International Journal of Advances in Scientific Research and Engineering (ijasre)

E-ISSN : 2454-8006

DOI: 10.31695/IJASRE.2023.9.6.9

Volume 9, Issue 6
June - 2023

The Impact of Weave Structure on the Efficiency Characteristics of Chenille Yarn-Produced Upholstery Woven Fabric

Dr. Marwa Yassin

Lecturer at Spinning, Weaving and Knitting

Department Faculty of Applied Arts

Benha University, Egypt

ABSTRACT

In this study, we have investigated the effect of weaving structure on the Efficiency properties of upholstery woven fabrics. Different four weaving structures have been produced in four samples. To Enhance Efficiency properties through the effect of weave structure in terms of (friction, pilling, thickness, weight, and tensile properties), chenille yarns were used as weft yarn. All the samples were tested for fabric friction, pilling, thickness, weight, and tensile properties. The results indicate that weaving structure has a significant effect on the Efficiency properties of upholstery fabrics.

Key words: Chenille Yarn, Efficiency Properties, Upholstery Fabrics, Weaving Structure.

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1. INTRODUCTION

Upholstery fabrics are a large subcategory of home textile items and account for a sizable share of both textile imports and exports. The Traditional upholstery like furniture, automobile, upholstery like automotive, marine upholstery, and other all of these make extensive use of upholstery materials. Given how frequently upholstery materials are used, great performance is necessary.

The development of product qualities in textile design, particularly in the choice of textile goods and raw materials, is influenced by shifts in fashion trends. In recent years, the design and application of fancy yarns have grown, especially for upholstery fabrics, in terms of aesthetic qualities and visual standards. Chenille yarns, which have a lovely and voluminous appearance, are the decorative yarns most frequently used in upholstery [1].

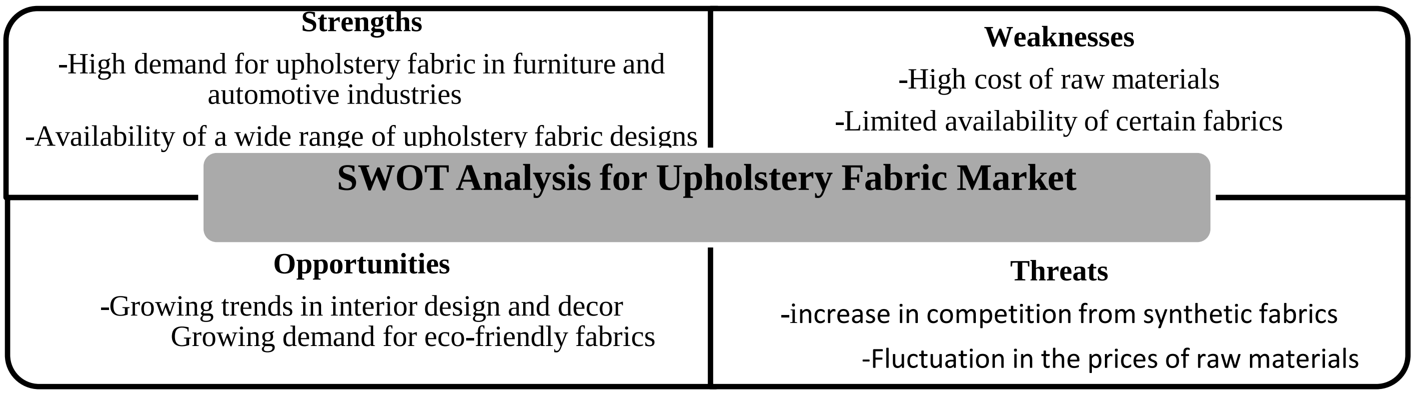


Figure 1: Swot analysis for upholstery fabric market [2] (Upholstery Fabric Market Report Global Forecast From 2022 To 2030, 2022)

Figure2: market research report titled Furniture Market[3] (GLOBAL FURNITURE MARKET2021-2025, 2021)

From the foregoing, it is clear to what extent the upholstery fabric market is growing during the current period and expected for the coming period, which requires attention to its specifications and characteristics.

A fancy yarn is one that intentionally introduces irregularities into its creation to deviate from the typical construction of single and folded yarns . The materials' ornamental effects are aided by fancy yarns. Fancy yarns are used for aesthetic purposes.became well-known textile novelty items over the past century, but the market boom for non-traditional yarns didn't occur until the 1970s. In the modern world, fancy yarns are a crucial end result of the spinning and twisting processes.Commercial chenille production began in the 1970s and has continued into the 1990s. Chenille is a pile fancy yarn that is becoming more and more fashionable every day [4].

Chenille yarns have a wide range of applications, Chenille yarns are known for being thick, soft, and light,
and have a furry surface, lustrous appearance, and color properties.However, Chenille yarn has a flaw in that it has poor properties for abrasion resistance. The physical characteristics and aesthetic appeal of the fabric deteriorate when the pile yarn is removed during fabric processing or during the intended use [5].

Weave structures are the backbone of the fabric, as they have a strong and direct impact on most of the properties and characteristics of the fabric , Where it plays a pivotal role in how the warp and weft threads intertwine, in order to achieve the functional and aesthetic performance required for the fabric.

Efficiency properties of fabrics vary according to the final purpose of end using the fabric, Among the properties that we will shed light on is(thickness , pilling , friction ,weight, tensile properties).

Fabrics are compressible material therefore, thickness gauge is one of the important properties of upholstery fabrics ,
Through testing and measuring the thickness of the executed research samples, we found that the thickness varied according to the weave structure used, The thickness also has vital effect on appearance and functionality of upholstery [6].

When the surface of the fabric touches another surface in the presence of movement in any direction, a force of **friction** is generated between the two surfaces.Corrosion is the apparent result of friction, but there are many non-apparent changes that occur in fabrics and affect their properties, specifications, and efficiency.(5)

Where **tensile strength** is one of the most important mechanical properties of fabrics, which expresses the behavior of fabrics under the influence of tensile forces applied on its axis, and the nature of use of the tested fabric is the main factor in determining the level of load required to be applied to the test sample, as it is not necessary to reach the cutting point, but it may be sufficient With a limited load amount commensurate with the required performance efficiency [7].

Pilling the entanglement of fibres, generally termed as pills, stands protruding on the fabric surface during use [8].

In this research paper, we aim and look forward to to Enhance Efficiency properties through the effect of weave structure in term of (friction , pilling ,thickness, weight, tensile properties) As we will show below.

2. MATERIALS AND METHODS

Efficiency properties are essential to chenille upholstery fabric such as thickness, weight, friction resistance, because lint loss can occur as a result of use and friction. Upholstery fabrics must be resistant to abrasion, which occurs as a

DOI: 10.31695/IJASRE.2023.9.6.9

result of friction ,In this investigation, we initially produced these samples using chenille yarns as weft yarns to Produce an upholstery fabric with four weave structures in order to study the relationship between the weave structures, and the performance properties of the chenille upholstery fabrics.

Upholstery Fabric Research Target, which is plain pattern structure, has been produced with four different weave structures, and we will show the executive specification as below.

2-1-1-Specifications of the Machine Used In Production

Table 1. Specifications of the machine

N	Specifications of the machine	
1	Shedding device	Jacquard
2	Type machine	Picanol optimax
3	Country of origin	Belgium
4	Manufacturing year	2017
5	Manufacturing company	Stäubli
6	Speed of the machine	300 picks \ min
7	Width of warp without selvage	140 cm
8	Number of repeat	4 repeats
9	Repeat width	36.36 cm
10	Jacquard capabilities	2866 hooks
11	Design hooks	2400 hooks
12	Jacquard net construction method	Parcel
13	Reed used (dents per cm)	11 dents \ cm
14	Denting	6 ends \ dent

2-1-2-specifications of the warp used in production:

Table 2. Specifications of the warp

N	Specifications of the warp	
1	Warp threads per cm	66 threads\cm
2	Warp material	Polyester
3	Warp count	150\1 denier
4	Warp colour	1 black:1 gold

2-1-3-specifications of the weft used in production:

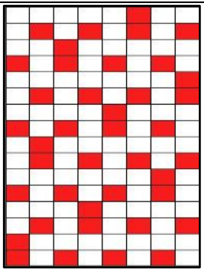
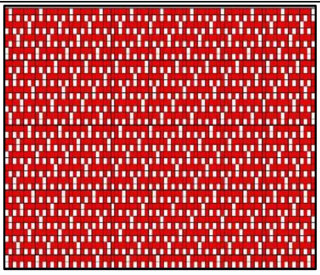
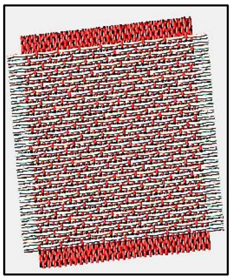
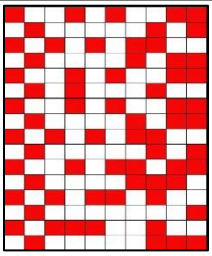
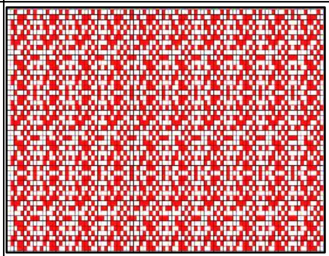
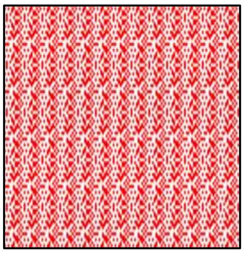
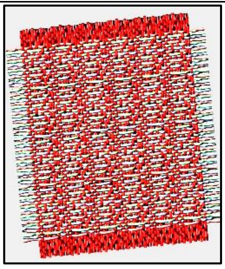
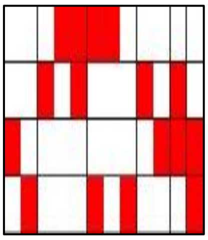
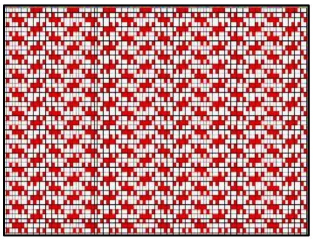
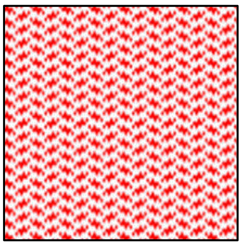
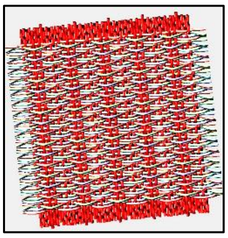
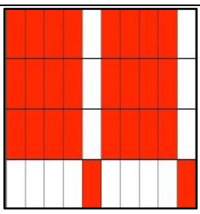
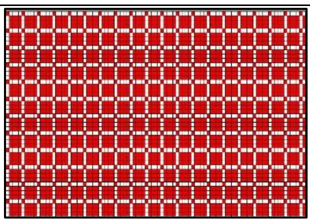
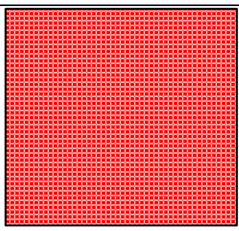
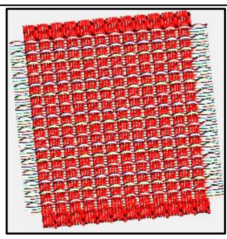
Table 3. Specifications of the weft.

N	Specifications of the weft	
1	weft picks per cm	15 picks\cm
2	Weft material	Polyester chenille:Polyester punch
3	weft count	4.5\1 m:300\1 denier
4	Weft colour	Chenille gold:polyestergold

DOI: 10.31695/IJASRE.2023.9.6.9

2-1-4-specifications of the weave strucure used in production

Table 4. Specifications of the wave structure

specifications of the weave structure					
N	Weave structure	Executive drawing by Texcelle	The executive drawing of the entrance to the machine	3D-simulation	Executed samples
1					
2					
3					
4					

Then the tests were conducted on the implemented samples to analyze the results of tests and verify the hypotheses of the research results. The tests were as follow.

2-2 The Tests

2-2-1 Test Fabric Weight

This test was followed (ASTM D3776 / D3776M - 09a Standard Test Methods for Mass Per Unit Area (Weight) of Fabric), In this test, a number of samples measuring 10 x 10 cm are made, and using a sensitive scale with four decimal digits, the weight is calculated for each sample, then the arithmetic average of the samples is calculated, and by multiplying the result by 100, we get the weight of the square meter,the results are as follows:

DOI: 10.31695/IJASRE.2023.9.6.9

Table 5. Test readings for weight per square meter of fabric.

N	Readings cm^2\gm			Average	Square meter weight
	1	2	3		
1	4.3957	4.3635	4.3345	4.3345	436.45
2	3.9651	3.8683	3.8685	3.9006	390.06
3	3.8204	3.8833	3.8606	3.8547	385.47
4	3.0103	3.0143	2.9864	3.0036	300.36

2-2-2 Test Fabric thickness

This test was followed (ASTM D1777 - Standard Test Method for Thickness of Textile Material)
The thickness of the fabric is measured by passing the fabric under the foot of the device under the weight of the foot only, and the measurement is done in more than one place of the fabric after it has been straightened and not exposed to any external pressure or influence, the results are as follows.

Table 6. Test readings for thickness per mm of fabric.

N	Readings					Average
1	1.62	1.67	1.68	1.72	1.70	1.67
2	1.30	1.32	1.29	1.32	1.33	1.31
3	1.40	1.43	1.42	1.41	1.45	1.42
4	0.84	0.86	0.85	0.86	0.88	0.85

2-2-3 Test Fabric friction(abrasion)

This test was followed (ASTM D4966-22) often stated in terms of the number of cycles on a specified machine, using a specified technique to produce a specified degree or amount of abrasion caused by friction, Since abrasion is the result of friction, abrasion resistance is an important property in the efficiency properties of fabrics to any external pressure or influence, the results are as follows:

Table 7. Test readings for friction of fabric.

N	Reading
1	2100
2	2730
3	4710
4	1743

2-2-4 Test Fabric pilling

This test was followed (ASTM D4970\D4970M-16e3) Pills vary appreciably in size and appearance and depend on the presence of lint and degree of color contrast. These factors are not evaluated when pilling is rated solely on the number of pills.The degree of fabric pilling is evaluated by comparing the tested specimens with visual standards,

DOI: 10.31695/IJASRE.2023.9.6.9

which may be actual fabrics or photographs of fabrics, showing a range of pilling resistance. The observed resistance to pilling is reported on an arbitrary scale ranging from 5 to 1 (no pilling to very severe pilling).
to any external pressure or influence, the results are as follows:

Table 8. Test readings for pilling of fabric.

N	Reading
1	5
2	5
3	4.75
4	4.75

2-2-5 Test Tensile Strength and Elongation Fabric

This test was followed (Tensile properties of fabrics ISO13934),Determination of maximum force and elongation at maximum force using the strip method ,The method is restricted to the use of constant rate of extension (CRE) testing machines, According to the following:

Table 9. Tensile strength and elongation test specifications

N		
1	Load Range	1000 N
2	Extension Range	250 mm
3	Gauge Length	200 mm
4	Speed	100 mm\min
5	Preload	0.01 N
6	Auto Reurn	On

The results are as follows:

Table10. Test readings for Tensile strength and elongation of fabric

N	Warp Specimen	Elongation %	Maximum Force N
Sample 1	Warp 1	18.30	1153
	Warp 2	19.76	1138
	Warp 3	12.75	1228
	Mean	16.94	1173
	Std. Dev.	3.699	48.22
Sample 2	Warp 1	17.55	962
	Warp 2	16.76	952
	Warp 3	17.10	943
	Mean	17.14	952
	Std. Dev.	0.3950	9.51
Sample 3	Warp 1	17.96	998
	Warp 2	16.35	881
	Warp 3	16.55	905
	Mean	16.95	928

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	Std. Dev.	0.879	61.8
Sample 4	Warp 1	8.44	519.0
	Warp 2	8.96	484.5
	Warp 3	8.76	488.5
	Mean	8.72	497.3
	Std. Dev.	0.2648	18.87

3. RESULTS AND DISCUSSION

Based on the above and what was produced from the samples according to the weave structure of the sample used, a test is performed for the characteristics of the samples in terms of (weight, thickness, heaviness, friction, tensile strength and elongation), and based on the results of those tests, Knowing that all the inputs are stable with only one element changing, which is the weave structure, to which the results will be attributed .we can discuss the results as follows:

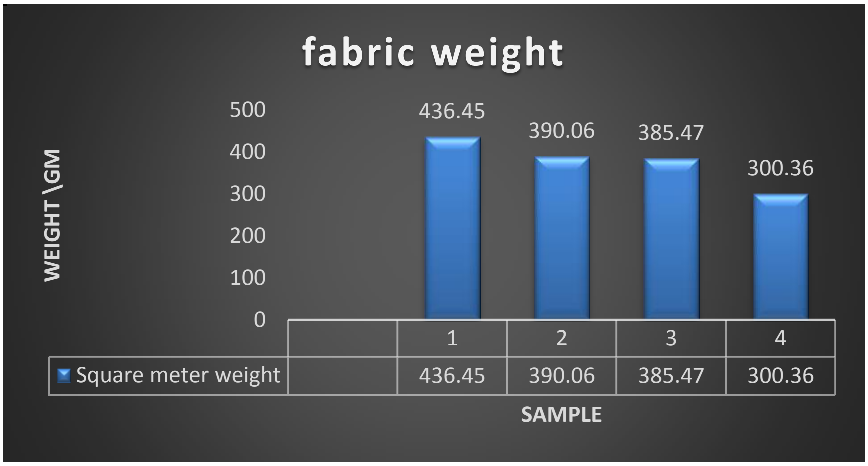

Figure1.Comparative analysis of Fabric weight

Based on the results of the weight test, and as shown in the Figure1, we find that the weave structure of the sample (1) achieved the highest weight, while the weave structure of the sample(4) achieved the lowest weight.

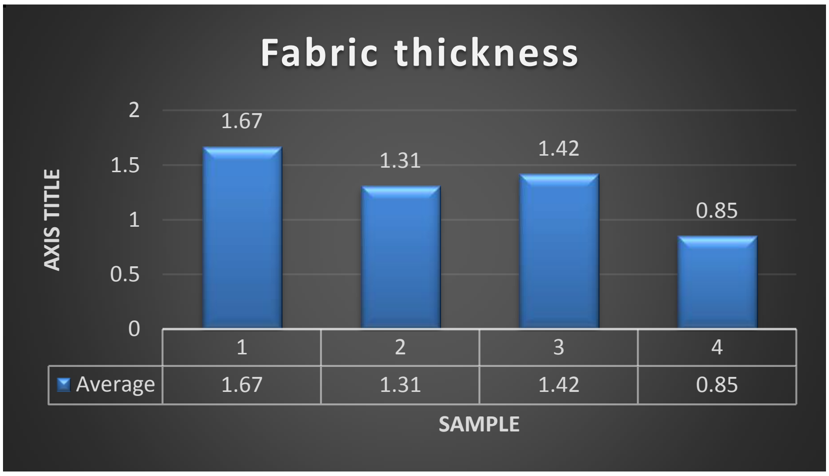

Figure2. Comparative analysis of Fabric thickness

The weave structure of the sample (1) obtained the highest thickness, while the weave structure of the sample (4) achieved the lowest thickness, according to the fabric thickness test findings, as shown in Figure 2.

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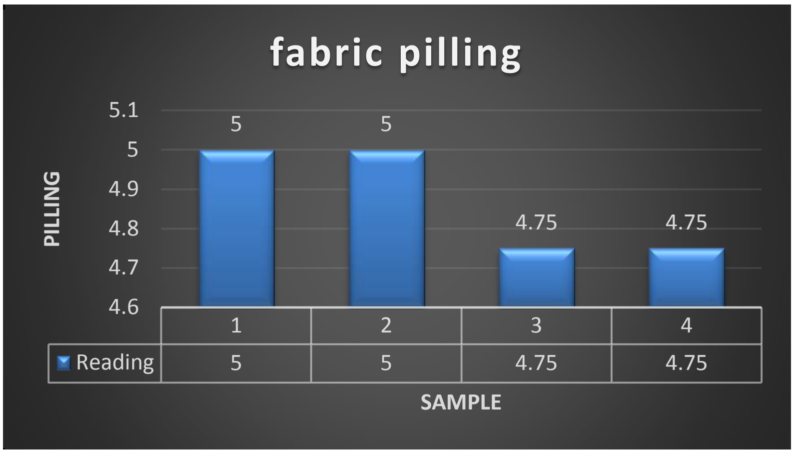

Figure3. Comparative analysis of Fabric pilling

Based on the results of the pilling test, and as shown in figure 3, we discover that samples 1 and 2's weave structure was equal in achieving the highest resistance to pilling; while samples 3 and 4's weave structural composition was also equal in achieving a slightly lower resistance to pilling. However, overall, the four samples almost attained the highest level of pilling resistance.

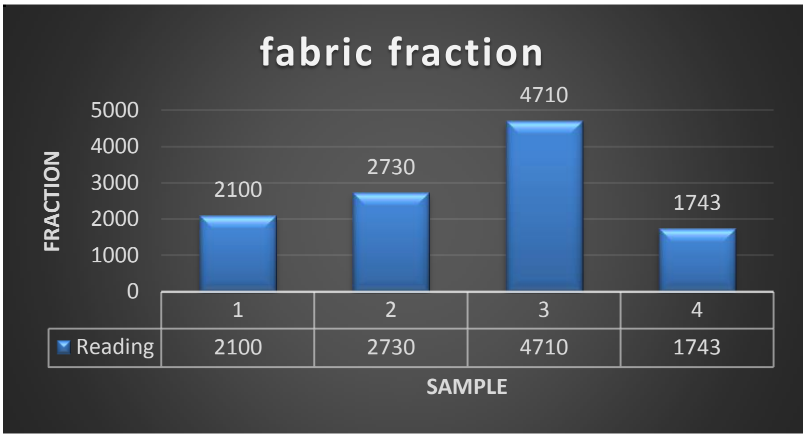

Figure4: **Comparative analysis of Fabric fraction**

It is clear from the results of the friction test, as shown in the figure 4, that the weave structure of the sample 3 achieved the highest rate of friction and abrasion resistance, while the weave structure of the sample 4 achieved the lowest rate of friction and abrasion resistance.

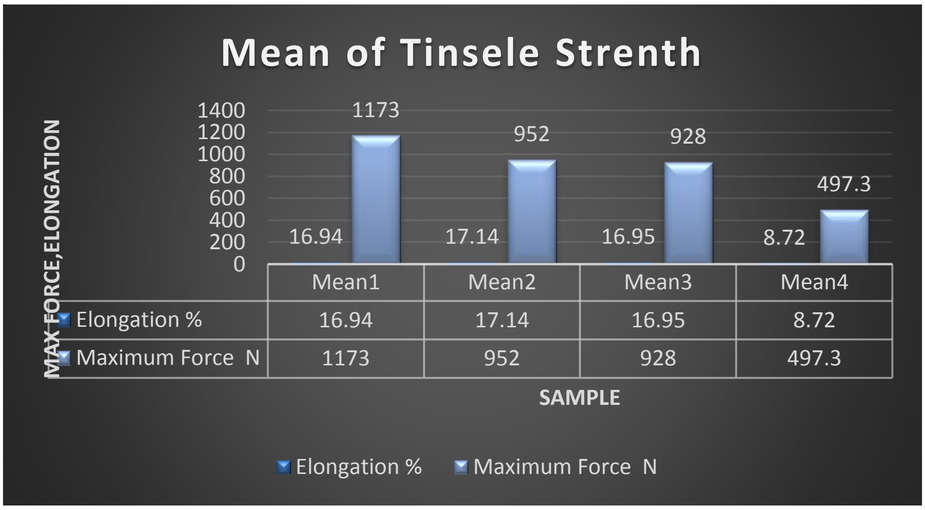

Figure5: Comparative analysis of Mean of Fabric tensile strength & elongation

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As shown in Figure 5, the weave structure of sample 1 represents the highest average tensile strength and elongation, while the weave structure of sample 4 represents the lowest average tensile strength and elongation.

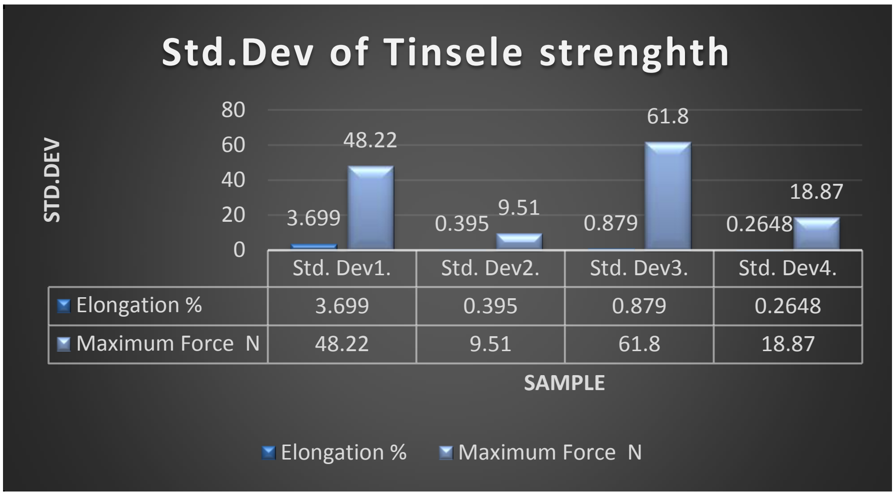

Figure6: Comparative analysis of Std. Dev of Fabric tensile strength & elongation

Figure 6 shows that Standard deviation of Fabric tensile strength elongation the weave structure of sample 3 is the highest, while the weave structure of sample 2 is the lowest.

Thus, we have proven the hypothesis of the association and influence of the textile structure on the properties of the upholstery fabrics in question.

Then we discuss now the arrangement of the weave structures of the implemented samples in terms of achieving the results based on the results of the tests that were conducted, which are shown in the following table (11).

Table 11. The order of achieving the weave structures of the samples for the tested properties.

	weight	thickness	pilling	fraction	Mean t.s	std.dev t.s
sample1	1	1	1	3	1	3
sample2	2	3	1	2	2	1
sample3	3	2	2	1	3	4
sample4	4	4	2	4	4	2

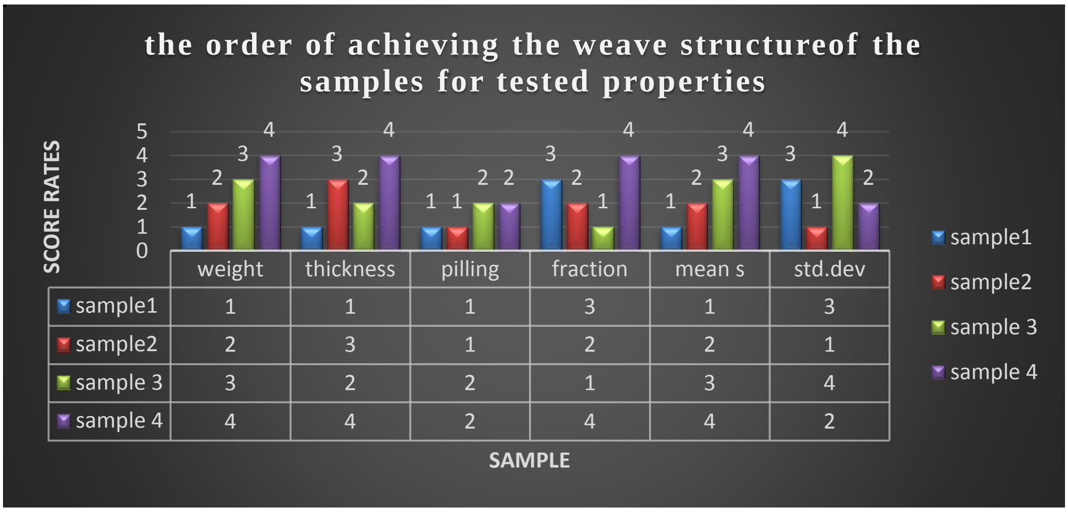

Figure7: Comparative analysis of the order of achieving the weave structure of the samples for tested properties

We conclude from the foregoing that the weave structure has a prominent and influential role in the efficiency properties (weight - thickness - pilling - tensile strength and elongation - friction and abrasion resistance), which is clearly reflected in the good performance, longevity and efficiency of use chenille yarn-produced upholstery woven fabric.

DOI: 10.31695/IJASRE.2023.9.6.9

It is among the four weave structures that have been used, implemented, and tested for their effect. We can say that the weave structure of the first sample occupies the leading position in terms of weight, thickness, and mean of tensile strength and elongation, while it shares the first place with the weave structure of sample 2 in the pilling, while it occupies the second place in Standard deviation tensile strength and elongation.

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