[International Design Journal](https://digitalcommons.aaru.edu.jo/faa-design)

Volume 11
Issue 4 *Issue 4*

Article 29

2021

The Mechanistic role in production linen fabric using different Piqué Technique.

Ahmed Ramadan Abd El Hamid Mohammed El-Tantawi
Faculty of Applied Arts, Spinning Weaving and knitting Department, Damietta University., en_a.r5050@hotmail.com

Follow this and additional works at: https://digitalcommons.aaru.edu.jo/faa-design

Part of the Art and Design Commons

Recommended Citation

El-Tantawi, Ahmed Ramadan Abd El Hamid Mohammed (2021) "The Mechanistic role in production linen fabric using different Piqué Technique.," *International Design Journal*: Vol. 11 : Iss. 4 , Article 29.
Available at: https://digitalcommons.aaru.edu.jo/faa-design/vol11/iss4/29

This Article is brought to you for free and open access by Arab Journals Platform. It has been accepted for inclusion in International Design Journal by an authorized editor. The journal is hosted on Digital Commons, an Elsevier platform. For more information, please contact rakan@aaru.edu.jo, marah@aaru.edu.jo, u.murad@aaru.edu.jo.

The Mechanistic role in production linen fabric using different Piqué Technique.

Ahmed Ramadan Abd El Hamid Mohammed El-Tantawi.
Faculty of Applied Arts, Spinning Weaving and knitting Department, Damietta University.
en_a.r5050@hotmail.com.

Abstract:
Each fabric material has its unique existence; for instance, the Linen fabric is popular not only for its attractive appearance and rich history but also the manufacture of this fabric is characterized by complicated interlacing techniques to shows its splendor. When it comes to varieties of piqué technique to production most linen fabric in markets, it is worth understanding about realizing process owing to a decade's worth of learning from its manufacturing experience. This study intends to analyze the respective effect of the mechanistic role at weaving machines as shed angle, warp tension and weave density with different pique techniques on Linen fabrics propriety. It is founded that Clear Positive and Opposite relationships between measured parameter give clear judgment for assessing the behavior of blended linen fabrics for textile manufacturers in terms of mechanical and physical properties with customer satisfaction is intended; as well as an indicator for reasoning cluster of excellence integrative production and economical aspects, which is a factor in markets

Keywords:
Linen Fabrics, Piqué Technique., Shed Angle.

Paper received 5th April 2021, Accepted 25th May 2021, Published 1st of July 2021

Introduction

Few can dismiss linen's immense worth as one of nature's most valuable commodities. Linen is a longer-staple category, and as such, the fiber is spun on a long-fiber spinning system [5]. For desired performance properties on some end use beside reduce costs in some situations, linen is blended with other fibers such as cotton, viscose, and polyester.

Due to continuous progress in technology and the efforts of numerous researchers, Fabrics are produced from One hundred percent linen and their blends with natural fibers and man-made fibers have been studied for handle and comfort properties [14,8]., in addition to researchers have studied the thermo physiological comfort, chemical and biotreatment properties of linen fabrics subjected to various finishing treatments [2].

Product development at weaving mills aims to study the raw material with which technique or weave structure using, taking into consideration the machine setting to find correct conduct experiments for production and also rising productivity and flexibility as Christian Brecher reported [6].

When it comes to linen fabrics, they have exceptional aesthetic and drape qualities. Fabrics made of linen One of the mostly used fabrics, especially in the summer which considered to be more durable than cotton and other blends [10]., these usage proprieties due to their multicellular, lustrous, and very compact bast fiber with high stiffness, tensile properties, comfort, elegance appearance along with good absorbency, and wicking abilities [4,22]. There are a variety of weaving structures used to create linen fabrics, but the Pique technique is the most popular way to showcase this material's beauty.

About the article or technique with the bizarre name "Piqué" or "Cord Weave", plunge into the interesting history of the origin of this technique; consider the types and areas of its application. Piqué or some people used to call it "Lakost" (from the name of the fashion house), appeared on the world market at the beginning of the last century. The word pique comes from the French word meaning "quilted," and the effect in this weave is similar to the raised effect in quilting. This group of weave structures has a cord or wale produced by lengthwise woven areas held up as ridges through filling floats on the back of the fabric [17].

Piques weave structure are made on a dobby loom. In wide wale pique, 20 or more warp may be used in the face of the cord with two yarns woven in between each wale. In the six-warp cord in Figure 1:

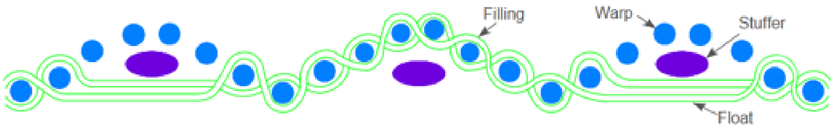


Figure 1. Yarn interlacing for six-warp cord.

This work is licensed under a Creative Commons Attribution 4.0 International License

Two consecutive filling yarns float across the back of the odd-numbered cords and are then woven in with the face of the even-numbered cords. The next two consecutive filling yarns an alternate with the first two by floating across the back of the even-numbered cords and weaving into the face of the odd-numbered cords [29].

Corded fabrics have a right and wrong Side. In general, these fabrics tear more easily in the lengthwise direction. If there are stuffer yams, tearing the fabric crosswise is especially difficult [26].

Fabrics woven by Pique weave structure tend to be more resistant to wrinkling than plain weave flat fabrics. They also have more body. There are many types of Pique as scientists reported as Birdseye pique it has distinguished a tiny diamond-shaped design formed by the wavy arrangement of the cords or wales. Some fabrics are called pique but are not made with pique or cord weave. These include: waffle pique, embossed pique, picolay, and dimity pique. More classification of the structure is the classification of Bedford or pique that is reported by Wastosn and Grosicki.

To some extent, Woven fabric by Pique is; A fabric in the form of a piece of cloth with a unique pattern and structure. In appearance, the structure of the fabric peak is somewhat similar to the famous waffle towels; however, the pattern may differ significantly.

The popularity of the fabric made by Pique came precisely due to the original texture - on the one hand, clothes and other accessories from this material look solid and simple at the same time, and on the other, attractive and fashionable. Piqué fabric has many benefits, including flexibility and sustainability due to it is not crumpled, Hygroscopicity absorbs moisture significantly and acceptable air permeability due to its spacing on structure., also due to its unique manufacturing structure and the ability to combine synthetics and other fibers, it can provide awesome strength properties, especially in particular of silk, wool, and microfiber as reported by J. R. AJmeri and Züleyha [11,31].

Finally, as we had more appreciation research for the propriety of piqué fabric, as well; we found that not only it had many acceptable properties as autonomy, resistant to sunlight clean and healthy.etc.., but also the only flipside of the pique is that such a fabric will cost expensive. In addition, there are quite a few fakes on manufacturing with its influence on the market. So that it is generally necessary to do trails at the weaving mill, in order to find optimized setting parameters for any articles to raise productivity, it is also important to reduce downtime of weaving machines and give acceptable parameters in fabric textile laboratory tests.

According to the literature, limited comprehensive studies are found in the subject of studying machine setting as warp tension, shed angle and so on for term (The Mechanistic Machine role), which are related to Pique linen fabrics production; Hence this research will assist the textile and apparel industry in this area. During weaving, the warp yarns undergo considerable fluctuations of tension.

Warp tension and shed angle are the major parameters of the weaving process to synchronization the machine for the production of any article, knowledge on the course of these parameters during weaving is essential to perfectly set up a machine for perfect weaving.

First, to introduce the Fundamentals of warp yarn tension, according to the Oxford dictionary, the term “tension” is defined as an effect produced by forces pulling against each other. In textile language, yarn tension means the tensile stress developed within the yarn when it is subjected to an external tensile strain. Therefore, the magnitude of yarn tension depends upon the external strain. Tension is expressed in gram or Newton [21].

The behavior of textile structures properties (yarn and fabric) under tension depends on their filament arrangements of cross section [3]. Then, there is basic information about the Passage of warp yarns through the loom and weaving process as Gloy. Ysm [9], reported in his paper section: (Simulation of warp tension), He presented how the woven fabric is formed.it can indicate shortly as Fig. 2 shown.

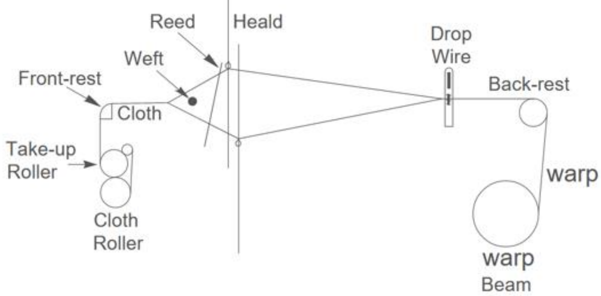


Fig.2 Passage of warp yarns through the loom

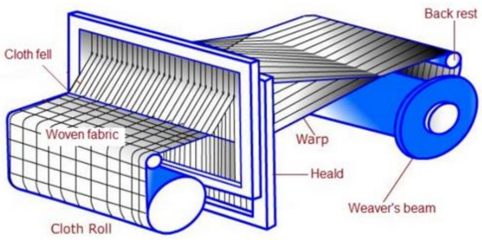


Fig.3 cloth fell schematic

After that, the necessity of tension in textile processing at few words is an essential and inherent phenomenon in forming a clear shed for insertion of filling yarns. Warp tension is also necessary for holding Phoneme as shown at Fig.3 called cloth fell., to the correct preset position for obtaining the predetermined pick spacing when weaving [19].

The intensity of crimp in the two sets of warp and filling yarns due to interlacement and determining the eliminate fluctuation of the tensioning system for loom is defined by the clear tension of the two sets. This is, in essence, achieves a suitable weaving and governs the cloth's various properties.

Judicious application of tension on the yarn is, therefore, most effectively. Irrespective of loom tensioning system, the yarn output tension is defined by a numeric degree of the frictional characteristic for the yarn passes surface over [16]. Due to interlacement warp tension, variations during weaving cause irregularity in weft density and other physical properties of woven fabrics. Hence, average warp tension should remain constant in terms of the weaving cycle or pick sequence. So as to avoid excessive peak tension values, as well as too low values of it, this would lead to unsatisfactory shedding. It is known that the highest effect on the tension in the warp (about 59%) is exerted by shedding, while that of beating-up is assessed at about 39% and that of the beam and take up roll at about 5%. Loom operation studies showed that 88% of all warp breakage occurred at a point between the back harness and the reed, probably due to fatigue of the yarn as it travels from loom beam to the woven fabric [15].

The study of warp tension mechanics dates from very early work reported by Schlichter [23]. Zitouni and Karnoub [13,30], disused the effect of different warp tension for Chenille Fabric using Jacquard loom by using different weave density using polyester yarns, the same results can conclude in three points: first relation; there is an inverse relationship between weft density and warp tension. Second relation, is a direct relationship between weave float and warp tension also weft count and warp tension relation. Third relation is that there is no effect of the weft type on warp tension. In despite of pervious clear results; there is a reservation from the researcher on these two studies. First, they are identical, but with a different title - Secondly, large values of the warp tension from (12-33) Cn/tex have been used in such heavy fabrics which considering significantly divergent values usage , which it follows without the slightest doubt there are changed in many machine adjustments to apply these stresses, which should be mentioned in the study presented and their effects in fabric parameters. Admittedly, there are mechanical adjustments-controlled warp tension changes as heights of backrest system, the heddles, and the beat-up force. The knowledge of circumference speeds for warp and fabric beams including chosen correct shed angle of cam motion. These Superimposed mechanical adjustments give a different mechanical and physical parameter for any article at textile laboratory.

It can summarize that to ensure efficient working of the loom and desired qualities of the cloth produced, the warp yarns are required to be fed up to the required extent and under a certain optimum tension in each pick, determined by the type of cloth to be woven, throughout the weaving out of the warp beam. The mean tension exerted on the warps is dependent mainly on the difference between the circumference speeds of the warp beam and the fabric beam for each article [1].

Second to introduce the principle of shed geometry., The shed is formed by moving some warp yarns in the upper position and the others in the lower position. The shed angle is controlled by outside cam motion which concocts by Harness Frame position. By the shed movement, the warp yarns form a quad limited by the fabric edge, the upper and lower rest positions of the eye of the heddles, and the warp stop system [12].

In the case of yam structure in woven fabric and their behaviors, several approaches have been used to describe the classification of a shed, there are types of shed geometry as Fig.4 describe [20].

The study of the mechanism of shed angle has been a subject of intensive research for a

This work is licensed under a Creative Commons Attribution 4.0 International License

considerable time. Numerous models have been developed to study shedding as Deniz [7] reported in his investigation.
At the first level of approach, there are components that may part of the Shed Geometry of may contribute to it are: Frame Height- Frame Depth- Cloth Support (front rest) -Height Back Rest (and Deflecting Roller)- Height and Depth- Virtual Shed -Dividing Line- Dropper Box adjustment and dropper's movement- Top Shed Line- Bottom Shed Line- Front Shed- Rare/Back Shed [25,28].

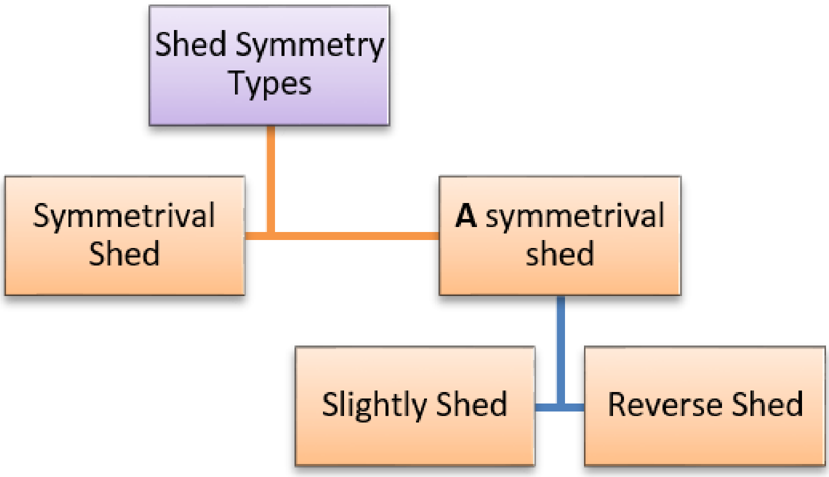


Fig.4 Shed geometry types.

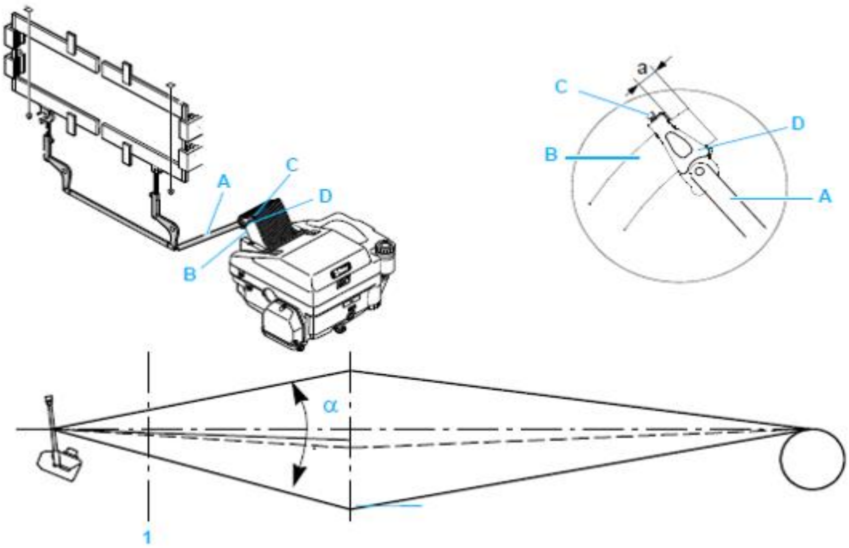


Fig.5 Shed Mechanism.

As Fig.5 indicate, in modern loom adjusting shed high can be controlled by the stroke **"c"** of the harness frames is determined by the position of the clamp "D" on the lever "B". The stroke "k" is a function of the distance "A" for a shed angle **α**, and this for each harness frame position must indicated in table degrees in each machine manual [18].

Several studies have been used to analyze the effect of shed angle geometry and its influence on fabric parameters. Xiaogang Chen [27], expressed mathematically the establishment of the balanced weaving according to Euler's equation. He founded that the earlier shedding type helps stop the new pick from bouncing back. It's a factor affected in cloth formation. Suzan Ahmed [24]. studied the effect of shed geometry on starting mark of woven fabric., its experimental uses polyester and cotton with different adjustments of the loom at heald frame, take off and let off system with Loom stoppage time. We can say that she founded in her investigation, each sample she tried has a specific adjustment at the loom to reduce starting mark.

Ultimately, with the above background in mind, the number of publications has increased in the last decade, which indicates the effect of loom setting on fabric properties using common fabrics. Current research is moving towards the applications of such parameters using Pique technique with a deeper understanding of the relationship between resistance properties and different loom settings and configurations for pique Linen Fabrics.

2.1. Research specimens. Experimental protocol**:** Subsequently two shed angles with two values of warp tension were selected for specific warp yarn count for two blended linen fabric at different weave density with two pique weave structure, and only loom settings like; heald frame height, crossing angle were triggered to change the shedding angle, and then the effect of all parameters on fabric physical and mechanical proprieties were tested. It shortly describes by equation below:

^{2} Shedding ^{angle} × 2 Warp count $^{(\,(45/2)\ /\ (35/2)\,)}$ × 2 Tension Warp ^{value} × 2 pick $^{/\ Inch}$ =^{32} samples.

32 woven linen fabrics were used. 256 experimental are measured. The specification of the loom and samples are given in Table 1&2 respectively and their tests parameters given in Table .3.

Table (1)
shown the specification of loom parameter

Loom parameter.	
Manufacture	Piconol Gama 2007.
Weft insertion system	Rapier.
Shed system	Negative dobby (Stäubli 2670)
Machine speed	450 rbm.
Machine width	190 cm
Let off system	Electronic
Take up system	Electronic
Warp stop motion	Electric
Initial Warp tension	(1, 3) Kn
crossing angle (Shedding close time)	From (40 - 320)º
Shed angle.	(24 º- 28 º)

Table (2)
shown the specification of fabric parameter

Fabric Parameter.	
Weave structure	Pique (4&6)
Warp count	35/2 &45/2 linen.
Warp density/Inch	56
Warping beam width /cm	147
Warp width in reed /cm	153
Drawing -In reed	2
Warp Yarns Total	3090
Pick / Inch.	46 & 65
Reed count / Inch	26
Linen weft count	17.5 Ne
	22.5 Ne
Selvdages	16 yarns each side
	Palin (2/2) weave structure.

As shown in **Table.3**: On the Picanol Gama rapier weaving at Misr Spinning and Weaving Company located in El-Mahalla El-Kubra., All samples made from blending linen for both warp and weft as given below:

- **Blending (A):** Article No.1 - Samples from (1 to 16) are made from the yarn count (45/2) Mixture Blending Fibers (40% Linen & 60% Polyester).
- **Blending (B):** Article No.2 Samples from (17 to 32) are made from the yarn count (35/2) Mixture Blending Fibers (20 % Linen & 80 % Polyester).

Due do the researcher deepen, the numeric date laboratory tests for Mixture Blending Fibers used in current research for known its good blending, neither less than according eye reading for general view laboratory tests it's give a good ^{RKM} value, this mixture blending has been produced in El-Mahalla El-Kubra company since 60 years ago according archive records named (Giza 7). Therefore, referring Mixture Fibers research note or not to be not, it has no space in current or somewhere research. It is a good mixture in the Egyptian market., It is also exported to many countries.

All samples using Pique weave structure by using (4 &6) warp yarns., as shown in Fig. (6&7) with 2 values of warp tension (1&3) Kn. and two values of weave density (46&56) Pick / Inch also used.

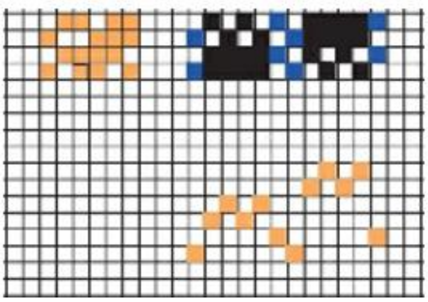


Fig.6 (4) warp cords.

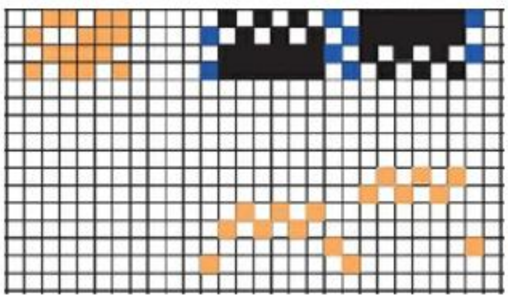


Fig.7 (6) warp cords.

Weave structure.

All samples' thickness was measured; weight of samples was counted. As shown in **Table. 4**

This work is licensed under a Creative Commons Attribution 4.0 International License

attached at Appendix. Parameter used for commercial production.

Table1.3. Woven fabrics' specifications.

Table (3). Specification of the specimens.

Groups.	Article / Blending	Sample code	No. Of piqué	Weave density.	Warp Tension.	Shed angle.	Tensile Strength. Warp Breaking force (N)	Tensile Strength. Warp Ext. (%)	Tensile Strength. Weft Breaking force (N)	Tensile Strength. Weft Ext. (%)	Tear Force Falling Pendulum (ASTM) 1424 (N) Warp	Tear Force Falling Pendulum (ASTM) 1424 (N) Weft	Tear Strength (ASTM 2261) (N) Warp	Tear Strength (ASTM 2261) (N) Weft
1	Article (1) Blending (A)	1	6	46	1	28	1159.83	30.33	752.45	33.64	18.71	27.19	58.16	60.91
		9	4	46	1	28	1289.53	32.96	854.47	38.21	20.74	25.72	54.09	48.12
	Article (2) Blending (B)	21	4	46	1	28	907.58	26.9	578.5	34.44	19.51	22.39	50.83	45.73
		29	6	46	1	28	915.3	26.44	615.45	38.75	21.16	21.14	55.38	58.86
2	Article (1) Blending (A)	2	6	56	1	28	1213.91	34.28	918.99	33.11	20.89	21.75	67.45	54.39
		10	4	56	1	28	1331.84	33.77	1106.9	40.07	18.44	20.79	55.29	51.21
	Article (2) Blending (B)	22	4	56	1	28	953.5	29.45	661.22	31.27	17.84	18.33	40.34	44.39
		30	6	56	1	28	895.54	26.42	803.68	36.28	18.89	16.95	47.61	56.69
3	Article (1) Blending (A)	3	6	46	3	28	1181.09	31.83	796.8	34.22	21.43	24.93	74.77	54.75
		11	4	46	3	28	1258.4	30.99	889	35.36	16.66	23.04	60.39	45.35
	Article (2) Blending (B)	23	4	46	3	28	917.08	28.12	641.03	31.65	20.54	18.55	48.69	44.25
		31	6	46	3	28	936.84	28.19	651	39.15	19.67	21.92	49.95	57.43
4	Article (1) Blending (A)	4	6	56	3	28	1351.55	33.65	921.36	35.55	21.34	20.05	69.55	47.59
		12	4	56	3	28	1253.15	32.15	982	40.24	16.15	21.28	47.97	47.90
	Article (2) Blending (B)	24	4	56	3	28	970.94	29.3	654.05	31.65	18.06	16.44	44.11	43.46
		32	6	56	3	28	947.79	28.04	817.27	38.81	20.54	15.86	39.14	54.46
5	Article (1) Blending (A)	5	6	46	1	24	1235.3	32.5	828.2	36.5	20.84	26.38	58.55	53.95
		13	4	46	1	24	1220.15	32.15	838.75	37.42	19.61	22.74	52.73	48.51
	Article (2) Blending (B)	17	4	46	1	24	945.58	29.9	573.68	32.61	16.44	20.34	44.24	45.69
		25	6	46	1	24	886.15	36.43	653.03	28.82	21.12	25.74	47.70	51.90
6	Article (1) Blending (A)	6	6	56	1	24	1234.58	36.02	966.17	36.13	22.31	18.91	48.53	50.41
		14	4	56	1	24	1248.99	33.99	1029	39.63	16.78	20.33	47.28	44.77
	Article (2) Blending (B)	18	4	56	1	24	920.69	28.66	706.74	34.31	15.10	18.07	43.09	41.48
		26	6	56	1	24	916.24	31.46	511.27	32.59	21.07	29.74	61.06	57.49
7	Article (1) Blending (A)	7	6	46	3	24	1262.89	33.25	639.29	31.17	23.19	25.91	59.29	52.67
		15	4	46	3	24	1224.6	31.7	827.33	39.09	21.92	23.45	48.51	52.67
	Article (2) Blending (B)	19	4	46	3	24	912.24	28.83	646.53	30.07	16.95	19.72	49.59	44.95
		27	6	46	3	24	920.01	27.28	680.5	39.27	24.48	30.93	75.49	70.70
8	Article (1) Blending (A)	8	6	56	3	24	1281.62	32.33	683.61	28.11	20.13	18.30	52.19	54.43
		16	4	56	3	24	1217.17	34.01	1025.58	39.66	17.84	21.81	48.09	45.69
	Article (2) Blending (B)	20	4	56	3	24	944.74	28.57	763.27	36.27	16.83	13.96	40.36	43.75
		28	6	56	3	24	944.01	27.28	766.38	41.83	20.94	32.79	62.51	52.08

2.2. Laboratory Testing:

In the warp direction, tension is applied by the warp beam at two values tension at (1&3) KN, which allow weaving stability for two articles. In the filling direction, tension is applied by the loom temples and it is this tension which prevents the filling yarn from crimping.

The samples were prepared with a commercial process at mile, where the fabric was softened in Aqueous solution by adding half a kilo of (Berdet SC.) oil and a kilo and a half of (Bersoft NI) oil, washing by fabric's through with helpful of simple cylinder machine with cistern at heat - 80 ° C, then fabric is drying and ironing at 125°c Evaporation water point by using Ramallumin drying tower cylinders.

All tests were carried out in the warp and weft direction after conditioning specimens in a standard atmosphere (temperature 20 ± 2 °C, 65 ± 2% relative humidity at Uni- Governmental laboratory.

Tensile Strength and (Tear strength /Tongue method) measurements of the fabric samples were carried out on (Tian 10kn) James Heal instrument., accordance to ASTM 5035 and ASTM (2261)., respectively.

The standard test method (Tearing Strength of Fabrics by Falling-Pendulum Type) was used for determination of the force required to propagate a single-rip tear starting from a cut in a fabric with using automatic falling-pendulum type. This test was performed on tear tester (El Mater) James Heal instrument. Mass Per Unit Area (Weight) of Fabric according ASTM 37776 and specimens thickness according ASTM 1777 are counted using Hans Schmidt gauge instrument. All Fabric samples were cut according to pervious standards method. Three samples were used for each test and their average values were taken.

3. Results and Discussion.

To Clarify the Statistical transactions performed to found relationships between dependent and

Independent variables multiple comparison test was used. Pearson correlation analysis was done. ANOVA variance analysis through SPSS., The statistical software package SPSS 8.0 was used to interpret the experimental data.

Analysis statical protocol : to determine the Positive and opposite relations and its impact on measured properties. All the test specimens' results are divided in groups as shown in Table.3.and their interpretations are given in the following sections. All test results related to physical and etc. properties of the woven fabrics were evaluated in this study for not significant differences but in **Positive and opposite** relationships between parameters.

3.1. Tensile Strength propriety:

This **section**[1] studies the effect of the (Blending ratio, Shedding angle, Warp Tension & Weave Density) on specimen's Tensile Strength:

The statical schematic presented from Fig. (8) to Fig. (19) comparing groups as following:

Fig. (8&9) shown the relation between Group (1&5) to found the effect of shedding angle on specimen's tensile strength at **1kn** warp tension with **46 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.9 Article (1) blending (1) has the largest tensile strength value at (1289.53) N. at **28^{O}** shedding angle with (4) warp cords weave structure.
- In weft Direction: Also; specimen no.9 article (1) blending (1) has the largest tensile strength value at (854.47) N. at **28^{O}** shedding angle with (4) warp cords weave structure.

Fig. (10&11) shown the relation between Group (2&6) to found the effect of shedding angle on specimen's tensile strength at **1kn** warp tension with **56 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.10 Article (1) blending (1) has the largest tensile strength value at (1331.84) N. at **24^{O}** shedding angle with (4) warp cords weave structure.
- In weft Direction: Also; specimen no.10 article (1) blending (1) has the largest tensile strength value at (1106.9) N. at **24^{O} shedding** angle with (4) warp cords weave structure.

Fig. (12&13) shown the relation between Group (3&7) to found the effect of shedding angle on specimen's tensile strength at **3kn** warp tension with 4**6 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.7 Article (1) blending (1) has the largest tensile strength value at (1262.89) N. at **24^{O}** shedding angle with (6) warp cords weave structure.
- In weft Direction: specimen no.11 article (1) blending (1) has the largest tensile strength value at (889) N. at **28^{O} shedding** angle with (4) warp cords weave structure.

Fig. (14&15) shown the relation between Group (4&8) to found the effect of shedding angle on specimen's tensile strength at **3kn** warp tension with 5**6 pick / Inch**.: it founded that:

- In warp Direction: specimen no.8 article (1) blending (1) has the largest tensile strength value at (1281.62) N. at **24^{O} shedding** angle with (6) warp cords weave structure.
- In weft Direction: specimen no.16 article (1) blending (1) has the largest tensile strength value at (1025.58) N. at **24^{O} shedding** angle with (4) warp cords weave structure.

Fig. (16&17) shown the relation between Group (1&5&3&7) to found the effect of **warp tension** and **weave density** on specimen's tensile strength at **(1&3kn)** with 46 **pick / Inch on (24&28 ^{O} shedding** angle**)**.: it founded that:

- In warp Direction: specimen no.9 article (1) blending (1) has the largest tensile strength value at (1289.53) N. at 28O shedding angle with (4) warp cords weave structure.
- In weft Direction: specimen no.11 article (1) blending (1) has the largest tensile strength value at (889) N. at **28^{O} shedding** angle with (4) warp cords weave structure.

Fig. (18&19) shown the relation between Group (2&6&4&8) to found the effect of **warp tension** and **weave density** on specimen's tensile strength at **(1&3kn)** with 56 **pick / Inch.** on **(24&28 ^{O} shedding** angle**)**.: it founded that:

- In warp Direction: specimen no.10 article (1) blending (1) has the largest tensile strength value at (1331.84) N. at 28O shedding angle with (4) warp cords weave structure.
- In weft Direction: specimen no.16 article (1) blending (1) has the largest tensile strength value at (1025.58) N. at **24^{O} shedding** angle with (4) warp cords weave structure

It Can Summarize in clear relations between effective parameters om tensile strength proprieties as following:

- There are positive relations between (weft density & No. of pique yarns & shedding angle) on Tensile strength warp direction.
- There is an inverse relation between (warp Tension) on Tensile strength warp direction.
- There are positive relations between (shedding angle & weft density) on Tensile strength weft direction.
- There are inverse relations between (warp Tension& No. of pique yarns) on Tensile strength warp direction.

With the observation that;

- Article (1) blending (1) has the highest values in each warp and weft tensile strength, it can be

This work is licensed under a Creative Commons Attribution 4.0 International License

concluded that there is a positive relationship between the polyester blending ratio and tensile strength, and vice versa.

- The Research ignore the tensile extension ratios for all samples from statical comparing due to this propriety consider a weak vector when assessment linen fabric in real markets.

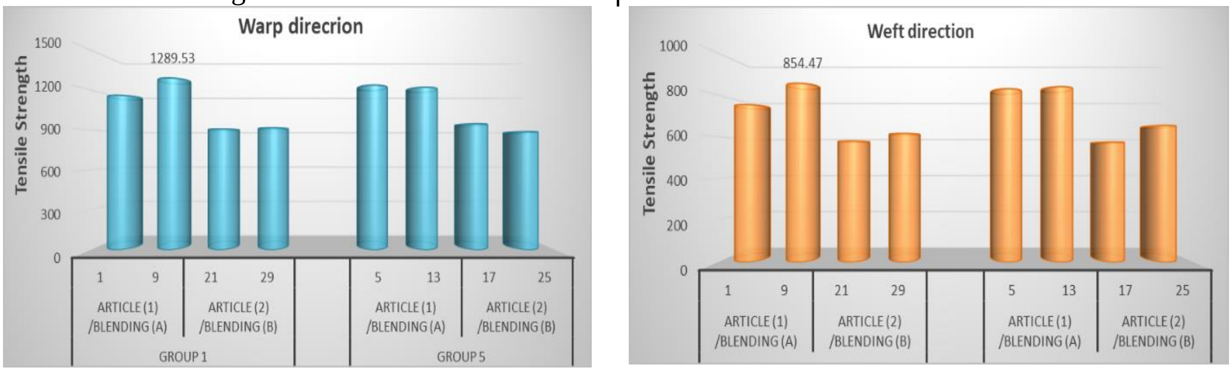


Fig. (8&9) shown the relation between Group (1&5) to found the effect of shedding angle on specimen's tensile strength at 1kn warp tension with 46 pick / Inch for both directions.

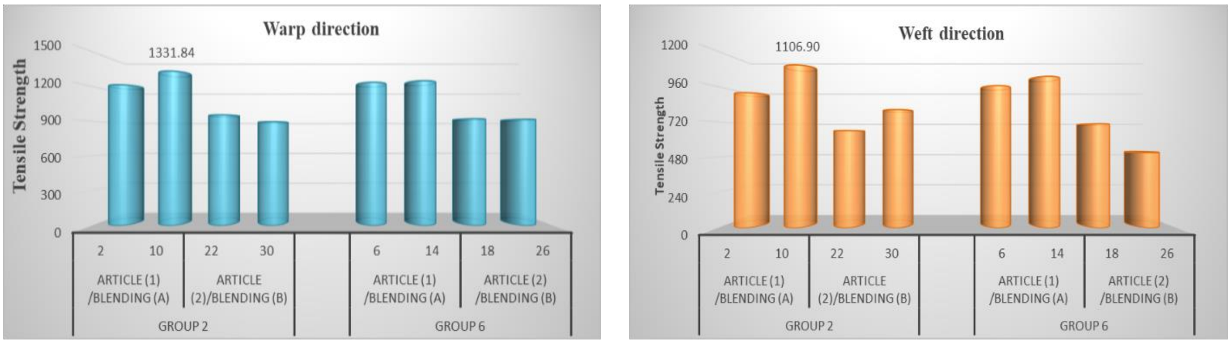


Fig. (10&11) shown the relation between Group (2&6) to found the effect of shedding angle on specimen's tensile strength at 1kn warp tension with 56 pick / Inch for both directions.

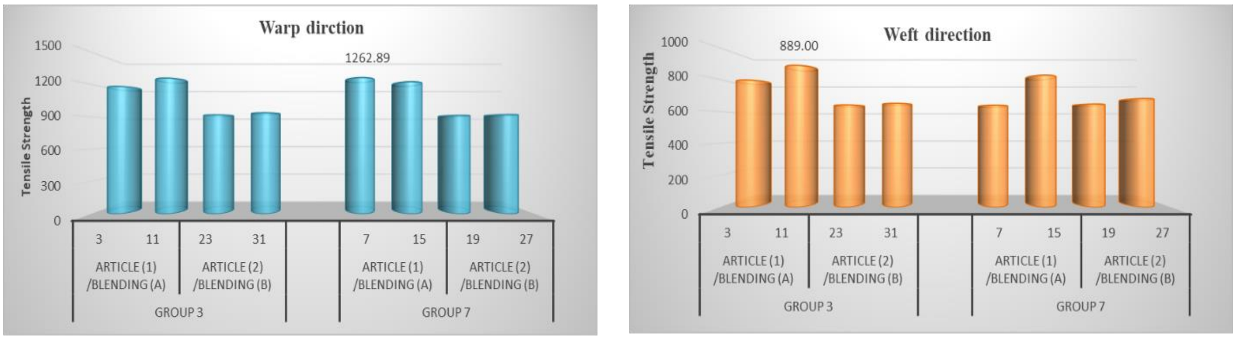


Fig. (12&13) shown the relation between Group (3&7) to found the effect of shedding angle on specimen's tensile strength at 3kn warp tension with 46 pick / Inch for both directions.

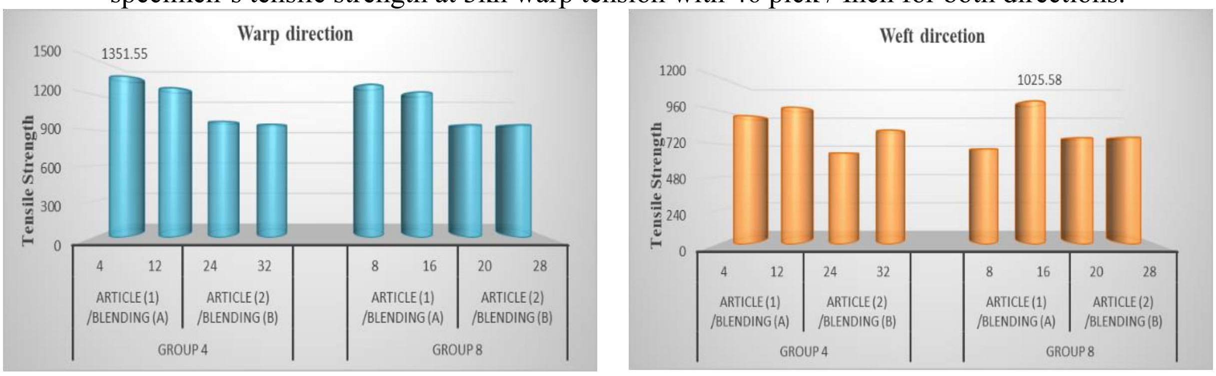


Fig. (14&15) shown the relation between Group (4&8) to found the effect of shedding angle on specimen's tensile strength at 3kn warp tension with 56 pick / Inch.

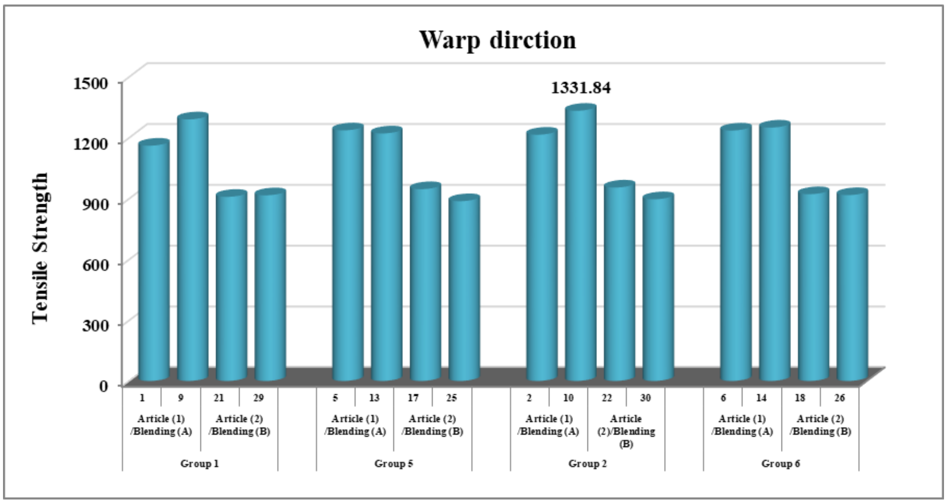


Fig. (16) shown the relation between Group (1&5&3&7) to found the effect of warp tension and weave density on specimen's tensile strength at (1&3kn) with 46 pick / Inch on (24&28 ^{O} shedding angle) in warp direction.

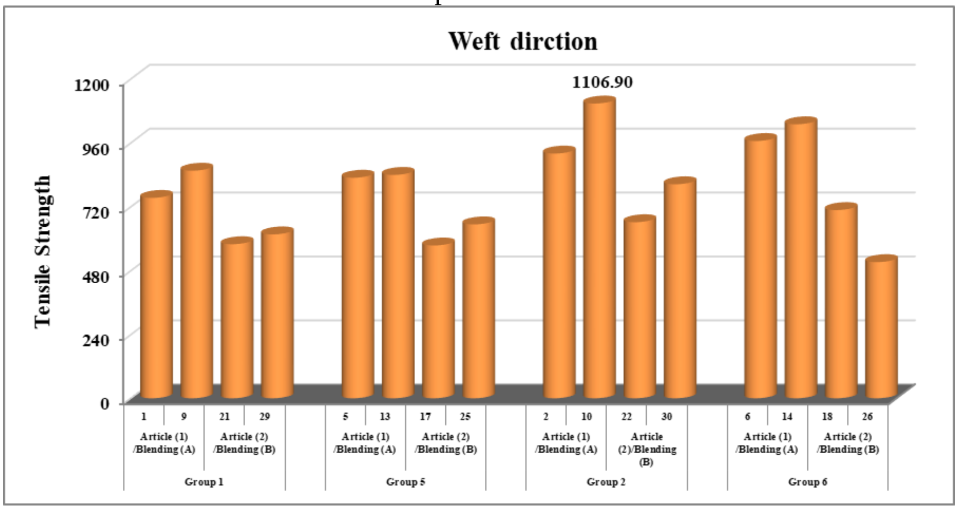


Fig. (17) shown the relation between Group (1&5&3&7) to found the effect of warp tension and weave density on specimen's tensile strength at (1&3kn) with 46 pick / Inch on (24&28 ^{O} shedding angle) in weft direction.

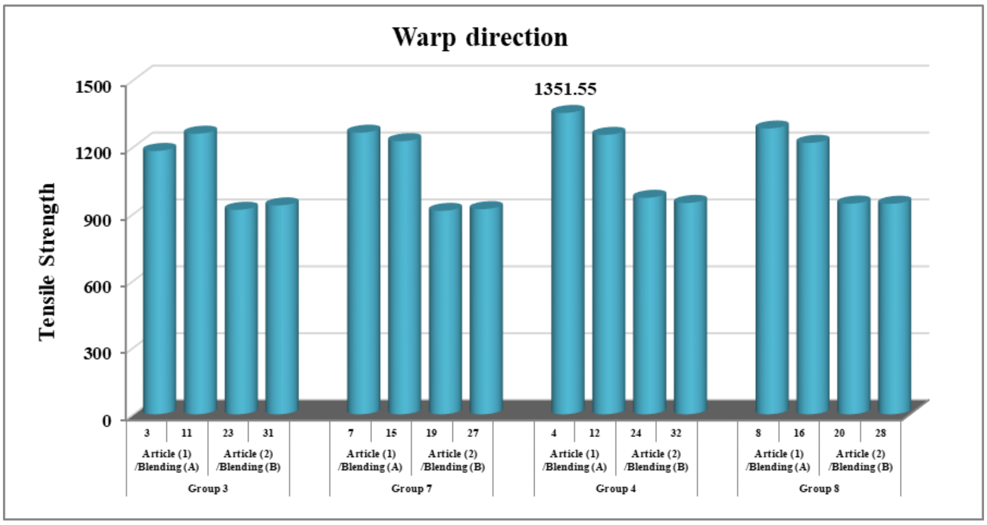


Fig. (18) shown the relation between Group (2&6&4&8) to found the effect of warp tension and weave density on specimen's tensile strength at (1&3kn) with 56 pick / Inch. on (24&28 ^{O} shedding angle) in warp direction.

This work is licensed under a Creative Commons Attribution 4.0 International License

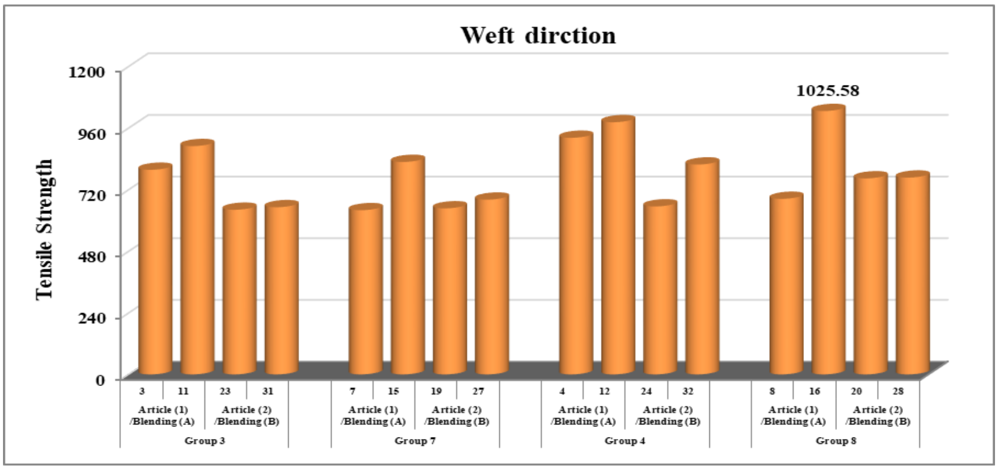


Fig. (19) shown the relation between Group (2&6&4&8) to found the effect of warp tension and weave density on specimen's tensile strength at (1&3kn) with 56 pick / Inch. on (24&28 ^{O} shedding angle) in weft direction.

3.2. Tear Force propriety: Falling-Pendulum Type.

The results of tearing force values can be summarized in the following point as shown from Fig. (20) to Fig. (31) attached at section[2], keeping in mind the statistical procedure for current research results reported above - and even the method of dividing specimens as presented in section [1]. (A precise description can be attached in the Appendices).

- There are positive relations between (Warp Tension & No. of pique yarns) on Tear force warp direction.
- There is an inverse relation between (shedding angle & weft density) on Tear force warp direction.
- There are positive relations between (Warp Tension, weft density, No. of pique yarns,) on Tear force weft direction.
- There is an inverse relation between (shedding angle) on Tear force weft direction.

With the observation that;

- Article (2) blending (2) has the highest values in each warp and weft Tear force, it can be concluded that there is an inverse relationship between the polyester blending ratio and Tear force, and vice versa.

Section [2:] This section studies the effect of the (Blending ratio, Shedding angle, Warp Tension & Weave Density) on specimen's **Tear force**: **Falling-Pendulum Type**.

The statical schematic presented from Fig. (20) to Fig. (31) comparing groups as following:

Fig. (20&21) shown the relation between Group (1&5) to found the effect of shedding angle on specimen's tear force at **1kn** warp tension with **46 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.29 Article (2) blending (2) has the highest tear force value at (21.16) N. at 28O shedding angle with (6) warp cords weave structure.
- In weft Direction: specimen no.1 article (1) blending (1) has the highest tear force value at (27.19) N. at **28^{O}** shedding angle with (6) warp cords weave structure.

Fig. (22&23) shown the relation between Group (2&6) to found the effect of shedding angle on specimen's tear force at **1kn** warp tension with **56 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.6 Article (1) blending (1) has the highest tear force value at (22.31) N. at 24O shedding angle with (6) warp cords weave structure.
- In weft Direction: Also; specimen no.26 article (2) blending (2) has the highest tear force value at (1106) N. at **24^{O} shedding** angle with (6) warp cords weave structure.

Fig. (24&25) shown the relation between Group (3&7) to found the effect of shedding angle on specimen's tear force at **3kn** warp tension with 4**6 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.27 Article (2) blending (2) has the highest tear force value at (24.48) N. at 24O shedding angle with (6) warp cords weave structure.
- In weft Direction: Also; specimen no.11 article (2) blending (2) has the highest tear force value at (30.93) N. at **28^{O} shedding** angle with (4) warp cords weave structure.

Fig. (26&27) shown the relation between Group (4&8) to found the effect of shedding angle on specimen's tear force at **3kn** warp tension with 5**6 pick / Inch**.: it founded that:

- In warp Direction: specimen no.4 article (1) blending (1) has the highest tear force value at (21.34) N. at 28O shedding angle with (6) warp cords weave structure.
- In weft Direction: specimen no.28 article (2) blending (2) has the highest tear force value at (32.79) N. at **24^{O} shedding** angle with (6) warp

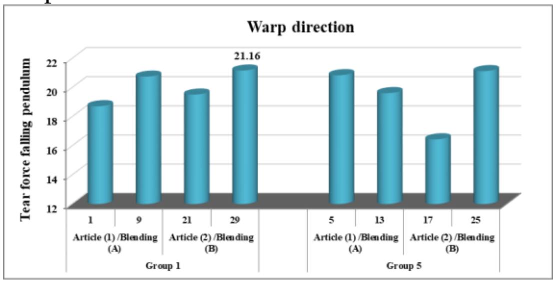
cords weave structure.

Fig. (28&29) shown the relation between Group (1&5&3&7) to found the effect of **warp tension** and **weave density** on specimen's tear force at **(1&3kn)** with 46 **pick / Inch on (24&28 ^{O} shedding** angle**)**.: it founded that:

- In warp Direction: specimen code No.27 Article (2) blending (2) has the highest tear force value at (24.48) N. at **24^{O}** shedding angle with (6) warp cords weave structure.
- In weft Direction: Also; specimen no.11 article (2) blending (2) has the highest tear force value at (30.93) N. at **28^{O} shedding** angle with (4) warp cords weave structure.

Fig. (30&31) shown the relation between Group (2&6&4&8) to found the effect of **warp tension** and **weave density** on specimen's tear force at **(1&3kn)** with 56 **pick / Inch on (24&28 ^{O} shedding** angle**)**.: it founded that:

- In warp Direction: specimen no.6 article (1) blending (1) has the highest tear force value at (22.31) N. at 24O shedding angle with (6) warp cords weave structure.
- In weft Direction: specimen no.28 article (2) blending (2) has the highest tear force value at (32.79) N. at **24^{O} shedding** angle with (6) warp cords weave structure.



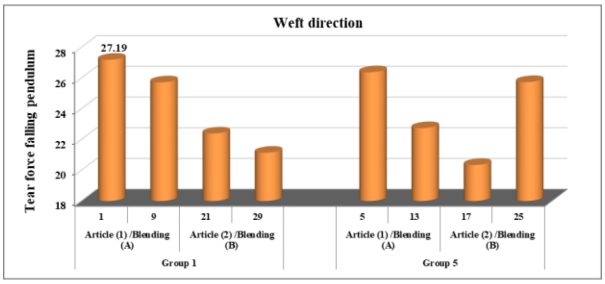
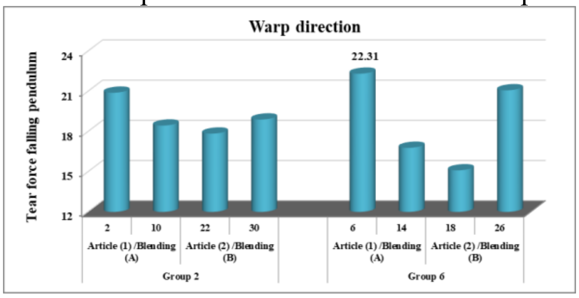


Fig. (20&21) shown the relation between Group (1&5) to found the effect of shedding angle on specimen's Tear force at 1kn warp tension with 46 pick / Inch for both directions .



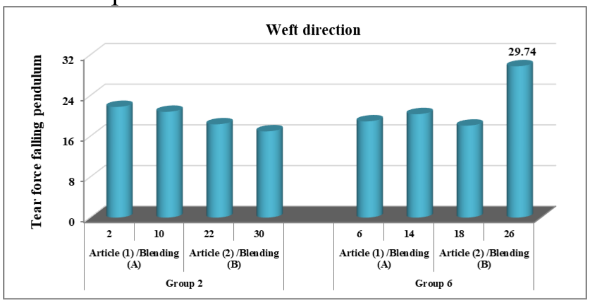
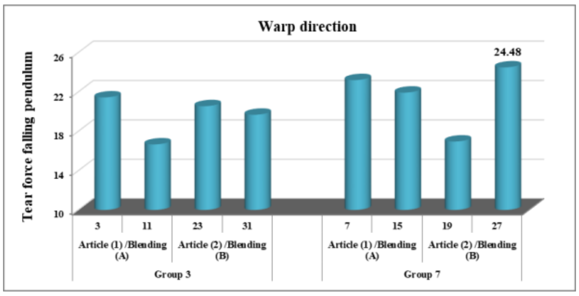


Fig. (10&11) shown the relation between Group (2&6) to found the effect of shedding angle on specimen's Tear force at 1kn warp tension with 56 pick / Inch for both directions.



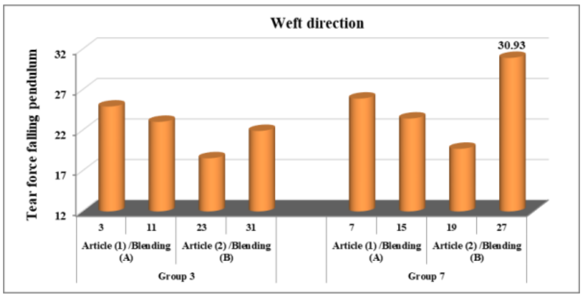
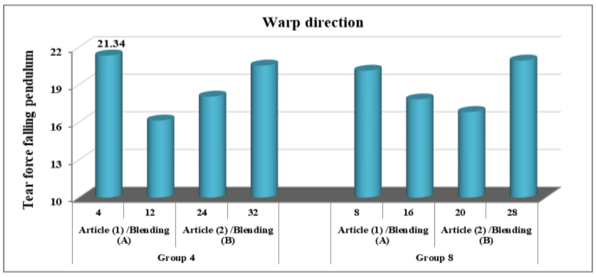


Fig. (12&13) shown the relation between Group (3&7) to found the effect of shedding angle on specimen's Tear force at 3kn warp tension with 46 pick / Inch for both directions.



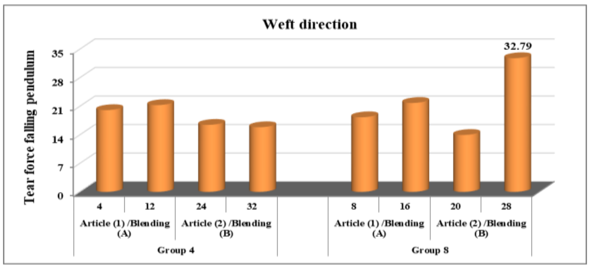


Fig. (14&15) shown the relation between Group (4&8) to found the effect of shedding angle on specimen's Tear force at 3kn warp tension with 56 pick / Inch.

This work is licensed under a Creative Commons Attribution 4.0 International License

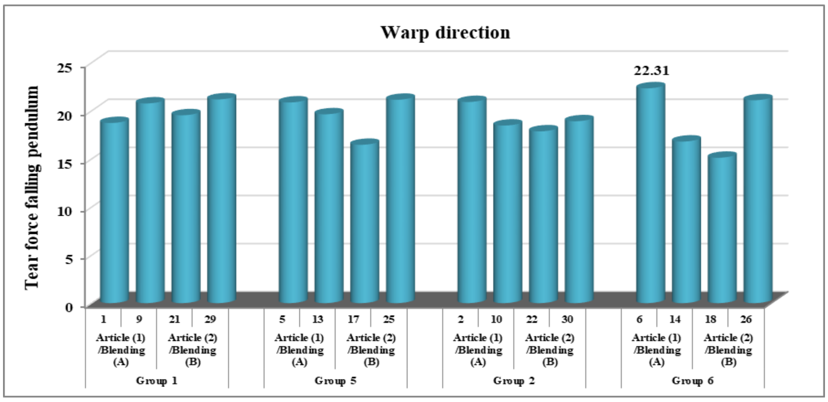


Fig. (16) shown the relation between Group (1&5&3&7) to found the effect of warp tension and weave density on specimen's Tear force at (1&3kn) with 46 pick / Inch on (24&28 O shedding angle)in warp direction .

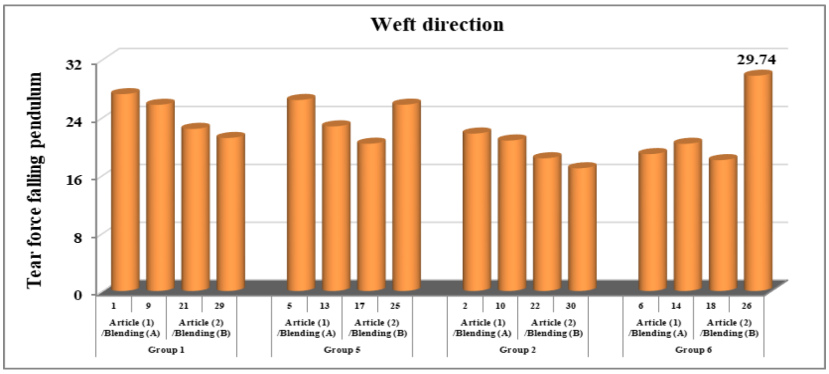


Fig. (17) shown the relation between Group (1&5&3&7) to found the effect of warp tension and weave density on specimen's Tear force at (1&3kn) with 46 pick / Inch on (24&28 ^{O} shedding angle) in weft direction.

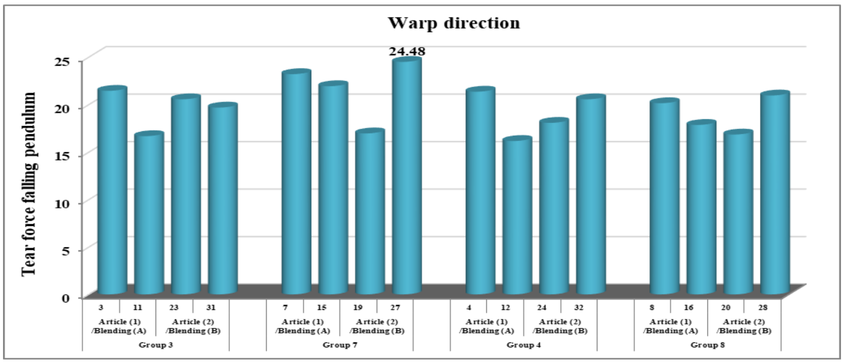


Fig. (18) shown the relation between Group (2&6&4&8) to found the effect of warp tension and weave density on specimen's Tear force at (1&3kn) with 56 pick / Inch. on (24&28 ^{O} shedding angle) in warp direction.

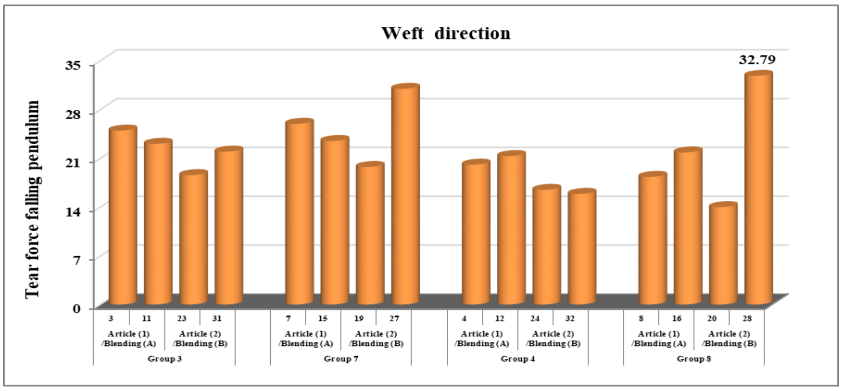


Fig. (19) shown the relation between Group (2&6&4&8) to found the effect of warp tension and weave density on specimen's tensile strength at (1&3kn) with 56 pick / Inch. on (24&28 ^{O} shedding angle) in weft direction**.**

3.3. Tear Strength propriety: Tongue method.

Likewise, clause 3.2.; The results of **Tear Strength** values can be summarized in the following points as shown from Fig. (32) to Fig. (43): (A precise description can be attached at section³).

- There are positive relations between (Warp Tension& No. of pique yarns &) on Tear strength warp & weft directions.
- There are inverse relations between (shedding angle & weft density) on Tear strength warp & weft directions.

With the observation that;

Article (2) blending (2) has the highest values in warp Tear strength values, it can be concluded that there is an inverse relationship between the polyester blending ratio and Tear strength, and vice versa.

Section ³: This section studies the effect of the (Blending ratio, Shedding angle, Warp Tension & Weave Density) on specimen's **Tear Strength: Tongue method**.

The statical schematic presented from **Fig. (32) to Fig. (43)** comparing groups as following:

Fig. (32&33) shown the relation between Group (1&5) to found the effect of shedding angle on specimen's tear strength at **1kn** warp tension with **46 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.1 Article (1) blending (1) has the highest tear strength value at (58.16) N. at **28^{O}** shedding angle with (6) warp cords weave structure.
- In weft Direction: Also; specimen no.1 article (1) blending (1) has the highest tear strength value at (60.91) N. at **28^{O}** shedding angle with (6) warp cords weave structure.

Fig. (34&35) shown the relation between Group (2&6) to found the effect of shedding angle on specimen's tear strength at **1kn** warp tension with **56 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.2 Article (1) blending (1) has the highest tear strength value at (67.45) N. at 28O shedding angle with (6) warp cords weave structure.
- In weft Direction: Also; specimen no.26 article (2) blending (2) has the highest tear strength value at (57.49) N. at 24O shedding angle with (6) warp cords weave structure.

Fig. (36&37) shown the relation between Group (3&7) to found the effect of shedding angle on specimen's tear strength at **3kn** warp tension with 4**6 pick / Inch**.: it founded that:

- In warp Direction: specimen code No.27 Article (2) blending (2) has the highest tear strength value at (75.49) N. at 24O shedding angle with (6) warp cords weave structure.
- In weft Direction: Also; specimen no.27 article (2) blending (2) has the highest tear strength value at (70.70) N. at 28O shedding angle with (6) warp cords weave structure.

Fig. (38&39) shown the relation between Group (4&8) to found the effect of shedding angle on specimen's tear strength at **3kn** warp tension with 5**6 pick / Inch**.: it founded that:

- In warp Direction: specimen no.6 article (1) blending (1) has the highest tear strength value at (69.55) N. at 28O shedding angle with (6) warp cords weave structure.
- In weft Direction: specimen no.32 article (2) blending (2) has the highest tear strength value at (54.46) N. at 28O shedding angle with (6) warp cords weave structure.

Fig. (40&41) shown the relation between Group (1&5&3&7) to found the effect of **warp tension** and **weave density** on specimen's tear strength at **(1&3kn)** with 46 **pick / Inch on (24&28 ^{O} shedding** angle**)**.: it founded that:

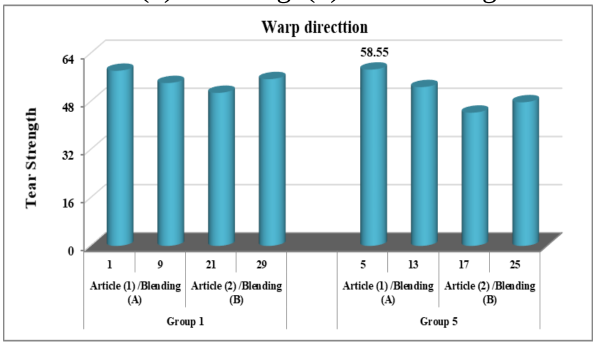
- In warp Direction: specimen code No.27 Article (2) blending (2) has the highest tear strength value at (75.49) N. at 24O shedding angle with (6) warp cords weave structure.
- In weft Direction: Also; specimen no.27 article (2) blending (2) has the highest tear strength value at (70.70) N. at 28O shedding angle with (6) warp cords weave structure.

Fig. (42&43) shown the relation between Group (2&6&4&8) to found the effect of **warp tension** and **weave density** on specimen's tear strength at **(1&3kn)** with 56 **pick / Inch on (24&28 ^{O} shedding** angle**)**.: it founded that:

- In warp Direction: specimen code No.2 Article (1) blending (1) has the highest tear strength value at (67.45) N. at 28O shedding angle with (6) warp cords weave structure.

This work is licensed under a Creative Commons Attribution 4.0 International License

- In weft Direction: Also; specimen no.26 article (2) blending (2) has the highest tear strength value at (57.49) N. at 24O shedding angle with (6) warp cords weave structure.



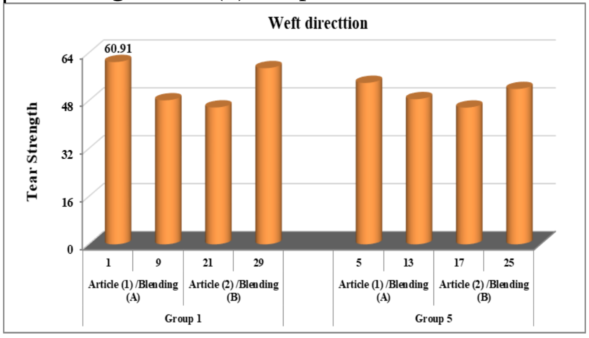
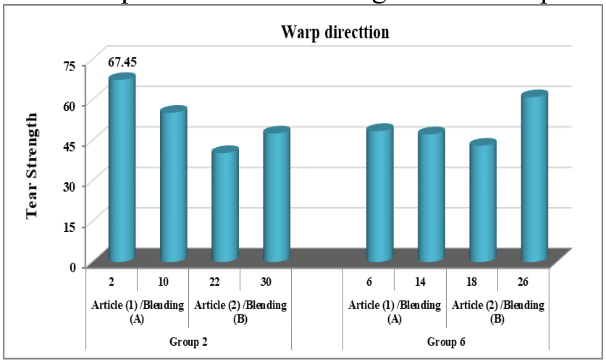


Fig. (32&33) shown the relation between Group (1&5) to found the effect of shedding angle on specimen's Tear Strength at 1kn warp tension with 46 pick / Inch for both directions .



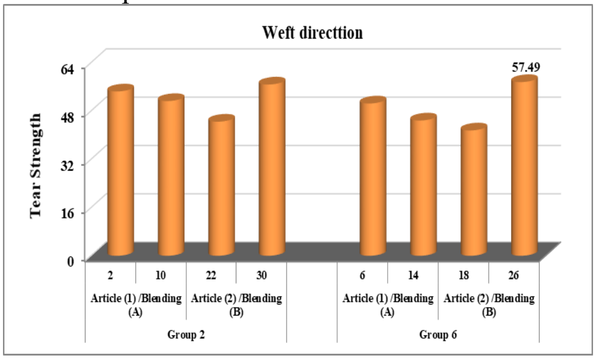
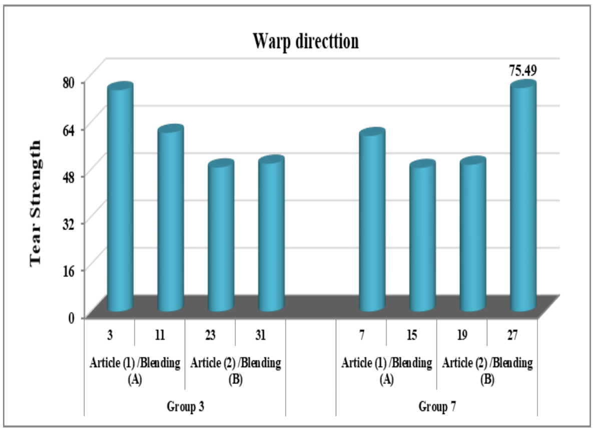


Fig. (34&35) shown the relation between Group (2&6) to found the effect of shedding angle on specimen's Tear Strength at 1kn warp tension with 56 pick / Inch for both directions.



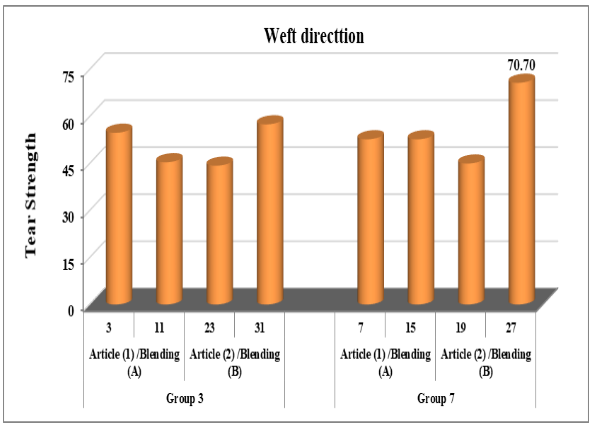
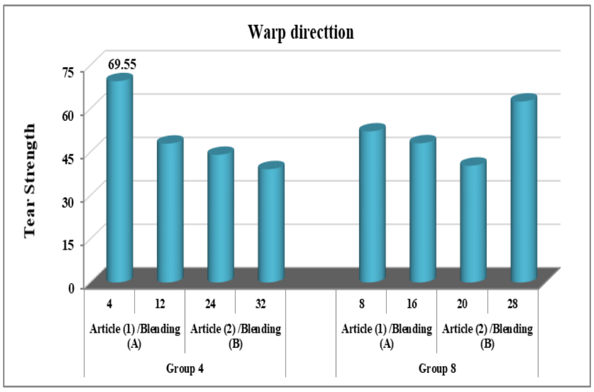


Fig. (36&37) shown the relation between Group (3&7) to found the effect of shedding angle on specimen's Tear Strength at 3kn warp tension with 46 pick / Inch for both directions.



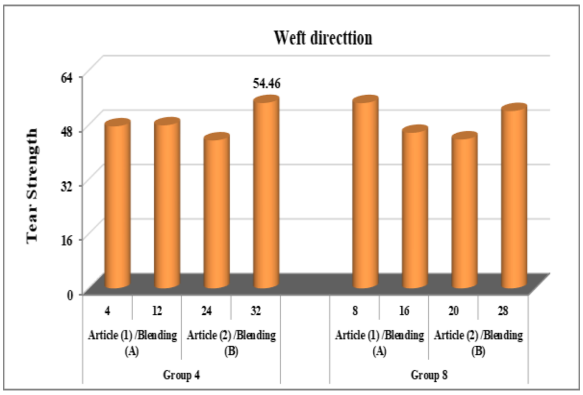


Fig. (38&39) shown the relation between Group (4&8) to found the effect of shedding angle on specimen's Tear Strength at 3kn warp tension with 56 pick / Inch.

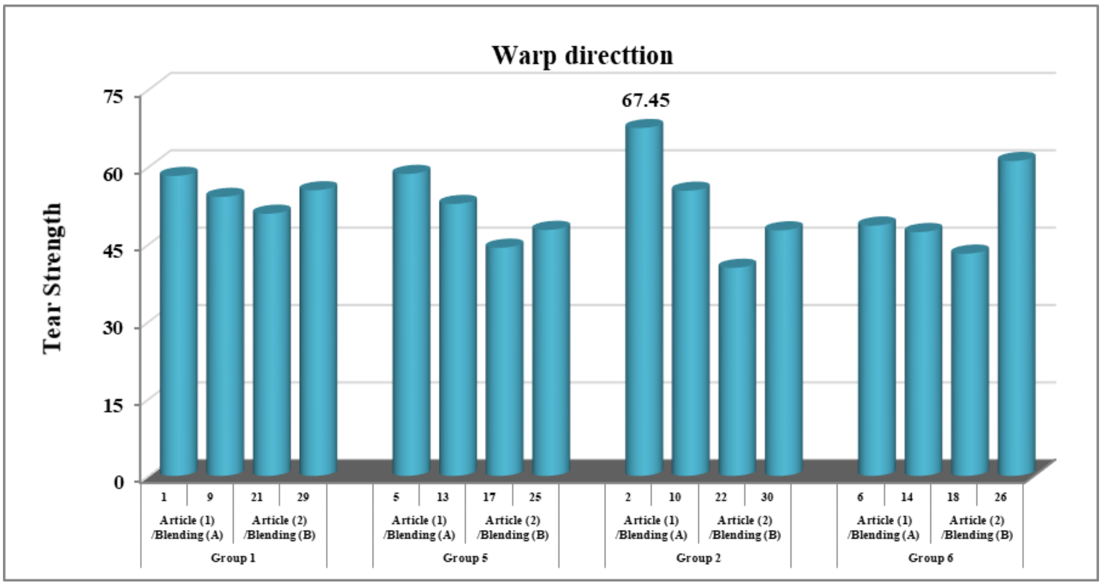


Fig. (40) shown the relation between Group (1&5&3&7) to found the effect of warp tension and weave density on specimen's Tear Strength at (1&3kn) with 46 pick / Inch on (24&28 O shedding angle)in warp direction .

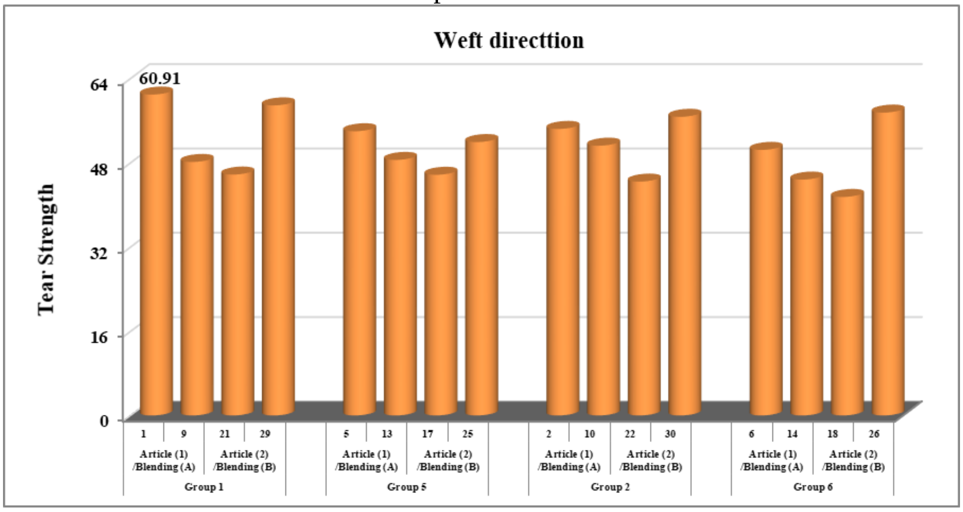


Fig. (41) shown the relation between Group (1&5&3&7) to found the effect of warp tension and weave density on specimen's Tear Strength at (1&3kn) with 46 pick / Inch on (24&28 O shedding angle) in weft direction.

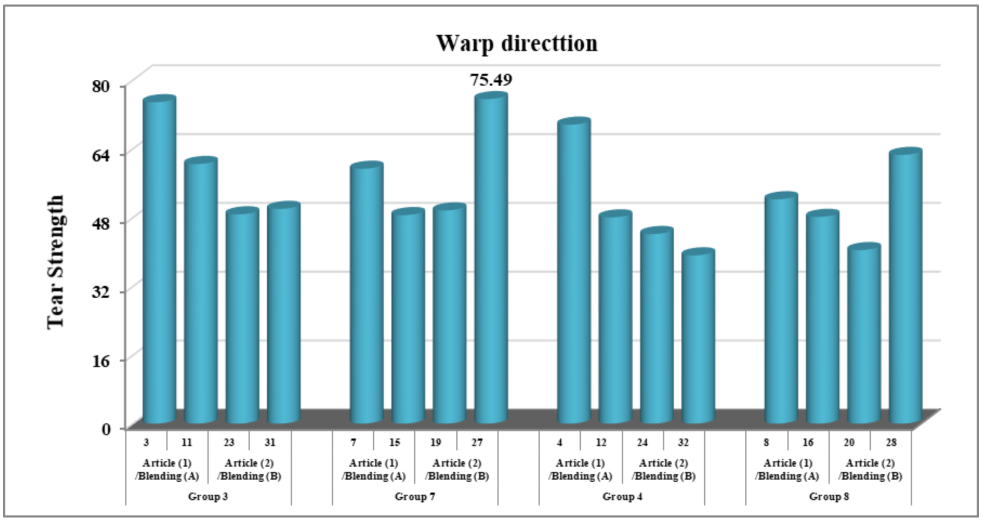


Fig. (42) shown the relation between Group (2&6&4&8) to found the effect of warp tension and weave density on specimen's Tear Strength at (1&3kn) with 56 pick / Inch. on (24&28 O shedding angle) in warp direction.

This work is licensed under a Creative Commons Attribution 4.0 International License

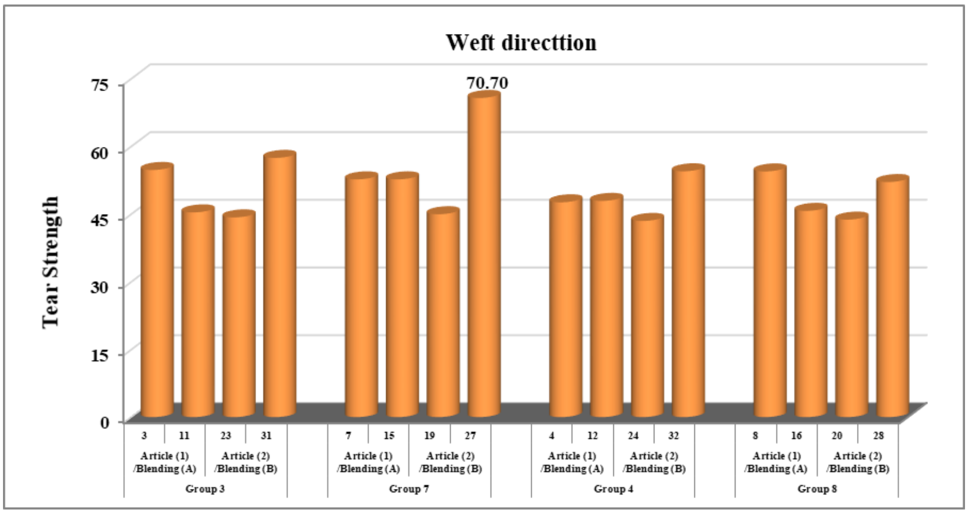


Fig. (43) shown the relation between Group (2&6&4&8) to found the effect of warp tension and weave density on specimen's Tear Strength at (1&3kn) with 56 pick / Inch. on (24&28 O shedding angle) in weft direction.

At the end of research results analysis; it can be hypothesized that final properties of fabrics depend more or less on many various technical and technological parameters, which should already be adjusted from the stage the fiber cultivation stage to the design phase of fabrics. In particular, every portion of the manufacturing machinery process is taken into consideration.

4. Conclusion:

In the study of woven fabric structure and its rheology, this industry considers the largest and most intricate supply chain in manufacturing. Advances in fiber& fabrics complexity technology have facilitated fabric globalization and enabled companies to span their geographical borders for manufacturing machines deal with these materials.

In relation to quality parameters of producing woven fabric; the arrangement, properties, and structure of the fibers within the yam and the yams within the fabric, generate a complex mechanism for the Synchronization process. Actually, the usual practice for producing an article could be obtained from one of the two common model classes. The first is purely geometrical and descriptive, whereas the other class is mechanistic and accounts for the forces acting upon the interlaced yarns in the fabric by which loom. This issue demands extensive attention in understanding the geometry of fabric structure manufacturing. This postulation work will therefore contribute to the research work on the impact of the variety of such linen article fabrics quality with indicated to market.

By examining the current research, it was found that the best Calibers or mechanical automatically synchronistical for the Belgium manufacturer: Picanol. as the model presented to use such a famous type of fabric: The study subject (Linen) Whereas, concerning the best experimental research samples, it was found that there are many effective measured mechanical properties specially when using warp tension (3kn) for many samples , Despite of in fact that only the specimen No, 29 is produced by many machines at textile lounges Stacked on the company producing the above research samples .Meaning somewhere many developing countries in the world deal with machines in an absurd way by producing fabrics if it is possible to say that despite their response to local and international markets based on the Egyptian linen reputation.

In useful brief, for good production, on Ancient Egyptian way by inviting the soaking of linseed to produce the best quality articles in the world until now, as well as cotton, I hope this research present ideas thinking for the engineers of companies will integrate with the researcher's country or any other developing countries., These countries intended technically that do not manufacture machines and equipment, So that a further study will be carried out once, by Finding the way of providing most quality and selling fabrics around the world by studying the mechanics of weaving machines controls, This study leading an question presented here why we did not turn to be the makers of that machinery industry.

Last but not least, **in-depth** understanding variables include design principle, the weave structure, the machine settings during weaving with crucial performance requirements, the properties of the component fibers, the component yarn properties, and the finishing of the final fabric., is necessary for the production cost benefit analysis, utilitarianism of fabrics with optimized performances for any applications or articles., which allows stakeholders to build sustainable weaving mills that are consciously dealing with materials ,machinery , energy consumption and waste and their products will have an consequential in markets .

Reference:

1. A Karnoub, N Kadi1, O Holmudd & others., (2017). The Effect of Warp Tension on the Colour of Jacquard Fabric Made with Different Weaves Structures 17th World Textile Conference Autex (Textiles - Shaping the Future).
2. Abdel-Halim, E. S., H. M. Fahmy, & M. G. Fouda., (2008). Bio scouring of linen fabric in comparison with conventional chemical treatment. Carbohydrate Polymers 74:707–11.
3. Ahmed Ramadan El-Tantawi. (2020). A Review on: The ratio between applied stresses and resultant strain behavior of textile materials (yarn and woven fabric). (5) online issue.
4. Aina Bernava. & Skaidrite Reihmaneb., (2018). Influence of modification methods on colour properties of a linen fabric dyed with direct dyes. Proceedings of the Estonian Academy of Sciences, (67) 2.
5. B.K. Behera., (2007). Comfort and handle behavior of Linen -Blended fabrics. Autex Research Journal, 7(1).
6. Christian Brecher., (2012). Integrative Production Technology for High-Wage Countries. Springer, Berlin, Heidelberg.
7. Deniz Mutlu Ala & Nihat Çelik., (2020). Design of an electropneumatic shedding mechanism for a sampling loom. Journal of The Textile Institute, (112).6.
8. Eylen Sema Dalbaşi & Gonca Özçelik Kayseri., (2019). A Research on the Comfort Properties of Linen Fabrics Subjected to Various Finishing Treatments. Journal of Natural Fibers. Published online: 08 Oct 2019. https://doi.org/10.1080/15440478.2019.1675210.
9. Gloy YS, Renkens W. & Herty M and Gries T., (2015). Simulation and optimisation of warp tension in the weaving process. Textile Science & Engineering .5(1).
10. Ikılem Gocek1, Umut Kivanc Sahin1, Ilkan Erdem & others., (2013).: A study on easy-care laundering of linen fabrics. Textile Research Journal 83(18).
11. J. R. Ajmeri. & S. S. Bhattacharya. (2013). Comparative Analysis of The Thermal Comfort properties of Knitted fabrics made of Cotton and Modal fibres. International Journal of Textile and Fashion Technology. (3)1 .
12. John Mcloughlin &Tasneem Sabir., (2017). High-Performance Apparel Materials, Development, and Applications 1st Edition. Elsevier-Science publisher.
13. Karnoub A, Kadi N1, Azari Z. & Bakeer ES., (2015). Find the Suitable Warp Tension to get the best Resistance for Jacquard Fabric. J Textile Sci Eng. (5)6. 1
14. Kawabata, S., & Niwa, M., (1991). 'Objective Measurement of Fabric Mechanical Property and Quality, its Application to Textile and Clothing Manufacture', Int. J. of Clothing Sci. and Tech. (17)18.

1. Mohsen Miraftab., (2009). Fatigue Failure of Textile Fibres. 1st Edition Woodhead publishing series in textile, Cambridge, England.
2. Mukesh Kumar Singh., (2014). Industrial practices in weaving preparatory. Woodhead publishing India Pvt Ltd.
3. Norma Hollenand. & Jane Saddler. (1964). TEXTILES. 2st Edition, THE Macmillan company, New Yourk.
4. Picanol.be. manufacturer. User hand manual for Model (Opti-Max I 2021).
5. Polona Dobnik Dubrovski. (2010). Woven Fabric Engineering, Sciyo, Intech Open Limited, London, United Kingdom.
6. Sabit Adanur, B.S., M.S., (2001). Hand book in weaving., Sulzer Textile Limited Switzerland, CRC Press is an imprint of Taylor & Francis Group.
7. Samir Kumar Neogi. (2015). Role of Yarn Tension in Weaving. 1st Edition. Woodhead publishing series in textile, India, Pvt Ltd.
8. Seher Perincek. & Kerim Duran., (2016). Optimization of enzymatic & ultrasonic bio-scouring of linen fabric by aid of Box-Behnken Experimental Design. Journal of Cleaner Production (135).
9. Sheikhzadeh M, Hosseini S. & Darvishzadeh, M., (2007). Theoretical evaluation of warp tension variations during weaving process. Indian J Fiber Text Res (32).
10. Suzan Ahmed., Shah Alimuzzaman. A. K. M. & Monjurul Haque. (2020). Effect of shed geometry on starting mark of woven fabric. SN Applied Sciences journal. (2)4.
11. Varadarajan, C. B. Senthil Kumar & N. Gokarneshan., (2013). Mechanics and calculations of textile machinery. Woodhead Publishing India 1st .
12. William Watson (1921). Textile Design and colour elementary weaves and figured fabrics

This work is licensed under a Creative Commons Attribution 4.0 International License

2st Edition. Longmans, Green and Co.

13. Xiaogang Chen., (2005). Characteristics of Cloth Formation in weaving and their influence on fabric parameters, Textile Research Journal. 75(4).
14. Yildiray Turhan. & Recep Eren., (2011). The effect of loom settings on wearability limits on air-jet weaving machines. Textile Research Journal 82(2).
15. Z.J. Grosicki., (1925). Watson's Advanced Textile Design. Compound Woven Structure, 3rd Woodhead publishing series in textile, Cambridge, England.
16. Zitouni Azari, Nawar Kadi. & Amer Kaarnoub. (2015). The effect of warp tension on Jacquard fabrics specification, Journal of Textile and Fashion Technology, (1) 1.
17. Züleyha Degirmencil. & Ebru Çoruh., (2016). Comparison of the performance and physical properties of plain, pique, double pique and fleeced knitted fabrics. Tekstile ve Konfeksiyon 26(2).

Appendix.

Table.4. Specimen's weight and Thickness values.

Groups.	Article / Blending.	Sample code	No..Of piqué	Weave density.	Warp Tension	Shed angle.	Weight /M²	Thicknes s /mm
1	Article (1)	1	6	46	1	28	289	1.06
	Blending (A)	9	4	46	1	28	284	1.05
	Article (2)	21	4	46	1	28	206	0.83
	Blending (B)	29	6	46	1	28	204	0.87
2	Article (1)	2	6	56	1	28	310	1.05
	Blending (A)	10	4	56	1	28	330	1.02
	Article (2)	22	4	56	1	28	233	0.89
	Blending (B)	30	6	56	1	28	236	0.88
3	Article (1)	3	6	46	3	28	352	1.10
	Blending (A)	11	4	46	3	28	279	1.00
	Article (2)	23	4	46	3	28	210	0.83
	Blending (B)	31	6	46	3	28	212	0.92
4	Article (1)	4	6	56	3	28	317	1.12
	Blending (A)	12	4	56	3	28	325	1.09
	Article (2)	24	4	56	3	28	241	0.92
	Blending (B)	32	6	56	3	28	242	1.02
5	Article (1)	5	6	46	1	24	279	1.06
	Blending (A)	13	4	46	1	24	278	0.99
	Article (2)	17	4	46	1	24	213	0.93
	Blending (B)	25	6	46	1	24	219	0.95
6	Article (1)	6	6	56	1	24	**352**	**1.13**
	Blending (A)	14	4	56	1	24	316	1.03
	Article (2)	18	4	56	1	24	235	0.90
	Blending (B)	26	6	56	1	24	251	0.91
7	Article (1)	7	6	46	3	24	299	1.20
	Blending (A)	15	4	46	3	24	286	0.98
	Article (2)	19	4	46	3	24	218	0.84
	Blending (B)	27	6	46	3	24	220	0.93
8	Article (1)	8	6	56	3	24	332	1.23
	Blending (A)	16	4	56	3	24	320	1.02
	Article (2)	20	4	56	3	24	234	0.92
	Blending (B)	28	6	56	3	24	240	1.01