed 2012]. The results of color measurement of tapestry fragment No.2 have the same hue and value of color in most of colored areas, which interprets that most of natural dyes existed in this object have the same light fastness properties. Because, Natural dyes such as madder, lacs, kermes, and cochineal, which are known as mordant dyes, have anthraquinone chemical structures, which improve both UV protection and antibacterial activity [Pargai et al, 2020]. Furthermore, the fineness or coarseness of the yarn in combination with the thread spacing influences the appearance of tabby , which used in tapestry technique [Kirjavainen 2008].

Conclusion:

The paper presents many methods to determine the color fastness of tapestry textiles, Which are considered nondestructive methods to measure the rate of dye fading, through using some symbols and numerical values, which refer to the depth, direction and rate of colors, In addition to, munsell color system, which used to determine the Hue and Value of the dyed textiles. Three tapestry fragments were examined visually by using these techniques, without the need

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to take any samples. The results proved the good state of preservation for the most fragments.

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