FABRICS ANALYSIS AND CHARACTERIZATION THAT USUALLY ARE USED IN THE TEXTILE CONSOLIDATION

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ABSTRACT*: Much of the research in to work on the conservation of textiles has been developed in aesthetic and macroscopic terms. This research, however, that is being developed by the Department of Cultural Goods Restoration and Conservation and the Department of Paper and Textile Engineering at the Universidad Politécnica de Valencia, aims to study consolidation methods and materials that are used in textile conservation.*

KEYWORDS: conservation, consolidation, textile

INTRODUCTION

As textiles are made of organic materials, they are highly sensitive to degradation as a result of biological, physical, chemical and environmental action. Indeed due to their fragile nature, any attempts at fabric conservation may also cause lasting damage, Consequently, knowing and understanding the characteristics and properties of any material that may come in to contact with these textiles is very important. Given that this vulnerability is well known, we decided to embark on a study to evaluate these types of material (Green, L. R. and Thickett, D. 1995), particularly those that are is normally used in textile consolidation.(Landi, Sheila.1998).

Due to the fragile nature of some textiles, consolidation, together with cleaning (Vicente Palomino, Sofía.1998) is amongst the more delicate of processes used in the preservation of textiles. The most common procedure used is the sewing of certain consolidation fabrics to the original textile. (Masdeu, C; Morata, L, 2000).

As a result of this, we decided that it would be interesting to carry out a study in to the most frequently used consolidation textiles, choosing initially those fabrics which we considered optimum, depending on the individual characteristics of the work on which they would be used.

OBJETIVES

The objective of this research was to obtain a series of facts gained from detailed analysis of these fabrics, which could then be valued so as to know where, when and how best they could be used, or indeed if they were useful at all.

There were numerous factors that needed to be taken into consideration during our research, such as: type of ligament, composition of material, density per cm, transparency, resistance, stiffness, ageing, etc. Consequently it was very important to have a sound knowledge of the material to be worked with. The fabrics initially chosen for this research were: Tetax," "Nylon net," silk "Organza," silk "Crepelina," and "Ponguée". These are the most commonly used textile supports in the field of fabric consolidation.

METHODOLOGY

Amongst the wide range of useable fabrics, we limited ourselves to using only those with characteristics of transparency and resistance. The suitability of each fabric and its specific characteristics had initially to be ascertained. To do this, specific procedures of chemical and physical analysis were used. Then the results were then logged in to a series of tables which were then analysed to draw conclusions from the research.. The methods of analysis that were used are:

1. Characterization of materials.
2. Measurement of tensile resistance. Dynametrics.
3. Rapid ageing of the sample fabrics.
4. Colorimetric measurements.

1 Characterization of materials

A study of the properties each of the materials was carried out, in which their composition, type of the constituent threads, fabric density and the weight were all ascertained.

2 Measurement of tensile resistance

The measure of tensile resistance of a fabric gives a particular value, which can be modified by altering its fibres or structure or the parameters to which it is subjected, eg humidity percentage of humidity, the application of light or heat or a particular treatment, or indeed the simple passing of time.

The test samples underwent both tensile resistance tests (sample size 50mm x 200mm) and velocity tests (displacement between clamps 20 mm/min + 5 mm/min.) These specifications are given in the Standard UNE EN ISO 1924-2:1994 "Determination of tensile properties - Part 2: Constant rate of elongation method" [3.7]. These characteristics need to be taken in to consideration as they can exercise some influence on the results.

3 Rapid ageing of the sample fabrics

After carrying out the various applications, a study was carried out to determine which product showed better resistance to the passage of time. A series of fabric tests were developed to evaluate this behaviour and then establish comparisons, some of which were standardised.

The results obtained from these tests allowed the various products to be compared between each other, enabling those products which yield a more yellowish colour to be established. Given these results, it is obvious that a restorer will opt for those products which posses the required properties of transparency, higher resistance, ease of sewing but with a lower tendency to yellowing. The application of heat was also studied under the parameters.

3.1. Heat application

To evaluate the action of rapid ageing, the possibility of using the following norms and standards, to study any induced effects ,was considered, :

- UNE 57092:2002 Paper and cardboard. Accelerated ageing process.
- UNE EN 12224:2001 Geotextiles. Determining aging process in the open.
- UNE 12280:2002. Textiles covered by plastic and cardboard.

Two specific rules on the ageing of textiles were discarded: one of them is specific to geo-textiles, the conditions of the application of which are far removed from the aims of the research into the textiles carried out in this study, and the other describes the aging of textiles covered in plastic and rubber, samples of which were not used in this analysis. Consequently, our research was carried out following UNE 57092 Part 1:2002 [Paper and cardboard. Rapid ageing. Treatment of dry heat to 105ºC], equivalent to the ISO 5630-1:1982. This stipulates that a sample should be subjected to a single dose of dry heat at a temperature of 105º + 2ºC. In part 2 of the same document, it is stated that it is possible to raise this heat to between 120ºC and 150ºC. In parts 3 & 4, the conditions are given for rapid ageing with damp heat treatment at 90ºC with a relative humidity of 25% and at 80ºC with 65% relative humidity respectively.

Given the installations and equipment available in the Department of Textile and Paper Engineering (DITEXPA), where the research took place, it was decided to carry out the accelerated aging test using the dry treatment to 105ºC method, ie norm UNE 57092. part 1. To carry out this type of aging process, a special oven is required that can be set to precisely 105º C with an error of ± 2º C, so a WTR Binder convection oven was used.

The various simples of tissue were hung in the stove in such a way that allowed the air to circulate without contaminating them. The norm stipulates that if different types of paper are to be tested, then they should be tested separately, so as to avoid possible contamination due to distillation or sublimation products. This procedure was followed with the fabric samples to stop possible interferences between textiles that might alter the final result.

The maximum recommended exposure time is 72 ± 1 hours, although the norm does allow this to be reduced to either 24 ± 1 or 48 ± 1 hours. In this study, simples were exposed to heat for 72 hours.

3.2. Ageing action measurements

The effect of time on textiles can be seen by weaker resistance, variation in colour and so on. When restoring a cultural object, any application or process used should have as little, if indeed any, affect as possible on the item. After applying a particular restoration treatment or after submitting the sample to a rapid aging process, specific measurement processes should be used to determine whether any colour variations might occur in a substratum.

3.2.1. Colour measurements

Colour measurement should always be carried out in the same way (Gilabert Pérez, Eduardo J.1998), as a set of external factors exists that can affect any results obtained, such as colour of the areas that surround around the object, the light source used to light up the object, and the particular geometry of the reflection measuring system.

In the current study, the various colorimetrics of various fabric types were measured after they had been exposed to rapid aging processes. When considering which textiles to restore, a natural starting point would be whites that may or may not be dyed at a later date, so as to reduce their perception or aspect, so that better (or more correct) measures to evaluate the aging effect correspond to differing levels of whiteness in the samples. However, given that the fabrics that are worked on have different colorations, measurements were carried out using CEILAB space colour differences as a base, rather than grades of white, which could lead one to believe that a more yellow material responds initially in a worst manner.

The measurements were carried out according to the CIELAB system, with the conditions determined by the UNE 40435:1994 norm.

3.2.2. Tensile resistance measurement

The measure of tensile resistance of a fabric gives a particular value. This value can be altered if any of its fibres are modified or it is subjected to a process or with the simple passage of time. Variations in this process are conditioned by relative humidity, the application of light and heat, the particular processes applied to the product etc.

The samples were subjected to tensile tests under conditions specified in the UNE EN ISO 20187:1994 norm, which stipulates temperature conditions of 20ºC ± 2ºC, and a relative air humidity of 65% ± 2%.

We used the same procedure as in the tensile resistance test carried out on untreated fabrics

4. Colorimetry

After analysing any aging effects on the colour of the fabrics (as described in the previous section), a series of tests using the same parameters was carried out to reveal which was the most transparent, (in itself a very important quality when it comes to carrying out consolidation work on a fabric.)

Measurements of CEILAB space colour differences were carried out, with the CIELAB colour space adopted from the UNE [3.17] norm

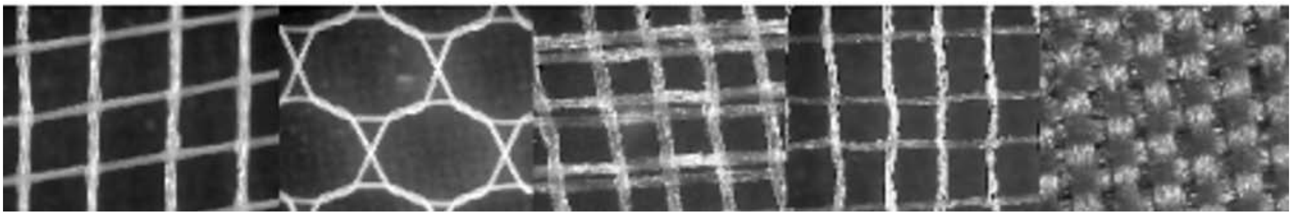

Figure 1

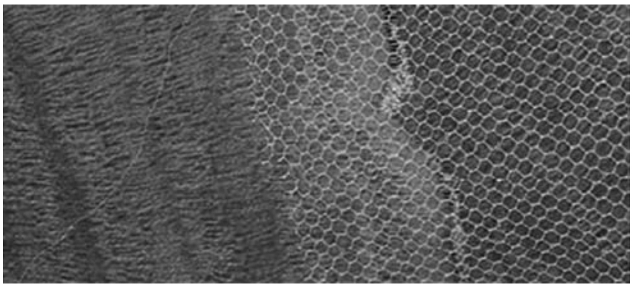

Figure 2

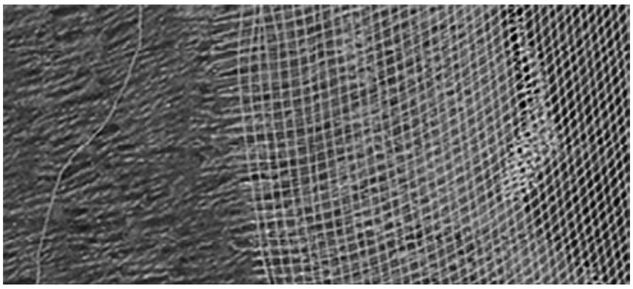

Figure 4

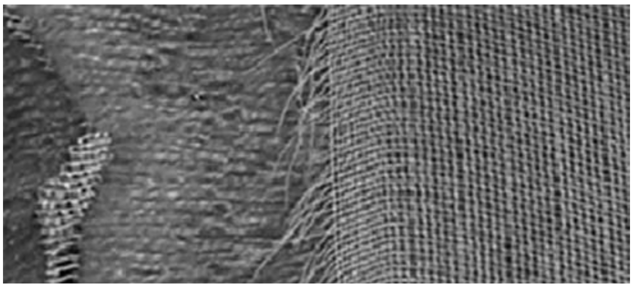

Figure 3

RESULTS

The results of the tests described above are given below, using tables to make them easier to understand and visualise, (figures 1, 2, 3 and 4).

1. Comparison of the weights, densities and type of threads and their fineness (table 1)

Results:
- The nylon net is the lightest fabric of the study
- The silk pongeé is the heaviest fabric of the study.
- Silk Crepelina has the lowest of these values.
- Pongée has the highest of these values.

Fabric Commercial name	Material	Threads Thickness		Density		Fabric's grammage
		Weft	Warp	Weft	Warp	
Silk crepeline	Silk	3 tex	3 tex	43	43	0.00153 gr/cm2
Organza silk	Silk	4 tex	4 tex	39	58	0.0021 gr/cm2
Pongee	Silk	7 tex	4 tex	60	60	0.00459 gr/cm2
Tetex	Polyester	4 tex	4 tex	28	28	0.00127 gr/cm2
Nylon net	Nylon					0.00103 gr/cm2

Table 1

2. Results of the fabric tensile tests: new fabrics and those after 72 hours of heat induced ageing (tables 2, 3, 4 and 5).

By stretch method

Material		Strength per centimetre N/cm					
		Series					
		x		*s*		*v*	
		New	72h. in stove	New	72h. in stove	New	72h. in stove
Nylon net	columns	65.46	76.9	3.66	5.01	5.58	16.9
	rows	2.96	11.81	0.09	1.71	3.10	14.42
Tetex	warp	25.10	23.07	1.44	1.84	5.72	7.98
	weft	25.61	23.25	0.72	1.22	2.79	5.24
Silk pongee	warp	74.01	65.31	9.37	12.85	12.66	19.68
	weft	85.03	75.34	2.68	7.88	3.15	10.46
Silk crepeline	warp	13.26	11.51	1.50		11.33	
	weft	12.53	11.60	0.57	0.58	4.55	5.01
Silk organza	warp	26.57	35.74	3.26	7.51	12.26	21.03
	weft	33.92	25.83	2.48	2.89	7.31	11.19

Table 2

Results:
- The crepelina is the least resistant.
- The pongee is the most resistant.
- Fabric whose properties varied the most after heating process in the oven

Material		Length increase %					
		Serie					
		x		*s*		*V*	
		New	72h. in stove	New	72h. in stove	New	72h. in stove
Nylon net	columns	27.55	27.02	1.55	0.56	5.62	13.4
	rows	24.72	24.15	3.95	1.86	15.97	7.69
Tetex	warp	15.93	19.35	1.53	2.13	9.61	11.01
	weft	20.33	16.50	1.03	1.82	5.08	11.04
Silk pongee	warp	19.88	16.26	3.27	2.77	16.46	17.04
	weft	12.11	9.37	0.61	1.54	5.00	16.45
Silk crepeline	warp	10.91	6.23	1.85	1.85	16.95	23.9
	weft	14.00	6.63	0.64	0.64	4.54	9.58
Silk organza	warp	14.50	8.80	2.81	2.97	19.36	33.81
	weft	11.29	11.14	1.78	1.51	15.81	13.51

Table 3

Results:
- The nylon net has more stretch capacity before reaching breaking point than others.
- The crepelina of silk is the fabric with the lowest stretch capacity.
- Fabric whose properties varied the most after heating process in the oven.

Material		Strength in Newton FH.N					
		Series					
		x		*s*		*v*	
		New	72h. in stove	New	72h. in stove	New	72h. in stove
Nylon net	columns	65.46	326.57	3.66	64.27	5.58	19.68
	rows	14.81	376.68	0.46	39.39	3.10	10.46
Tetex	warp	125.52	115.37	7.18	9.20	5.72	7.98
	weft	128.03	116.27	3.58	6.10	2.79	5.24
Silk pongee	warp	370.07	326.57	46.86	64.27	12.66	19.68
	weft	425.16	376.68	13.40	39.39	3.15	10.46
Silk crepeline	warp	66.32	57.54	7.51	2.14	11.33	12.8
	weft	62.65	57.98	2.85	2.91	4.55	5.01
Silk organza	warp	132.83	178.68	16.29	37.57	12.26	21.03
	weft	169.61	129.13	12.40	14.45	7.31	11.19

Table 4

Results:
- Fabric whose properties varied the most after heating process in the oven.
- The Pongée requires more newtons exerted on it than the others for it to break.
- The Nylon net needs less newtons exterted than the others.

Material		Break point Nmm					
		Series					
		x		*s*		*v*	
		New	72h. in stove	New	72h. in stove	New	72h. in stove
Nylon net	columns	1850	1436	227.1	313.1	12.27	21.8
	rows	520	430	136.7	175.4	26.29	33.9
Tetex	warp	2440	2444	375	291	15.37	11.93
	weft	2815	2182	272.9	275.7	9.69	12.63
Silk pongee	warp	6789	4429	2400	1747	35.35	39.45
	weft	6017	4384	251.3	1128	4.18	25.78
Silk crepeline	warp	1011	473.7	251.6	127.8	24.90	26.8
	weft	1212	490.5	88.97	48.79	7.34	9.95
Silk organza	warp	2283	2036	795.2	1081	34.83	53.08
	weft	2480	1685	540.4	379	21.79	22.53

Table 5

Results:
- The pongee needs more energy of fracture.
- The crepelina needs less breaking energy, along with the nylon net. This leads us to believe that this fabric should be placed in the direction of the columns in those areas where most tension is expected to be received or where higher resistance is needed.
- Fabric whose properties varied the most after heating process in the oven.

3. Results of the colourimetric analysis

Comparative tables of the fabrics exposed and not exposed to a 72 hour heating process (tables 6, 7, 8, 9 and 10) .

Silk *organza* is material that shows greatest change before and after the heating process, which shows that it is modifies colour more than the other samples.

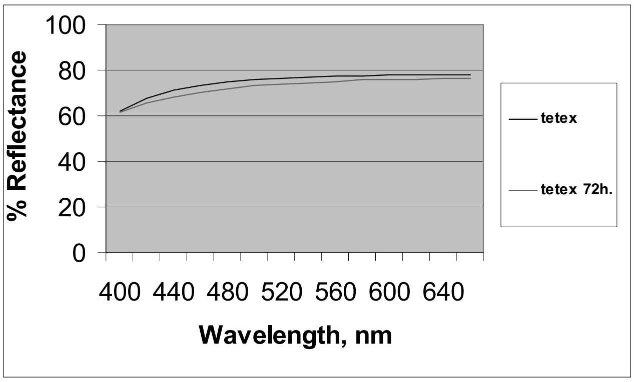

Table 6

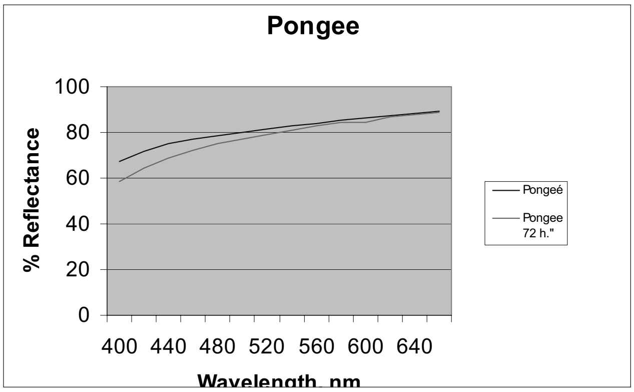

Table 7

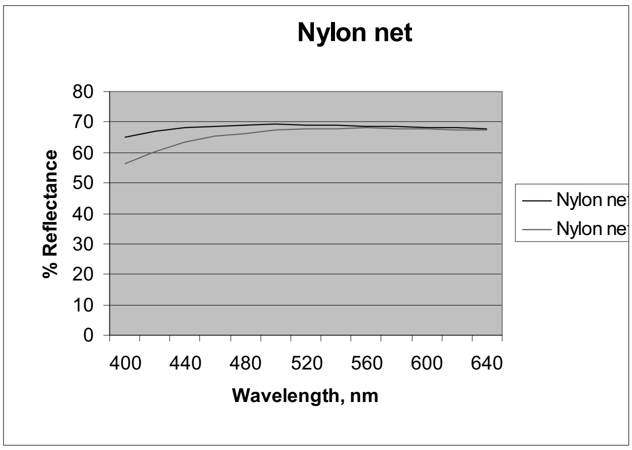

Table 8

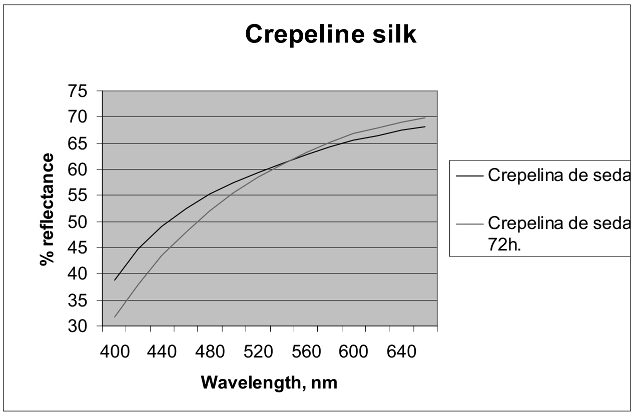

Table 9

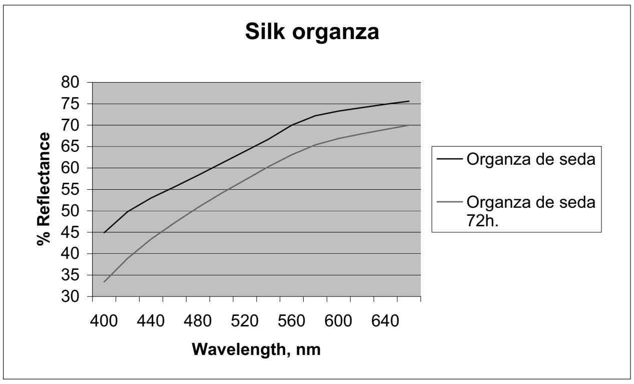

Table 10

Comparative table to measure the transparency of the analysed fabrics (table 11)

As we can see in the table below, the material which least modifies the sample colour is nylon net with pongee the material that most modifies the sample colour.

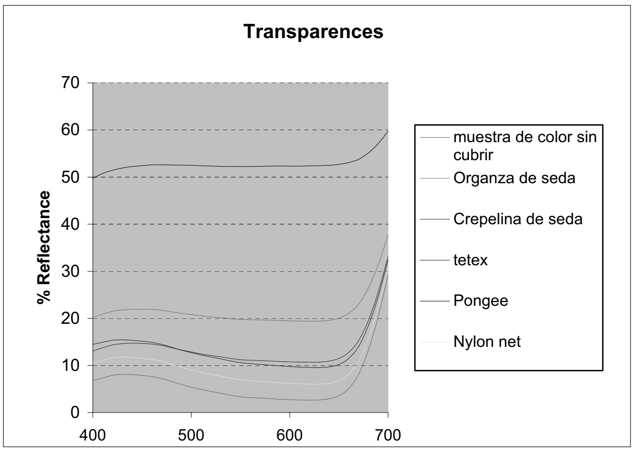

Table 11

CONCLUSIONS

By analyzing the results, we can draw several conclusions. During the research, we observed a direct relationship between weight, density with tensile resistance. Fabrics such as crepeline, which have been used for a long time, are losing their popularity and are being replaced by the more commonly used nylon net, which, in its columns has a high level of tensile resistance, responds well against aging and which has high levels of transparency. A further conclusion that can be drawn from the results is that the relative direction of placement of the fabric, weft-warp or row-column is very important, as this has large effects on the variation levels of tensile resistance.

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Versión española

TÍTULO: ***Análisis y caracterización de los tejidos que normalmente se utilizan en la consolidación textil***

RESUMEN: *Muchos de los estudios sobre la conservación de las obras textiles, han sido desarrollados en términos macroscópicos y estéticos. Esta investigación, es el resultado de una ón entre los departamentos de Conservación y Restauración de Bines Culturales y el de Ingeniería Textil y Papelera de la Universidad Politécnica de Valencia.*
Se centra en el estudio de métodos y materiales de consolidación utilizados en la conservación textil.
El presente trabajo, plantea como objetivo, estudiar las características de los tejidos que normalmente se utilizan en la consolidación, para determinar características y propiedades, de forma que sirva para poder escoger entre ellos, dependiendo de las necesidades de la pieza a intervenir y del método de aplicación que requieran.

PALABRAS CLAVE: *conservación, consolidación, textil*