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DESIGN SOME MULTILAYER FABRICS FOR OUTDOOR FURNITURE UPHOLSTERY

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ABSTRACT

Outdoor fabrics refer to woven textile made of a wide variety of synthetic fibers acrylic, polyester, olefin and various blend including cotton. These fabrics are coated and laminated with synthetic materials and treatment becomes greater strength and environmental resistance.

This research aims to produce some multilayer fabrics for outdoor furniture upholstery. The sample under study is produced in multilayer (triple) by using woven and non-woven techniques. The woven fabrics (outer layers) are produced using 100% polyester yarns, count of weft yarn 450 denier, count of warp yarn 300 denier with two weaving structure (plain weave 1/1 and twill weave 1/3) and four weft sets (16, 18, 20 and 22 picks/cm) warp set 24 ends/cm. The non-woven fabrics (inner layer) made of semi blending between polyester and polypropylene fibers (weight 250 gm/m^2) fiber of 6 denier. Needle punching technique using 800 beats/min and depth of needle punching 10 mm. Two bonding technique were used to bond the layers together, needle felting and adhesive material (PVA)using(hot calendars)at100ºC. Produced fabrics are treated against water, fire, UV radiation and fouling nature. Tests are carried out to evaluate the samples produced under study. The obtained test result are presented and discussed.

Keywords: Coated, Lamination, Mechanical Properties, Multilayer Fabrics, Outdoor Fabrics.

I. INTRODUCTION

Technical textile are especially designed and engineered structure that are used in products, processes or services of mostly non-textile industries **[1].** Technical fabrics feature a great variety of applications such as in agriculture, architecture, medical textile, outdoor fabrics, military textile, automotive industry, storage, packing, etc **[2].** Water proof-fabrics (coating – lamination) are of significance in the field of hygiene agriculture, protective clothing, sports wear and construction industries, they are used as roofing and covering material **[3].**

1.1 Outdoor Fabrics

Outdoor fabrics "refer to woven textile made from a wide variety of synthetic fibers acrylic, polyester, olefin and various blend including cotton. These breathable fabrics are made with water proof properties by a chemical treatment process during manufacturing **[4].**

1.2 Common Outdoor Fabrics Uses

- Outdoor living: cushions, umbrellas, awnings, canopies.
- Boating: boat covers, sail covers, enclosures.

- Automotive: fabric convertible topping, fabric awnings, upholstery, carpeting.
- Outdoor sports clothing and shelter: such as mountain climbing, camping rock climbing, horse riding, rafting, skating, gliding parachuting, tents **[5,6].**

1.3 Multilayer Fabrics

Multilayer fabrics are that type of fabrics which are composed of one or more layers with an additional adhesive layer **[7].** The fabric structure, method of production, weight and materials of each layer can be controlled according to the required properties and final usage **[8,9].** The fabrics are coated and laminated with synthetic materials such as films, polymer sheets, rubber, foam and leather becomes greater strength and environmental resistance **[10].** Multilayered materials especially in the textile industry, contain at least one layer of the textile material which may be a woven fabric, knitted fabric, or nonwoven fabric. Multilayered materials can be produced in different ways:

- By laminating a polymer layer to the textile surface material.
- By direct applying a polymer to the textile material.
- By indirect applying a polymer to the textile material **[11,12].**

1.4 The Requirements of Outdoor Fabrics

Outdoor fabrics are constantly exposed to environmental condition especially outdoor upholstery fabrics such as (rain, wind, UV radiation and mildew) which causes degradation of physical and mechanical properties especially UV radiation. The penetration of UV radiation in synthetic fibers causes photo oxidation and results in decrease in elasticity, tensile strength and a slight increase in the degree of crystalline **[13].**

Treatment and multilayer on the textile provides new properties of the fabric. Whereas physical and mechanical properties of multilayer fabrics depend on material type, weave type, yarn type, warp and weft density, yarn count, mass per square meter, number of layer (fabric thickness) and type of coating, lamination or bond technique **[14].** Hence the outdoor fabrics achieve the required specifications and properties such as : tensile strength, elongation at break, tear resistance, abrasion resistance , high water and UV radiation resistance to meet the requirement of the usage **[15].**

II.THE EXPERIMENTAL

2.1 Preparation of Samples

2.1.1 Specification of Samples

The present research is concerned with the multilayer fabrics which are suitable for outdoor. Woven and non-woven technique was applied to produce 16 samples with triple layers. Two bonding technique was used to bond the layers together (needle felting) and (adhesive material) *(*PVA) using (hot calendars)at100ºC. The woven layers (outer) were produced from polyester continuous filament yarn of weft and warp by using two difference woven structure (plain 1/1 and twill 1/3). Table (1) shows the specification of woven fabrics (the outer layers). Non-woven layer (inner) were made of polyester and polypropylene fibers having 6 denier and 250 gm/m^2. Table (2) shows the specification of non-woven fabrics (the inner layer). Table (3) shows the specification of all the samples.

2.1.2 The Treatments

- Treatment against moisture using polyurethane binder is achieved by spraying on the samples surface.
- Against fouling nature using: aliphatic hydrocarbon + carbon dioxide + urethane is achieved by spraying on the samples surfaces.
- Against ultra violet rays using: polyurethane A + hardener MC-polypaint B is achieved by spreading the samples on the surfaces by means of a brush.
- Against fire using: phosphoric salt + tylozin is achieved by immersing the samples in the treatment solution.

2.2 Tests

The experimental tests have been achieved in the weave laboratory in the National Institute for Standards in Haram, Giza in a standard environment (relative moisture: 65±2, temperature 20^{o}C±2).

In order to evaluate the performance properties of the produced samples, the following tests were carried out.

1- Tensile strength and elongation at break in both directions was determined in accordance with (ASTM-D 4595-83) by using tensile testing machine – Tinius olsen – SDLATLATLAS, model H5KT.

2- Tear resistance was determined in accordance with (ASTM-D 4533-82) by using tensile testing machine – Tinius olsen – SDLATLATLAS, model H5KT.

3- Fabric abrasion resistance was determined in accordance with their lost of weight (%) after 500 cycle accordance with (ASTM-D 4158-79) by using Rub tester – computext – Budapest.

4- Fabric thickness: this test was carried out according to (ASTM-D1777-1996).

5- Fabric weight: this test was carried out according to (ASTM-D3776-1979).

Table (1): Woven Fabric Specification

No.	Property	Specification
1	Warp type	Polyester filament yarn
2	Weft type	Polyester filament yarn
3	Warp count	300 den.
4	Weft count	450 den.
5	Warp set	24 ends/cm
6	Weft set	16, 18, 20, 22 picks/cm
7	Weave structure	Plain 1/1, Twill 1/3

Table (2): Non-Woven Fabric Specification

No.	Property	Specification
1	Fiber type	Polyester and polypropylene
2	Fiber count	6 den.
3	Web formation	C. L.
4	Fabric weight	250 gm/m^2
5	Beats/min	800
6	Needles penetration depth	10 mm

Table (3): Samples specification

Three layers samples					Three layers samples				
Sample no.	Outer layer		Inner layer	Bonding technique	Sample no.	Outer layer		Inner layer	Bonding technique
	weave structure	Weft set picks/cm				Weave structure	Weft set picks/cm		
1	Plain 1/1	16	Semi blending between Polyester and polypropylene 250 gm/m^2	adhesive material	9	Plain 1/1	16	Semi blending between Polyester and polypropylene 250 gm/m^2	Needle felting
2	Plain 1/1	18			10	Plain 1/1	18		
3	Plain 1/1	20			11	Plain 1/1	20		
4	Plain 1/1	22			12	Plain 1/1	22		
5	Twill 1/3	16			13	Twill 1/3	16		
6	Twill 1/3	18			14	Twill 1/3	18		
7	Twill 1/3	20			15	Twill 1/3	20		
8	Twill 1/3	22			16	Twill 1/3	22		

III. RESULTS AND DISCUSSIONS

Results of experimental tests carried out on the produced samples were presented in the following tables and charts. Results were also statistically analyzed for the date listed and relationships between variables were obtained.

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3.1 Tensile Strength at Break

Table (4): Fabric tensile strength measurement results in both directions

Test	Tensile strength (kg)							
Bonding Technique	Adhesive material				Needle felting			
Weave structure	Plain Weave 1/1		Twill Weave 1/3		Plain Weave 1/1		Twill Weave 1/3	
Direction / Weft set	warp	Weft	warp	weft	warp	weft	Warp	weft
16	278.6	221.4	272.4	216.8	264.2	209.3	257.5	202.3
18	315.4	242.6	308.5	236.7	300.8	227.8	288.7	220.4
20	346.2	267.3	338.7	260.4	330.7	248.7	319.8	245.7
22	360.7	302.5	352.8	286.5	345.4	283.4	334.8	276.8

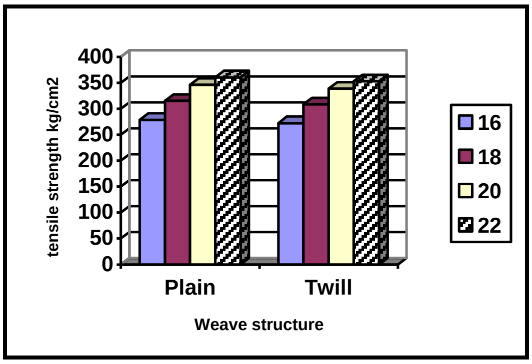

Fig. (1)

effect of fabric structure and number of picks/cm on the tensile strength at break in the warp direction for adhesive material

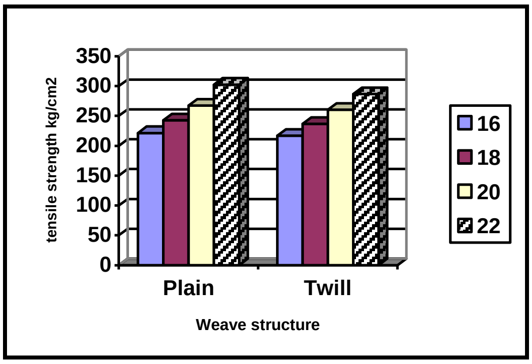

Fig. (2)

effect of fabric structure and number of picks/cm on the tensile strength at break in the weft direction for adhesive material

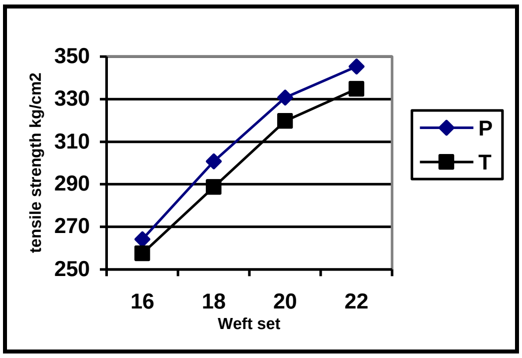

Fig. (3)

effect of fabric structure and number of picks/cm on the tensile strength at break in the warp direction of needle felting

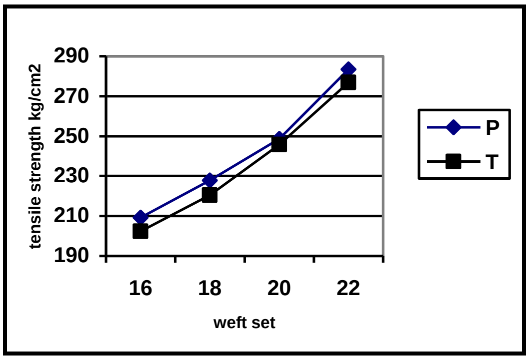

Fig. (4)

effect of fabric structure and number of picks/cm on the tensile strength at break in the weft direction of needle felting

Table (5) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on tensile strength at break in warp direction of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 13.675 X + 50.45	0.9839
Twill 1/3	Y = 13.15 X + 50.3501	0.9889

Table (6) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on tensile strength at break in weft direction of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 12.16 X + 11.26	0.9880
Twill 1/3	Y = 12.44 X - 0.059964	0.9932

3.1.1 Effect of picks/cm on the tensile strength at break in the warp and weft direction:

It is clear from table (4), and figs. (1- 4), that there are a direct relationship between the picks/cm and the tensile strength at break for all the samples were used for the test with all the weave structure. The direct proportionality can be interpreted as that increasing the number of picks/cm leads to that the warp and weft yarns become more near one another and contribute to resistance against tensile which results in increasing the tensile strength at break.

3.1.2 Effect of weave structure on the tensile strength at break in warp and weft direction:

It is clear from table (4) and fig. (1- 4) that the fabrics with the weave structure plain 1/1 has the highest tensile strength at break than the twill 1/3 this can be interpreted as that increasing the spacing between intersection decreases the tensile strength at break and that increasing the number of intersection/cm leads to increase the merging of yarns and weft in the fabric for all the samples.

3.1.3 Effect of the types of bonding technique on the tensile strength at break in warp and weft direction:

It is clear from table (4) and fig. (1- 4) that the samples used the adhesive material technique for bonding has recorded the highest rates of tensile strength compared to needle felting samples this can be explained that the sintering with needles may results in stressing some fibers and yarns unlike the samples used the adhesive material method between the first and second layers and between the second and third layers which lead join the layers without stressing the fibers and yarns.

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3.2 Elongation at Break

Table (7): Fabric elongation at break measurement results in both directions

Test	Elongation at break %							
Bonding Technique	Adhesive material				Needle felting			
Weave structure	Plain Weave 1/1		Twill Weave 1/3		Plain Weave 1/1		Twill Weave 1/3	
Direction / Weft set	Warp	weft	warp	weft	Warp	weft	warp	weft
16	27.7	22.1	26.8	21	24.8	18.3	23.7	18.5
18	30.5	23.5	29.4	22.4	27.3	20.6	26.4	20.2
20	34.2	25.2	32.7	24.3	31.4	22.4	29.2	22.8
22	36.3	27.8	34.8	26.6	33.8	25.6	31.8	24.7

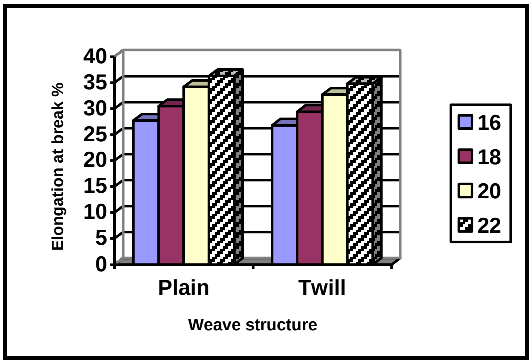

Fig. (5)

effect of fabric structure and number of picks/cm on the elongation at break in the warp direction for adhesive material

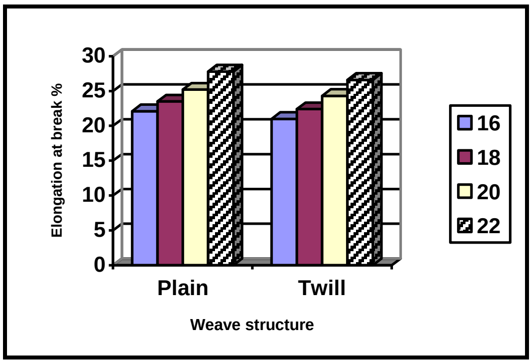

Fig. (6)

effect of fabric structure and number of picks/cm on the elongation at break in the weft direction for adhesive material

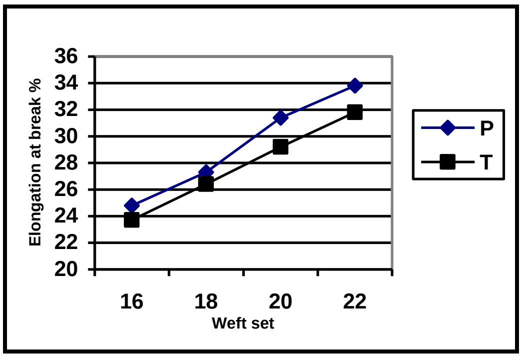

Fig. (7)

effect of fabric structure and number of picks/cm on the elongation at break in the warp direction of needle felting

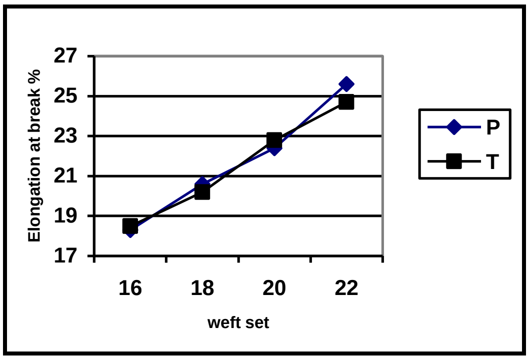

Fig. (8)

effect of fabric structure and number of picks/cm on the elongation at break in the weft direction of needle felting

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Table (8) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on the elongation at break in warp direction of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 1.555 X - 0.220001	0.9944
Twill 1/3	Y = 1.355 X + 2.03	0.9999

Table (9) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on the elongation at break in weft direction of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 1.185 X - 0.790003	0.9933
Twill 1/3	Y = 1.06 X + 1.41	0.9969

3.2.1 Effect of picks/cm on the elongation at break in the warp and weft direction

It is clear from table (7) and fig. (5-8) that there is a direct proportionality between the number of picks/cm and the elongation at break in the warp and weft direction. This can be explained as that increasing the number of picks/cm means increasing the number of picks exposed to elongation and hence, leads to increase the binding and merging between the weft and also the warp and thus results in more fabric flexibility before break and thereby more elongation in both directions.

3.2.2 Effect of weave structure on the elongation at break in the warp and weft direction

It is clear from table (7) and fig. (5-8) that the fabric of plain 1/1 recorded the maximum elongation then the twill 1/3 this can be explained that the plain 1/1 has more intersection than twill 1/3 which make the fabric more compacted and merging between the yarns and thereby more elongation for all the types of multi layers fabrics.

3.2.3 Effect of the types of bonding technique multi-layers fabrics on the elongation at break in the warp and weft direction

It is clear from table (7) and fig. (5-8) that the samples which used the adhesive material method have more elongation than those produced by sintering with needles. This can be explained as that fabric used the adhesive material method gives some flexibility to fabrics which causes more elongation than that of the fabrics produced by sintering with needles which leads to join the fibers, yarns and compressing them with each other and hence, reduces the fabrics elongation.

3.3 Fabric Tear Resistance

Table (10): Fabric tear resistance measurement results in both directions

Test	Tear resistance (kg)							
Bonding Technique	Adhesive material				Needle felting			
Weave structure	Plain Weave 1/1		Twill Weave 1/3		Plain Weave 1/1		Twill Weave 1/3	
Direction / Weft set	warp	weft	warp	weft	Warp	weft	Warp	weft
16	7.8	6.8	7.3	6.6	8.5	7.4	8.2	7
18	8.8	7.6	8.3	7.8	9.6	8.7	9.3	8.2
20	9.6	8.5	9.3	8.6	10.5	9.8	10.2	9.4
22	11.2	9.7	10.4	9.4	11.8	11	11.2	10.7

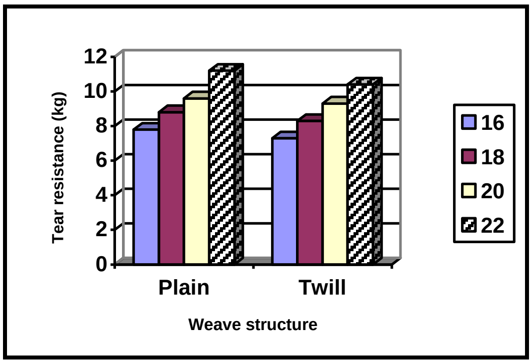

Fig. (9)

effect of fabric structure and number of picks/cm on the tear resistance in the warp direction for adhesive material

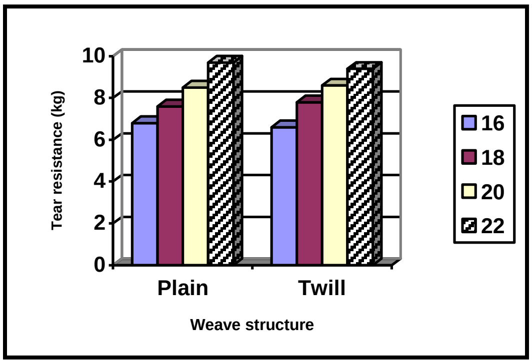

Fig. (10)

effect of fabric structure and number of picks/cm on the tear resistance in the weft direction for adhesive material

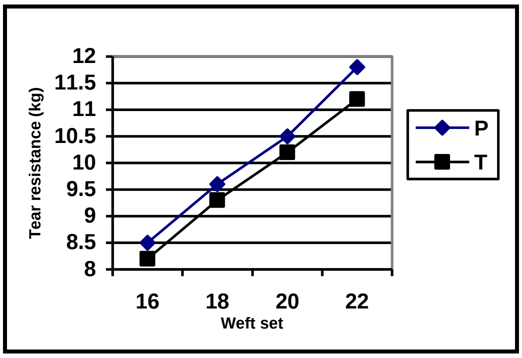

Fig. (11)

effect of fabric structure and number of picks/cm on the tear resistance in the warp direction of needle felting

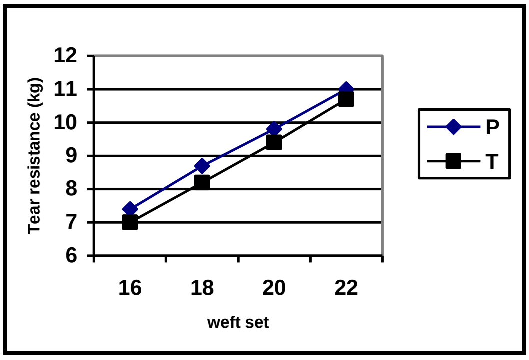

Fig. (12)

effect of fabric structure and number of picks/cm on the tear resistance in the weft direction of needle felting

Table (11) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on the tear resistance in warp direction of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 0.54 X - 0.16	0.9976
Twill 1/3	Y = 0.495 X + 0.32	0.9993

Table (12) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on the tear resistance in weft direction of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 0.595 X - 2.08	0.9995
Twill 1/3	Y = 0.615 X - 2.86	0.9998

3.3.1 Effect of picks/cm on the tear resistance in the warp and weft directions

Table (10) and fig. (9-12) show that directly proportional relation exists between the fabrics resistance to tearing and picks/cm in the directions of warp and weft. The fabric resistance increases with increasing the number picks per unit length. This can be explained as that the warp and weft yarns become more near one another and contribute to the resistance against tearing.

3.3.2 Effect of weave structure on the tear resistance in the warp and weft direction

Table (10) and fig. (9-12) show that the fabrics of plain 1/1 has the highest tear resistance, then the twill 1/3 this can be explained in view of the distribution of intersections as that the less spacing between the intersection leads to that the warp and weft yarns become more near one another and contribute to the resistance against tearing.

3.3.3 Effect of types of bonding technique on the tear resistance in the warp and weft directions

It is clear from table (10) and fig. (9-12) that the samples were produced by sintering with needle are more resistance to tearing than the samples were produced using the adhesive material method. This can be explained as that the method of sintering with needles gives the yarns more freedom to move and slide when a force affects the fabrics, unlike the fabric used the adhesive material method which results in more confinement of the yarns.

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3.4 Fabric Abrasion Resistance

Table (13): Fabric abrasion resistance (lost of weight% after 500 cycle) measurement results

Test	Abrasion %			
Bonding Technique	Adhesive material		Needle felting	
Weave st. / Weft set	Plain Weave 1/1	Twill wave 1/3	Plain Weave 1/1	Twill wave 1/3
16	2.7	3.8	2.2	3.3
18	2.2	3.3	2	2.9
20	1.8	2.9	1.6	2.5
22	1.5	2.6	1.2	2.1

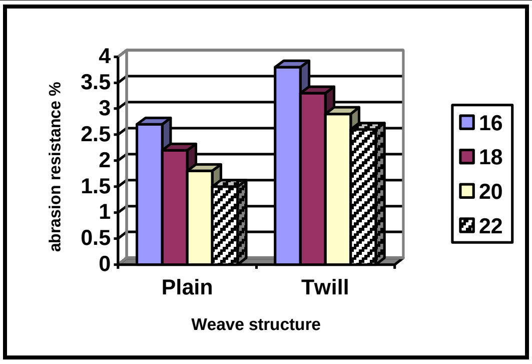

Fig. (13)

effect of fabric structure and number of picks/cm on the abrasion resistance for adhesive material

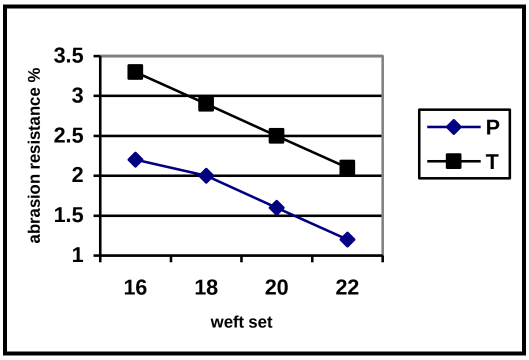

Fig. (14)

effect of fabric structure and number of picks/cm on the abrasion resistance for needle felting

Table (14) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on the abrasion resistance of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = - 0.17 X + 4.98	- 0.9898
Twill 1/3	Y = - 0.2 X + 6.5	-1

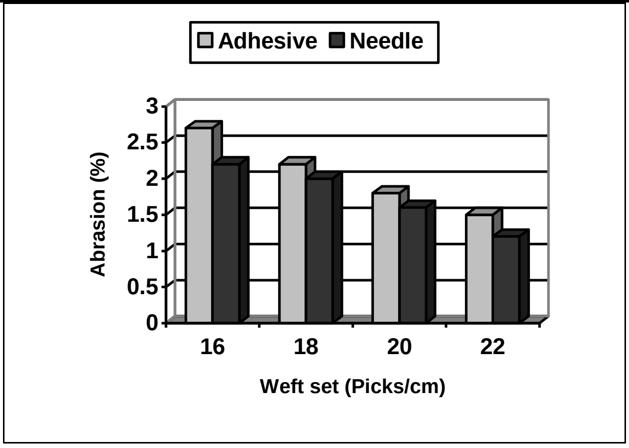

Figure (15) Effect of picks/cm on the abrasion resistance for the fabric produced with plain 1/1.

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3.4.1 Effect of picks/cm on the abrasion resistance of fabrics

It can be noticed from table (7) and fig. (4) there is a direct relation-ship between the number of picks/cm and the abrasion resistance this can be explained that the increase in number of picks/cm cause fabrics to be more compacted leading to the increase in fabric abrasion resistance.

3.4.2 Effect of the weave structure on the abrasion resistance of fabrics

Table (13) and fig. (13-15) show that the fabric of plain 1/1 has the highest abrasion resistance then the twill 1/3 this can be explained that the twill weave 1/3 has long floats which increase the surface that is subjected to abrasion compared to plain weave structure.

3.4.3 Effect of the types of bonding technique on the abrasion resistance of fabrics

It can be noticed from table (13) and fig. (13-15) that the samples produced by sintering with needles are more resistance to abrasion than the samples were produced by using the adhesive material method. This can be explained as that the surface of the fabrics produced by the first method in not smooth enough which results in non-fabric abrasion distribution on the samples surface, whereas the samples produced by the fabric used the adhesive material method have more flat surface which leads to fabric abrasion distribution on the samples surface and hence leads to more abrasion and more weight loss than that occurring with the samples produced by sintering with needles.

3.5 Thickness of Fabric

Table (15): Fabric thickness measurement results

Test	Thickness mm			
Bonding Technique	Adhesive material		Needle felting	
Weave st. / Weft set	Plain Weave 1/1	Twill wave 1/3	Plain Weave 1/1	Twill wave 1/3
16	2.92	3.07	2.72	2.85
18	3.16	3.29	2.94	3.04
20	3.34	3.42	3.15	3.24
22	3.50	3.63	3.38	3.46

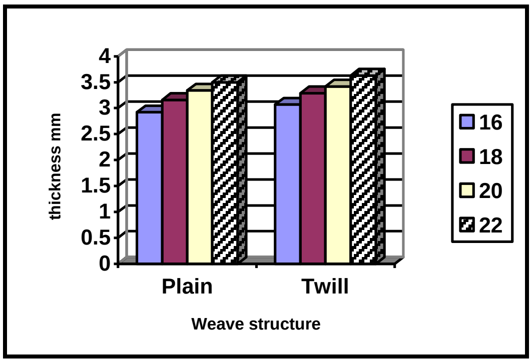

Fig. (16)effect of fabric structure and number of picks/cm on the thickness for adhesive material

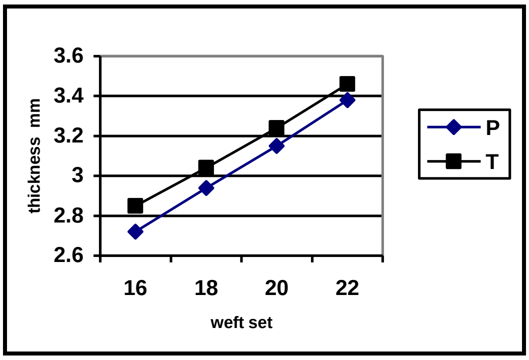

Fig. (17)effect of fabric structure and number of picks/cm on the thickness for needle felting

Table (16) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on the thickness of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 0.1095 X + 0.967	0.9999
Twill 1/3	Y = 0.1015 X + 1.219	0.9994

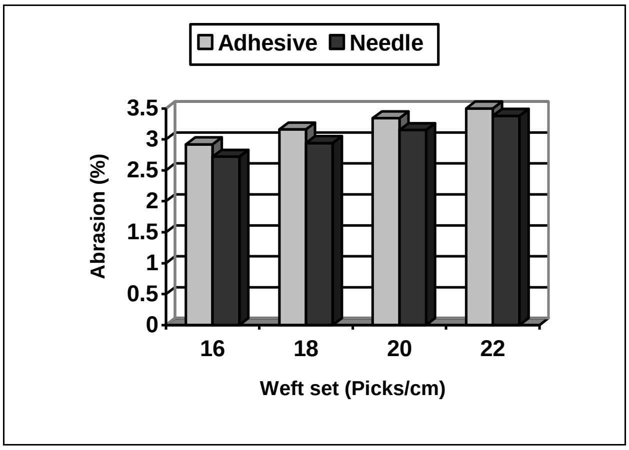

Figure (18) Effect of picks/cm on the thickness (mm) for the fabric produced with plain 1/1.

3.5.1 Effect of picks/cm on the fabric thickness:

Table (15) and fig. (16-18) show that there is a directly proportional relation between the thickness of fabric and the picks density. This can be attributed to the increase in the diameter of yarns.

3.5.2 Effect of the weave structure on the thickness for the fabric:

Table (15) and fig. (16-18) show the maximum thickness is achieved using the twill weave 1/3 then the plain weave 1/1. This can be explained as that the longer the spacing between intersection the more shrinking of the fabric after removal from the loom and the more the number of intersection per unit area the more the compression of the yarns and hence the less the thickness.

3.5.3 Effect of the types of bonding technique on the thickness for the fabric:

Table (15) and fig. (16-18) show that the needle felting samples have scored the lowest thickness compared to the samples used the adhesive material technique. This is mainly due to that needle felting technique cause fiber to be reoriented and so increasing the contact between the horizontal and vertical level structure increasing fabric compactness and decreases the space between fibers leading to the decrease of fabric thickness.

3.6 Weight of Fabric

Table (17): Fabric weight measurement results

Test	Weight gm/m^2			
Bonding Technique	Adhesive material		Needle felting	
Weave st. / Weft set	Plain Weave 1/1	Twill wave 1/3	Plain Weave 1/1	Twill wave 1/3
16	760	742	740	716
18	808	786	790	770
20	852	838	832	820
22	903	879	882	868

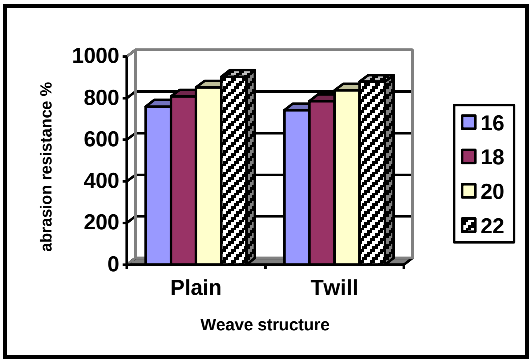

Fig. (19)

effect of fabric structure and number of picks/cm on the weight gm/m^2 for adhesive material

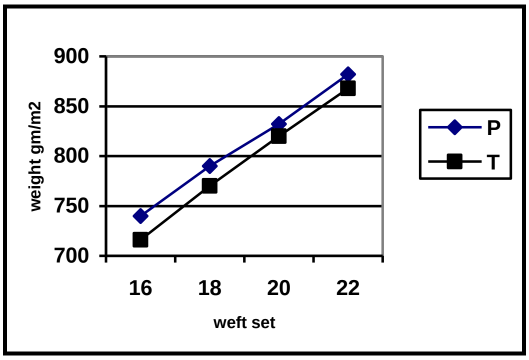

Fig. (20)

effect of fabric structure and number of picks/cm on the weight gm/m^2 for needle felting

Table (18) Regression equation and correlation coefficient for the effect of number of picks/cm and type of weave structure on the weight of needle felting

Weave structure	Regression equation	Correlation coefficient
Plane 1/1	Y = 23.4 X + 366.4	0.9994
Twill 1/3	Y = 25.3 X + 312.8	0.9996

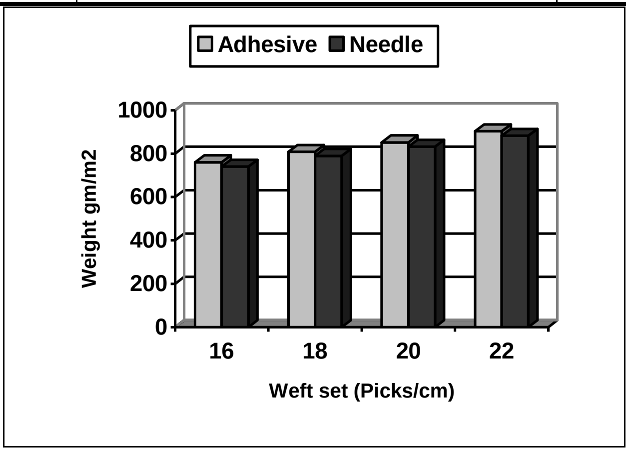

Figure (21) Effect of picks/cm on the weight (gm/m^2) for the fabric produced with plain 1/1.

3.6.1 Effect of picks/cm on the fabric weight:

Table (17) and fig. (19-21) show that there are a direct relationship between the picks/cm and the weight. This can be attributed to the increase in the diameter of yarns.

3.6.2 Effect of the weave structure on the fabric weight:

Table (17) and fig. (19-21) show that the fabric with the weave structure plain 1/1 has the increasing the weight than the twill weave 1/3. This can be explained that the plain 1/1 has more intersection than twill 1/3 and hence the more shrinking of the fabric.

3.6.3 Effect of the types of bonding technique on the fabric weight:

Table (17) and fig. (19-21) show that the needle felting samples have scored the lowest weight compared to the samples used the adhesive material technique. This can be attributed to the weight of the adhesive material which using to bonding the samples.

IV. CONCLUSION

In this study multi-layered samples of woven and non woven fabrics were produced for outdoor furniture upholstery , two bonding techniques were also used to bond the layers together, needle felting and the adhesive material method. Samples under study were also treated against moisture, fouling nature, ultra-violet radiation and fire. More results were reached for examples

- Bonding techniques method, weave construction and number of picks/cm have great impacts on the tensile strength ,elongation, tear resistance, abrasion resistance, weight and thickness as follow :
- The samples which used the adhesive material method have higher tensile strength, elongation, thickness, weight than the samples used needle felting technique for bonding.
- The samples used needle felting technique for bonding have higher tear resistance and abrasion resistance than the samples used the adhesive material method.
- The fabrics of warp direction have higher tensile strength, elongation and tear resistance than the fabrics of weft directions.
- Increasing the picks/cm leading to the increasing of tensile strength, elongation, tear resistance, abrasion resistance, thickness and weight.
- The plain weave has higher tensile strength, elongation, tear resistance and weight than the twill weave.
- The twill weave has higher thickness than the plain weave.

REFERENCES

[1] S., Adanur, "Handbook of weaving", technomic publishing company Inc., Lancaster Pennsylvania, 2001. P. 319.

[2] W. Fung, "products from coated and laminated fabrics, coated and laminated textile", the textile institute, wood head publishing Ltd., Cambridge, England, 2002, 149-153.

[3] Y. K., Kang, C. H., Park, J., Kim, T. J., Kang, "Application of Electro spun polyurethane web to breathable water – proof fabrics". Fibers and Polymers, 8/5, 2007, 564 – 570.

[4] C. Huang, "The comfortable requirements and development of sports wear fabrics", Guangxi Textile Science & Technology, 38 (4), 2010, PP.56-57.

[5] Y. Chen J. Yu, C. Chu, "The present and developing trend of the tent fabrics", Technical Textile, 12, 2004, 26-31.

[6] H. Zhang , S. Zhao , " The study of properties of high performance sports and outdoor clothing " , Tianjing Textile science & Technology, (1), 2006, PP, 17-20.

[7] A. R. Horrocks & S. C. Anand, "Handbook of Technical Textile", Wood head Pub. Ltd., England, 2000.

[8] V., Ashish, K. C., Manoj, "Synthesis and surface properties of environmentally responsive segmented polyurethane", Journal of colloide and interface science, 2002, 249, (1), 235-245.

[9] F.Walter, "Coated and laminated textile", 1st edition, wood head publishing Ltd., 2002, p. 210.

[10] S. Joneydi , A.Khoddami , A. Zadhoush , " Novel super hydrophobic top coating on surface modified PVC- coated fabric " , progress inorganic coatings , (76), 2013 , pp 821-826 .

[11] K. Singha, "A Review on Coating & Lamination in Textiles: Processes and Applications", American Journal of Polymer Science, 2(3), 2012, pp. 39-49.

[12] A. K. Sen, "Coated Textiles - Principals and Applications″(2 ed.), 2008, Boca Raton: CRC Press, Taylor & Francis Group, LLC. .

[13] J., Alvarz, B., L., Symonowicz, "Examination of the absorption of various fiber in relation to UV radiation", Autex Res. J. 3 (2), 2003, 0057.

[14] I., Jerkovicet, J. M., Pallares, X Capdevila. "Study of the Abrasion resistance in the upholstery of automobile seat", AUTEX Research Journal, Vol. 10, No. 1. , 2010.

[15] K. Bilişik "Abrasion Properties of Upholstery Flocked Fabrics", Textile Research Journal, Vol 79 (17), 2009 pp. 1625–1632.