The Effect of Fabric Construction Elements Variation on Some Mechanical and Physical Properties for Sueded Finished Fabrics

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Abstract:
In recent years, the use of sueding finishing has increased mainly in upholstery and clothing fabrics because it gives an aesthetic value in the fabrics and fibrous surface. When the grey fabric is sueded, it can affect the physical and mechanical properties of fabrics. The aim of this research is to investigate the effect of the sueding finishing on mechanical and physical properties and to put the most suitable standards for producing sueded fabrics by studying the relationship between fabric construction and sueding. In this research, there are 9 upholstery fabric samples, produced by using the same count in weft but different in the number of fibres in the cross-section filament and in weave structures. The grey and finished fabrics were tested with some mechanical tests. The test results obtained showed that the finished fabrics scored high rates in abrasion resistance than grey fabrics. The grey fabrics have scored high rates in tensile strength and fabric stiffness.

Keywords:
Sueding, Mechanical Properties, Fabric Construction, Weave Structure, Tensile Strength, Abrasion Resistance, Stiffness.

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Introduction:
Sueding is a mechanical finishing process in which a fabric is abraded on one or both sides to raise or create a fibrous surface. This fibrous surface improves the fabric's appearance, gives the fabric a softer, fuller hand, touches much as a peach and it can mask fabric construction and subdue coloration. It improves fabric aesthetics and it increases the value of the fabric in the marketplace.
In the textile industry, the process of sueding is also commonly known as "sanding" or "emerizing".
Sueding enhanced performance, such as the drapability, density, and uniformity of the raised fine fibers, and surface abrasion, to meet consumer demand. Also, sueding is used to prepare the fabric for subsequent raising. as a result, to make it easier to detach the fiber end.[1] Another purpose of Sueding is to alter the optical property of the surface by hiding or blending the fabric construction.[2]. Sueding can occur following bleaching and before to dyeing, as in the case of filament-woven textiles composed of polyester microfilament.[3]
The fabric to be sueded must be completely free from any finishing resin or adhesive substance remaining on the fabric surface after desizing. Also, the tension of fabric is very effective factor. It should be adjustable and readable for good sueding on the fabric area, it should be constant.
Fabric construction is an important factor in sueding process so that long weft float is advantageous since a tight plan weave is harder to suede than a 2/1 or 3/1 twill. Because the long weft floats create a better degree of fibrous surface for fabric. As well a it is necessary to prepare the fabric with non-permanent agents before sueded is done especially with polyester fabrics.[3], [4] [5]

1.1 Sueding Technology:
The technology employed in sueding has its own individuality. A sueding machine is made up of numerous rollers covered in sandpaper, which removes filaments from fabric to give it a soft hand, the warp or weft yarns on the surface of the fabric are destroyed by the sharp sand grains that stick to the sandpaper.
The used abrasive paper can vary depending on the degree of sueding needed and has to be replaced after a set number of operating hours or when it is not performing the sueding function adequately .[6]

1.2 Types of Sueding Machine:
There are two types of sueding machine.
1.2.1Single- Roller Machine: The components of a single-roller sueding machine are a metal roller with an abrasive coating and a pressure roller with rubber covering
1.2.2 Multi Roller Machine: The most common and adjustable sueding machine consists of four to twenty-four independently operated rollers covered with emery paper in varying grades

II. Experimental Work:
This research is concerned with studding the effect

of sueding finishing process on some mechanical and physical properties of upholstery sueded fabrics (tensile strength, stiffness, abrasion resistance) to enrich it and also improving its properties, and to meeting the functional purpose it is produced for. In this research 9 fabrics were produced according to 2 parameters then finished by a sueding machine.

2.1 The Parameters Used for Producing the Samples under Study:

2.1.1 First Parameter: Weave structure, this parameter consists from three levels

- Sateen 8
- Sateen 12
- Sateen 16

2.1.2 Second Parameter: Number of filaments in polyester cross section, this parameter contains 3 levels

- 144 filaments
- 288 filaments
- 576 filaments

2.2 Specifications (Machine and Fabrics)

2.2.1 The machine specification:

Table (1) machine Specifications

Type of loom	ALPHA
Manufacturing Country	Italy
Date of Manufacturing	2003
Reed count	15.5dent/cm
Denting	4 Ends/Dent
Width of reed	240 Cm
Shedding Device	Jacquard
Model of shedding Device	STAUBLI
Manufacturing Country	France
Jacquard Capacity	2688 Hooks
Design Hooks	2400Hooks
Harness Building Type	Straight
Weft Insertion Device	Rapiers
Capacity of weft selector	8 colors (fingers) and 2 fingers used for the design
Loom Speed	280R.P.M

2.2.2 Sueding machine specifications:

Table (2) sueding machine specifications

Brand name	Lafer SPA
Type/model no	GSI106
Manufacturing country	Italy
Year	2002
Machine speed	50m/min (max)
No of cylinder	Drum with 8 rollers with sand paper
No of motor	8
Working width	170 cm

2.2.3 The specifications of the produced fabrics:

2.2.3.1 Warp specification:

Table (3) warp specifications

Warp specification	
Material:	Polyester
Density/cm:	66 end / cm
Warp count	150 denier

2.2.3.2 Weft Specification:

Table (4) weft specification

Weft specification	
Material:	Polyester
Density/cm	30 pick /cm
Weft arrangement	1 weft 1(face): 1 weft 2 (back)
Weft 1 count	300 denier
Weft 2count	150 denier

2.4 Laboratory Tests Applied to Samples under Study:

2.4.1 Abrasion Resistance Test:

The test was done according to American standard specifications of JIS L 1018. [7]

2.4.2 Stiffness Test:

The test was carried out according to American standard specifications of ASTM D 3885. [8]

2.4.3 Tensile Strength Test:

The test was carried out according to standard specifications of ASTM D 5035. [9]

III. Result and Discussion:

The produced fabrics in this research were tested for some essential functional properties which reflected to their end uses.

Table (2) Results of Abrasion Resistance, Stiffness and Tensile Strength tests

	Sample Code	Samples parameters		Abrasion Resistance	Stiffness (MLG)	Tensile strength (Kg)
		No.of.filaments	Weave structure			
Before finishing	1	144	Sateen 8	1250	2670	123
Before finishing	2	144	Sateen 12	1000	2581	121
Before finishing	3	144	Sateen 16	882	2403	110
Before finishing	4	288	Sateen 8	1410	2404	140
Before finishing	5	288	Sateen 12	1390	2215	138
Before finishing	6	288	Sateen 16	1000	2136	133
Before finishing	7	576	Sateen 8	1740	2315	147
Before finishing	8	576	Sateen 12	1530	2200	145
Before finishing	9	576	Sateen 16	1100	2118	135
After finishing	10	144	Sateen 8	1530	2314	112
After finishing	11	144	Sateen 12	1420	2290	92
After finishing	12	144	Sateen 16	1320	2270	88
After finishing	13	288	Sateen 8	1580	2236	80
After finishing	14	288	Sateen 12	1490	2116	77
After finishing	15	288	Sateen 16	1215	2098	75
After finishing	16	576	Sateen 8	1790	2181	52
After finishing	17	576	Sateen 12	1765	1600	38
After finishing	18	576	Sateen 16	1300	1513	35

3.1 Fabric abrasion resistance test:

3.1.1 Effect of the number of filaments in cross-section (multi filaments) on fabric abrasion resistance:

It can be observed from table (5) and figure (1), (2) that the finer fibers give better abrasion so using finer fibers in the production of yarns causes an increment in the number of the fiber in the yarn cross-section with higher cohesion which results in better abrasion resistance. So, abrasion retention is better for fabrics with finer fibers. Fig. (1),(2) illustrates all the samples produced from 576 filaments scored the highest rates of abrasion resistance as samples number (16,17,18,7,8,9) Followed by 288 filaments samples numbers (13,14,15,4,5,6), the samples scored the least records produced from 144 filaments as samples number (10,11,12,1,2,3).

From the previous results table (5) and figure (1), (2) found that samples after sueding finishing gives better abrasion resistance than samples without sueding finishing. Due to the fabric will achieve a closer state, and the movement of fibers within the yarn will be limited. So, the sample scored highest rate is after finishing sample number (16).

3.1.2 Effect of weave structure on fabric abrasion resistance:

From the previous results table (5) and figure (1), (2) it is obvious that there is an inverse proportion between float length and abrasion resistance. so that a smaller float length gives better abrasion. Because the yarns are more tightly locked in structure and the wear is spread more evenly over all of the yarns in the fabric also more intersections give high crimp in weft direction towards the abrading surface.so highly crimped yarns will resist greater damage.

Fig (1),(2) illustrates all the samples produced by sateen 8 scored the highest rate of abrasion resistance as samples number (16,13,10,7,4,1) Followed by the samples produced by sateen 12 samples numbers (17,14,11,8,5,2).the samples scored least rates are produced by sateen 16 are number (18,15,12,9,6,3).

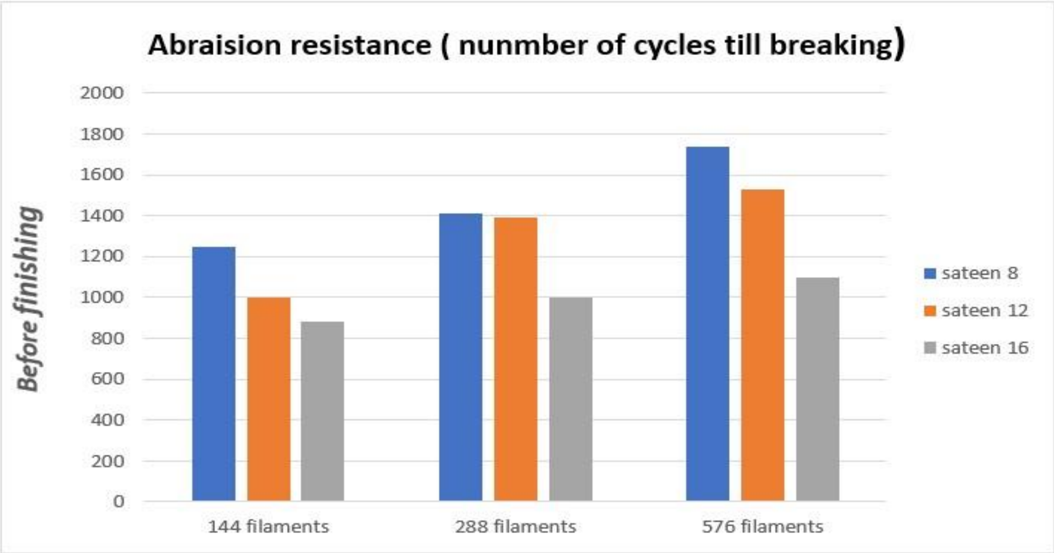

Figure (1) the effect number of filaments in yarn cross -section and weave structure on abrasion resistance before finishing

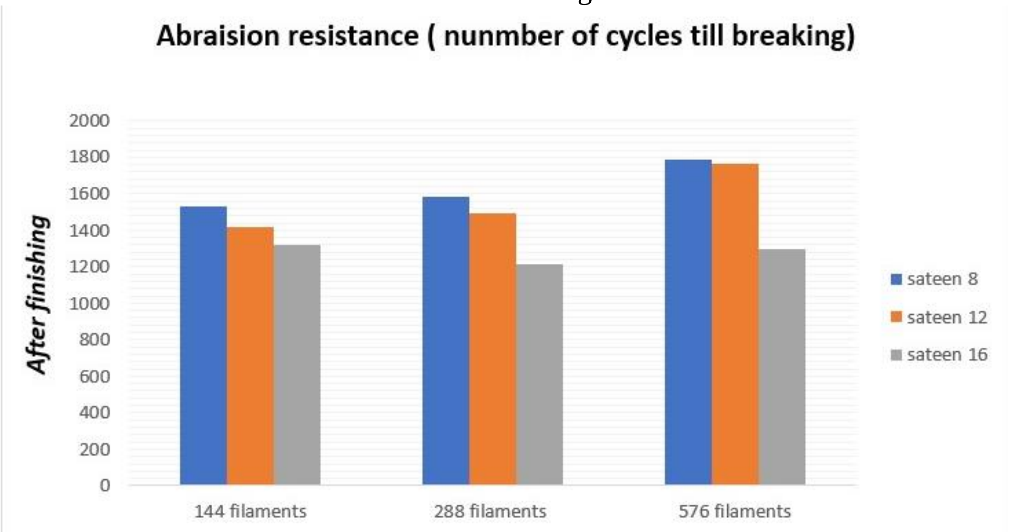

Figure (2) Effect of sueding on abrasion resistance after finishing

3.2 Fabric stiffness test:

3.2.1 Effect of the number of filaments in cross-section (multi filaments) on fabric stiffness:

The previous results are shown in table (5) and figure (3), (4) indicating that there is an inversely proportional between the number of filaments in yarn cross-section and stiffness. This is due to stiffness is usually controlled by fiber stiffness. This is because the freedom of movement of fibers in the yarn reduces stiffness and increase flexibility. And fabrics made of microfiber have unique properties like light weight and excellent drape because of their excellent finesse.

So from The previous results are shown in table (5) and figure (2), It can be seen that samples produced from 144 filaments scored the highest rates of stiffness as samples number (1,2,3,10,11,12). Following by 288 filaments samples numbers (4, 5, 6, 10, 11, 12) the samples scored the least records produced from 576 filaments as samples number (7, 8, 9, 16, 17, 18).

From the figure (2), it is noticed that after sueding finishing stiffness decreased. because sueding finishing improves fabric durability. Because of the fibrous surface gives the fabric softness and makes it more drape. So, the highest sample scored high rate of stiffness is before finishing sample number (1).

3.2.2 Effect of weave structure on fabric stiffness:

The previous results are shown in table (5) and figure (3), (4) show that the tight structure (smaller float) gives more stiffness than wide structure. This is due to the greater number of interlacements making the fabric have more stiffness.

So from figure(3), (4) it is noticed that all the samples produced by sateen 8 scored the highest rate of stiffness as samples number (16, 13, 10, 7, 4, 1) Following by the samples produced by sateen 12 samples numbers (17, 14, 8, 5, 2), the samples scored the least records produced by sateen 16 as samples number (18,15,12,9,6,3).

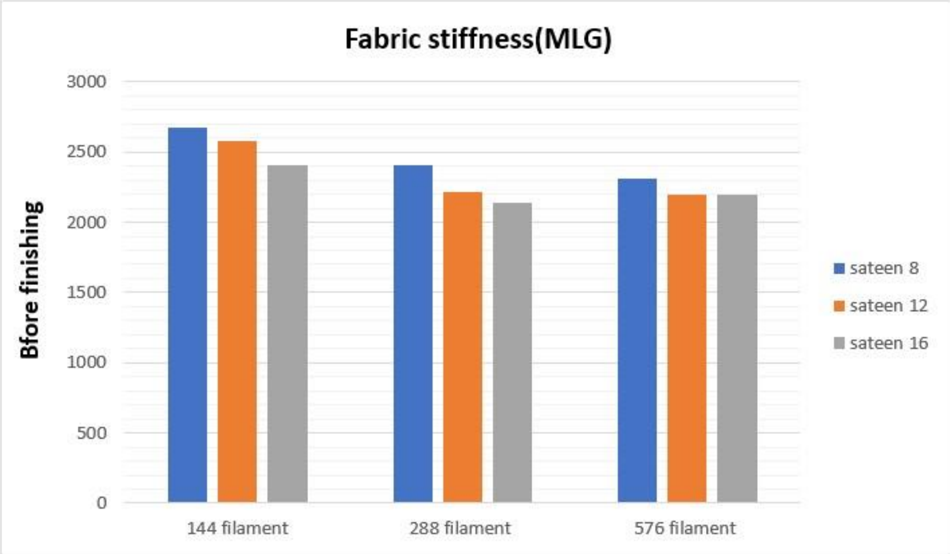

Figure (3) the effect number of filaments in yarn cross -section and weave structure on fabric stiffness before finishing

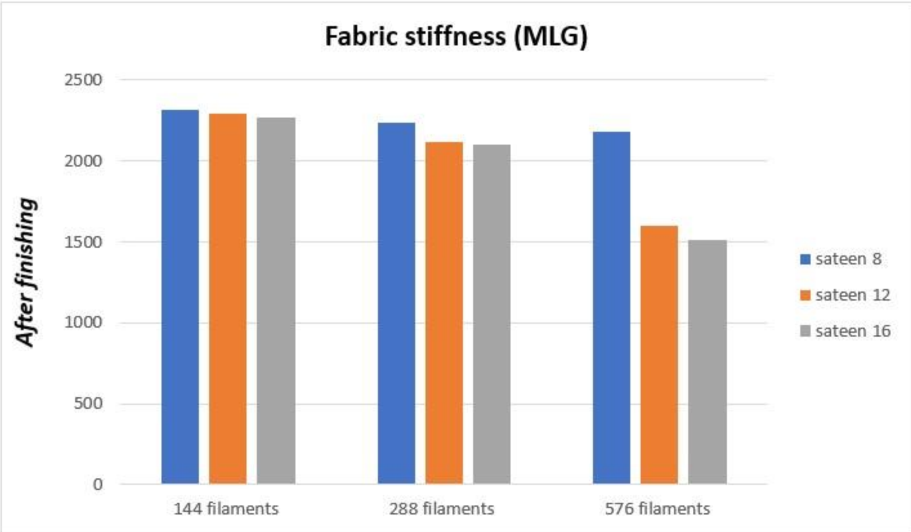

Figure (3) Effect of sueding on fabric stiffness after finishing

3.3 Fabric tensile strength:

3.3.1 Effect of the number of filaments in cross-section (multi filaments) on fabric tensile strength:

According to the results of the fabric tensile strength test table (5) figure (5), (6) It was observed that fine fiber gives strong yarn compared to coarser fibers which are spun into the same yarn count. This is due to the fact that a greater number of fibers in the cross section increase the internal friction provided by the higher number of fibers in the cross-section of yarn.

Figure (3) illustrates all the samples produced from 576 filaments scored the highest rate of tensile strength as samples number (7,8,9) Followed by 288 filaments samples numbers (4,5,6) the samples scored the least records produced from 144 filaments as samples number (1,2,3) before sueding finishing.

As far as it seems to microfiber samples after finishing lost more strength than ordinary fibers. Because of microfiber's **finesse** and the super small diameters of microfibers in yarn cross-section when these are exposed to the abrasion in sueding process. So, from presented results in table (5) the samples record least tensile strength after sueding finishing produced by 576 filaments number (18,17,16) followed by ones produced by 288 filaments number (14,15,16) and the samples scored highest rate after finishing which produced by 144 filaments number (10,11,12)

From the previous results of the fabric tensile strength test table (5) and figure (5), (6) it is clear that the samples after sueding finishing is less strong than samples before finishing. This could be explained that the fiber's mass is missed during sueding finishing. Also, fibers are raised to the fabric surface, the strength of these fibers would have contributed to the overall strength of the fabric construction is lost. Naturally, strength losses increase in direct proportion to the amount of pile created.

3.3.2 Effect of weave structure on fabric tensile strength test:

It is clear from figure (5), (6) and table (5) that smaller float length gives higher tensile strength. It is may be attributed to the following reasons:

1- The decrease in float length increase the number of interlaces the higher the strength under the same conditions. And weft crimp increases as a result the resistance of the fabric to tensile strength increases.
2- The increase in intersections increase the friction between yarns and increase the fabric coherence leading to increase the fabric tensile strength.

So from figure (5),(6) it is noticed that all the samples produced by sateen 8 scored the highest rate of tensile strength as samples number (1,4,7,10,13,15)Followed by the samples produced by sateen 12 samples numbers (2,5,8,11,14,17),the samples scored the least records produced by sateen 16 as samples number (18,15,12,9,6,3).

From figure (5), (6) it is clear that the fabrics before finishing (grey fabrics) have scored high rates for tensile strength. so, the highest sample scored is before finishing sample number (7).

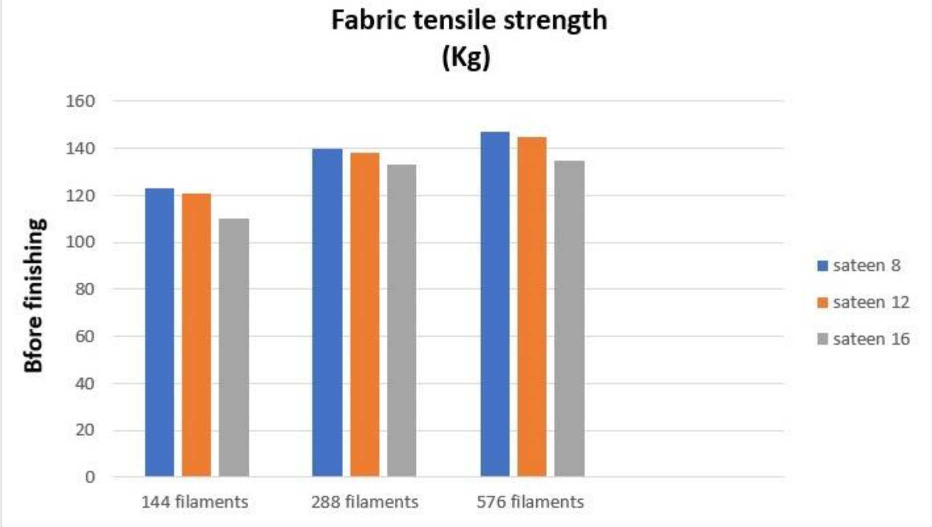

Figure (5) the effect number of filaments in yarn cross -section and weave structure on fabric tensile strength before finishing

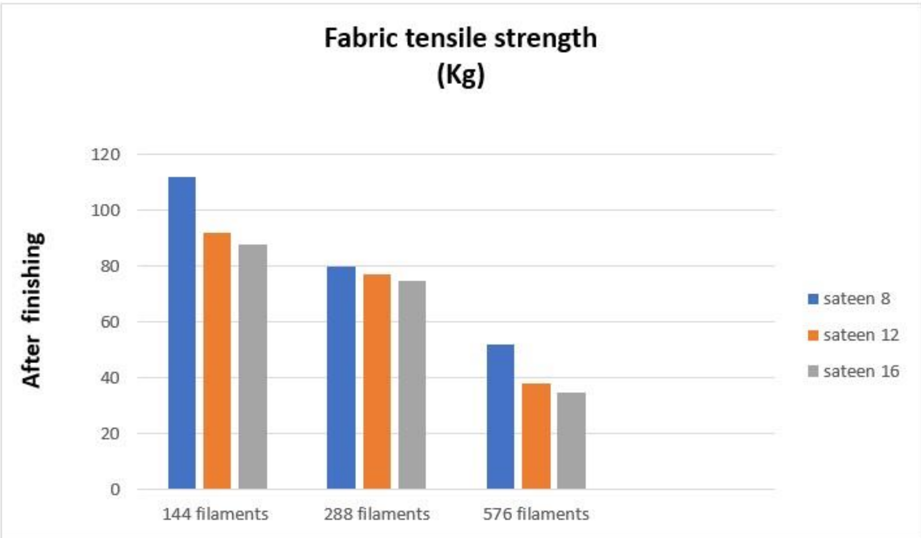

Figure (6) Effect of sueding on fabric tensile strength after finishing

IV. Conclusions:

From the previous results and discussion concerning some conclusions were achieved benefiting from it in the production of these type fabrics (Sueded fabrics) and their mechanical properties which effects on their efficiency in the end use. These conclusions are:

1- There is direct proportion between fiber finesse and abrasion resistance.
2- The smaller float gives better abrasion resistance
3- Samples after sueding finishing gives high rate of abrasion resistance.
4- Based on the results, we also conclude that there is an inversely proportional between the number of filaments in yarn cross-section and stiffness.
5- As far as the effect of fabric structure on fabric stiffness is concerned, it has been found that stiffness is affected by the number of yarn

intersections. the more yarn intersection the more stiffness in fabrics.

6- It was observed that samples after sueding finishing their stiffness decreased. This indicates that sueding finishing improves fabric durability.
7- There is a direct relationship between number of filaments in yarn cross -section and samples tensile strength.
8- Specially microfiber samples influenced by the abrasion which occurs in sueding process.
9- Samples which have tight structure scored high rate of tensile strength than others have wide structure.
10- The finished samples scored less rate of tensile strength than grey ones.

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