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ESTIMATING ABRASION RESISTANCE OF EXTRA WEFT FOR UPHOLSTERY FABRICS

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ABSTRACT

The abrasion resistance of extra weft for upholstery fabrics parameters was investigated. Designation of experimental framework based on warping bonded polyester threads on jacquard loom and picking the same denier of flat polyester yarns with two ground weaves, two picks arrangement, two figuring picks float length, and three numbers of abrasion cycles. Factorial analysis of variance results detected that independent variables had a reverse significant effects. The prediction equation expressed interaction of the independent variables and weight loss as a function of fabric abrasion resistance, was concluded; the participation percentages of each parameter were calculated.

Key Words: Abrasion Resistance, Fabrics Properties, Extra Weft, Weaves Structure, Upholstery Fabrics

I. INTRODUCTION

Upholstery fabrics are one of the important types of textiles manufactures to meet consumers requirements included good performance and appearance. Abrasion resistance is an essential property which determines upholstery durability. In this context, abrasion is the physical destruction of fibers, yarns, and fabrics, resulting from the rubbing of a textile surface over another surface [1]. Abrasion occurs during wearing, using, cleaning or washing process and this may distort the fabric, cause fibers or yarns to be pulled out or remove fiber ends from the surface [2][3]. Abrasion ultimately results in the loss of performance characteristics, such as strength, but it also affects the appearance of the fabric [4]. Early prediction method has described for the inherent abrasion resistance of textile materials substantively by the use of load-elongation diagrams of mechanically; energy coefficient E; This coefficient is considered as a function of low modulus of elasticity, large immediate elastic deflection, high ratio of primary to secondary creep, high magnitude of pri mary creep, and high rate of primary creep [5]. Resistance to abrasion is evaluated measuring the loss of mass, the loss of material strength, the increase in air permeability, and the increase of light bandwidth after the tear in the fabric, the reduction of thickness in tear, and the appearance of the worn surface [6]. The abrasion resistance of fabrics of different weaves have been examined in several studies before [7][8]. The long yarn floats and low number of interlacings decreased the durability of woven fabric by increasing the mass loss [9], the plain weve fabrics are generally the least porne to wear which increase with decrease in the density of yarn cross-over points and increase in yarn float length [10].

Extra figuring is an important method to obtain decorative motives on fabrics; principles of Figuring with Extra materials as threads in one or both ways and the advandages and disadvandages of figuring with each way were mensioned in basic refrences [11] [12] . Studies about extra figuring are rarely and limited to artistic expriments; the current paper introduces imperical evaluation of parameters control the abrasion resistance of extra weft figuring method which has a special senstivty for abrasion as a main propery in upholstering.

II. MATERIAL AND EXPERIMENTAL METHODS

2.1. Materials

Experimental samples were woven by a Jacquard loom (Smit GS900) with 2560 hook for figuring, width =142.2 cm, speed = 200 picks/min. used as following:

- Warp specifications: bonded polyester yarns, 150 denier, and 72 threads/cm.
- Wefts specifications: flat polyester yarns, 150 denier, and 36 yarns/cm.

All figuring samples were woven according three independent variables; ground weave, weft arrangement, and figuring float length, as shown in table (1)

Table 1. Independent variables levels of figuring experimental fabrics

Sample	Ground weave	Picks arrangement	Figuring picks float length
1	Plain 2/2 - extended twice horizentally	1 ground : 1 figuring	2.6 mm
2	Twill 3/3	1 ground : 1 figuring	2.6 mm
3	Plain 2/2 - extended twice horizentally	1 ground : 1 figuring	5.4 mm
4	Twill 3/3	1 ground : 1 figuring	5.4 mm
5	Plain 2/2 - extended twice horizentally	1 ground : 2 figuring	2.6 mm
6	Twill 3/3	1 ground : 2 figuring	2.6 mm
7	Plain 2/2 - extended twice horizentally	1 ground : 2 figuring	5.4 mm
8	Twill 3/3	1 ground : 2 figuring	5.4 mm

2.2. Methods

The abrasion of experimental samples were examined by martindale abrasion and pilling tester, M235 (manfactured by Sdl Atlas supplier) according to ISO 12947, part (1-3) [13]. The rubbed samples diamter = 388 mm under pressure load =12 kilopascal, rubbing speed = 47.5 rpm, with three cycles numbers 2000, 6000, and 10000. The number of abrasion cycles was added as fourth independent variable.

The significance effects of independent parameter on weight loss of experimental fabrics were estimated by factorial analysis of variance. Multiple-regression stepwise was applied to conclude participation ratio of parameters.

III. RESULTS AND DISCUSSION

Analysis of variance results referred that the interactions of the ground weave, figuring picks arrangement, float length, and number of abrasion cycles were highly significant, table (2) displayed the means of weight loss (%) of the four interaction variables together.

Table 2. Weight loss means affected by interaction of all variables together

Cycles numbers	Figuring picks float length	Ground weave	Picks arrangement	Weight loss %
2000	2.6 mm	Plain 2/2 extended	1 ground : 1 figuring	0.53
			1 ground : 2 figuring	1.65
		Twill 3/3	1 ground : 1 figuring	1.07
			1 ground : 2 figuring	2.84
	5.4 mm	Plain 2/2 extended	1 ground : 1 figuring	1.10
			1 ground : 2 figuring	2.86
		Twill 3/3	1 ground : 1 figuring	2.26
			1 ground : 2 figuring	3.55
6000	2.6 mm	Plain 2/2 extended	1 ground : 1 figuring	1.59
			1 ground : 2 figuring	3.85
		Twill 3/3	1 ground : 1 figuring	3.21
			1 ground : 2 figuring	5.11
	5.4 mm	Plain 2/2 extended	1 ground : 1 figuring	3.85
			1 ground : 2 figuring	5.71
		Twill 3/3	1 ground : 1 figuring	4.52
			1 ground : 2 figuring	6.51
10000	2.6 mm	Plain 2/2 extended	1 ground : 1 figuring	3.70
			1 ground : 2 figuring	6.04
		Twill 3/3	1 ground : 1 figuring	5.88
			1 ground : 2 figuring	8.52
	5.4 mm	Plain 2/2 extended	1 ground : 1 figuring	5.49
			1 ground : 2 figuring	8.57
		Twill 3/3	1 ground : 1 figuring	7.34
			1 ground : 2 figuring	10.65

3.1 Effect of Ground Weave on Abrasion Resistance of Extra Weft Fabrics

Analysis of variance results referred to a high significant effect of ground weave on abrasion resistance of extra weft fabrics; F=818731.2, Sig (0.000). Using plain 2/2 extended weave in the ground resisted the wear more than twill 3/3 where significantly decreased mean difference rates of fabrics woven by extended plain weave in the ground as shown in table (3). The increasing in interlacing of plain weave ground increased the stability of ground to face the abrasion fatigue; in addition the nature of distributions of plain intersections which got increased numbers of crowns especially with high density of warp threads so decreased the depth of vertical abrasion load on each crown while diagonal cords of twill weaves which were more clearer and prominent

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reduced withstanding the abrasion load applied on the fabric surface. Most wear effects were existed on figuring areas more than ground areas.

3.2 Effect of Picks Arrangement on Abrasion Resistance of Extra Weft Fabrics

Analysis of variance results referred to a high significant effect of picks arrangement on abrasion resistance of extra weft fabrics; F=1923307.2, Sig (0.000). Increasing the ratio of figuring picks to ground picks leaded to increased abrasion surface so increased the probability of weight loss; replacing ground picks that formed shorter floats with figuring picks that formed longer floats, table (4) showed the mean difference with the two arrangement and the significant increasing in weight loss according increasing the ratio of figuring picks to ground picks.

Table 3. Ground weaves and comparison between their means of weight loss %

Ground weave	Mean
Plain 2/2 extended twice horizentally	3.745
Twill 3/3	5.122

Level (I)	Level (J)	Mean Difference (I-J)
Plain 2/2 extended	Twill 3/3	-1.377 *

** The mean difference is significant at the 0.05 level*

3.3 Effect of Picks Arrangement on Abrasion Resistance of Extra Weft Fabrics

Analysis of variance results referred to a high significant effect of picks arrangement on abrasion resistance of extra weft fabrics; F=1923307.2, Sig (0.000). Increasing the ratio of figuring picks to ground picks leaded to increased abrasion surface so increased the probability of weight loss; replacing ground picks that formed shorter floats with figuring picks that formed longer floats, table (4) showed the mean difference with the two arrangement and the significant increasing in weight loss according increasing the ratio of figuring picks to ground picks.

Table (5) displayed two way significant interaction between picks arrangement and ground weave, The highest abrasion resistance rates of both weave grounds could be obtained by using equal ratio of picking in ground and figuring areas; this could be showed in figure (1), and (2).

Table 4. Picks Arrangement and Comparison Between their Means of weight loss %

Picks arrangement	Mean
1 ground : 1 figuring	3.378
1 ground : 2 figuring	5.488

Level (I)	Level (J)	Mean Difference (I-J)
1 ground : 1 figuring	1 ground : 2 figuring	-2.11 *

** The mean difference is significant at the 0.05 level*

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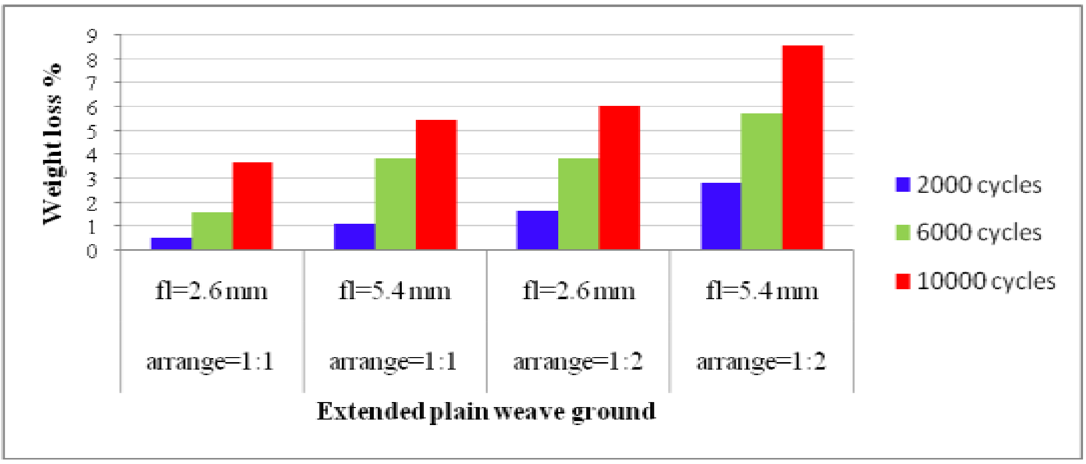
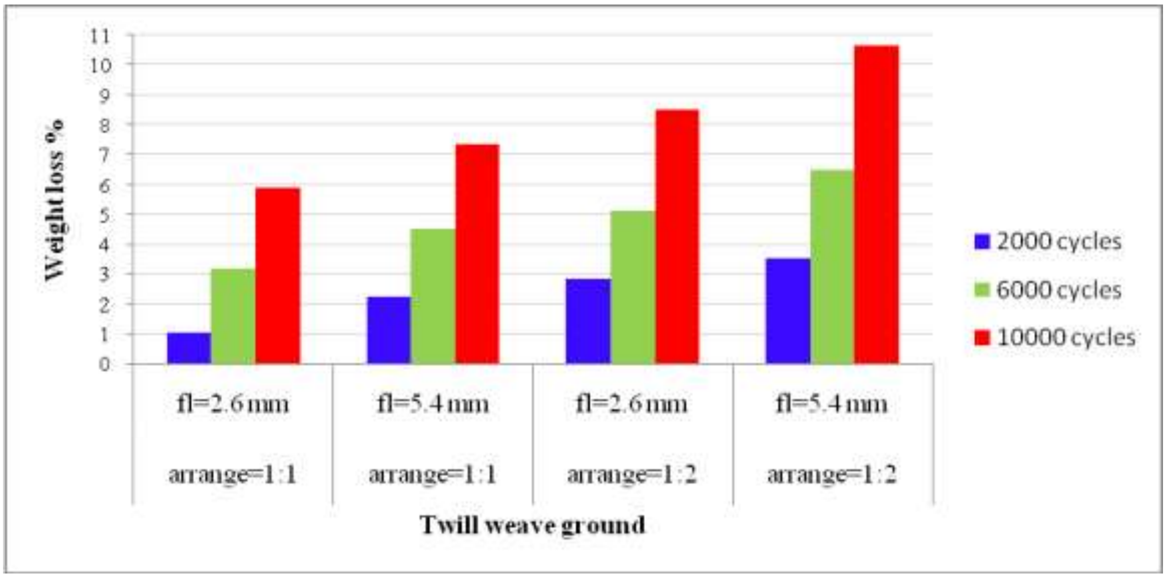
Table 5. Interaction between Picks Arrangement and Ground Weave

Ground weave	Picks arrangement	Mean
Plain 2/2 extended twice horizontally	1 ground : 1 figuring	2.710
	1 ground : 2 figuring	4.780
Twill 3/3	1 ground : 1 figuring	4.047
	1 ground : 2 figuring	6.197



fl (float length of figuring picks) arrange (ground picks numbers: figuring picks numbers)

Figure (1) Weight loss rates of experimental fabrics with extended plain weave ground



fl (float length of figuring picks) arrange (ground picks numbers: figuring picks numbers)

Figure (2) Weight loss rates of experimental fabrics with twill weave ground

3.4 Effect of Figuring Picks Float Lengh on Abrasion Resistance of Extra Weft Fabrics

Analysis of variance results referred to a high significant effect of figuring picks float length on abrasion resistance of extra weft fabrics; F=1017889.2, Sig (0.000). table (6) showed the mean difference with the two float length of figuring picks and the significant difference in weight loss. Increasing the float length of figuring picks caused prominent of exposure surface under abrasion load and extended the contact between abrader and fabric surface so the weight loss grew up. Tables (7), and (8) displayed two way significant interaction between float length and both of ground weave and picks arrangement, The highest abrasion resistance rates of the two cases could be obtained by using the shorter float length of figuring picks (2.6 mm).

Table 6. Figuring Picks Float Length and Comparison Between their Means Of Weight Loss %

Figuring picks float length	Mean
2.6 mm	3.666
5.4 mm	5.201

Level (I)	Level (J)	Mean Difference (I-J)
2.6 mm	5.4 mm	-1.535 *

** The mean difference is significant at the 0.05 level*

Table 7. Interaction between figuring picks float length and ground weave

Ground weave	Picks arrangement	Mean
Plain 2/2 extended twice horizentally	2.6 mm	2.893
	5.4 mm	4.597
Twill 3/3	2.6 mm	4.438
	5.4 mm	5.805

Table 8. Interaction between figuring picks float length and picks arrangement

Picks arrangement	Picks arrangement	Mean
1 ground : 1 figuring	2.6 mm	2.663
	5.4 mm	4.093
1 ground : 2 figuring	2.6 mm	4.668
	5.4 mm	6.308

3.5 Effect of Cycles Numbers on Abrasion Resistance of Extra Weft Fabrics

Analysis of variance results referred to a high significant effect of cycle number on abrasion resistance of extra weft fabrics; F=3668061.9, Sig (0.000). table (9) showed the mean difference with the three abrasion cycles numbers and the significant difference in weight loss. Results referred to increased effect of abrasion cycles on weight loss but this relationship wasn't linear.. Tables (l0), (11), and (12) displayed two way significant interaction between number of abrasion cycles and both of ground weave, picks arrangement, and figuring picks float length, The highest abrasion resistance rates of all cases could be obtained by using ten thousands abrasion cycles.

Multiple-regression stepwise was applied to predict theoritical values of independent variables as following:

$$Y = 8.147 + 1.377\ x_1 + 211\ x_2 + 0.548\ x_3 + 0.001\ x_4$$

Where:

y = weight loss % x_1 = ground weave [•] x_2 = picks arrangement [••]

x_3 = float length of figuring picks (mm) x_4 = number of abrasion cycles

Table 9. Abrasion cycles numbers and comparison between their means of weight loss %

Cycles number	Mean
2000	1.983
6000	4.294
10000	7.024

Level (I)	Level (J)	Mean Difference (I-J)
2000	6000	-2.311 *
	10000	-5.041 *
6000	10000	-2.730 *

** The mean difference is significant at the 0.05 level*

Table 10. Interaction between abrasion cycles number and ground weave

Ground weave	Cycles Number	Mean
Plain 2/2 extended twice horizentally	2000	1.535
	6000	3.750
	10000	5.950
Twill 3/3	2000	2.430
	6000	4.837
	10000	8.097

Table 11. Interaction between abrasion cycles number and picks arrangement

Ground weave	Cycles Number	Mean
1 ground : 1 figuring	2000	1.240
	6000	3.292
	10000	5.602

[•] expressed as weave factor (number of yarns/number of intersections).

[••] expressed as a ratio of number of figuring picks / ground picks.

1 ground : 2 figuring	2000	2.725
	6000	5.295
	10000	8.445

96.3 % of weight loss rates could be controlled by The four independent variables together; decreasing the number of abrasion cycles paticipated 63.6 % of decreasing the weight loss, decreasing the ratio expressed as number of figuring picks to ground picks improved 16.7 % of the weight loss, decreasing the float length of figuring picks paticipated 8.9 % of decreasing the weight loss, and decreasing the weave factor of ground weave improved 7.1 % of the weight loss.

Table 12. Interaction between abrasion cycles number and figuring picks float length arrangement

Ground weave	Cycles Number	Mean
2.6 mm	2000	1.523
	6000	3.440
	10000	6.035
5.4 mm	2000	2.442
	6000	5.147
	10000	8.012

Table 6. Figuring picks float length and comparison between their means of weight loss %

Figuring picks float length	Mean
2.6 mm	3.666
5.4 mm	5.201

Level (I)	Level (J)	Mean Difference (I-J)
2.6 mm	5.4 mm	-1.535 *

** The mean difference is significant at the 0.05 level*

IV. CONCLUSION

Results reffered to a highly significant effects of type of weave used in extra weft farics, picks arrangement, float length of figuring picks, and number of cycles on abrasion resistance.

Interlacing of plain weave in the ground increased its stability to face the abrasion fatigue; in addition the increased crowns on fabric surface resulting from plain intersections and the denser warp threads decreased the depth of vertical abrasion load on each crown while diagonal cords of twill weaves which were more clearer and prominent reduced withstanding the abrasion load applied on the fabric surface; most wear were existed on figuring areas.

The probability of weight loss increased by increasing the number of figuring picks compared to ground picks; replacing ground picks that formed shorter floats with figuring picks that formed longer floats. Increasing the float length of figuring picks caused prominent of exposure surface under abrasion load and extended the contact between abrader and fabric surface so the weight loss grew up.

The gradually increase of abrasion cycles reduced the abilty of fabrics to resist the abrasion load but that relationship was non linear.

The independent parameters controled together 96.3% of extra weft abrasion reietance rates; the number of abrasion cycles participated the most effect.

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