MEASURING THE COMFORT PROPERTIES OF EMBROIDERED FABRICS

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Abstract

Nowadays, all the world interests in evaluating comfort properties of the used product. Feeling comfort is very important issue which affects human mode and then human attitude at work and him/her health especially for kids. According to the great importance of embroidery in the global market so, it is necessary to test the comfort properties of embroidered fabrics. In this research work, the experimental procedure consists of sixteen embroidered woven and knitted samples followed by washing up to 30 times to assess the effect of washing on their performance. In order to evaluate their comfort properties, all of crease recovery, stiffness and hand were tested before and after washing. Two statistical analyses applied first; T-test to test the significance effect of washing on comfort. Second is Regression analysis to estimate the relation between each property and input variables. In conclusion, results show the specification of samples which gave more comfort.

Introduction

The comfort and the attractive appearance of the garment can't be separated. Embroidery is found on almost every piece of garment; outerwear, underwear, towels…etc. Comfort is a complicated property as it affected by; tactile properties which are subjective and mechanical properties which are objective properties. Several Researches used regression analysis to study the factor effect of selected properties on comfort. M.Sztandera [1-2] measured the mechanical properties by Kawabata evaluation system (KES-FS) and the tactile properties using the Comfort Affective Labeled Magnitude (CALM). It was found that elongation and hysteresis of shear force were the most significant mechanical properties, while compression resilience rate and graininess were found the most significant for comfort. Finally, it was expected that an Artificial Neural Network will be more efficient, as the comfort properties are very complicated and factors interact.

Thus several other researchers used neural network to analyze the factors affecting comfort [5-6]. Wang [7] used computational methods for simulating human psychological perception of moisture comfort sensation in multi-dimensions using neural networks and fuzzy logic modeling techniques. Models were validated with experimental result for 6 female students during a sport exercise. Results, show good agreement between simulated and experimental values.

The effect of embroidery on the performance of the fabric was not widely studied. Gholmy et al. [8] studied the effect of embroidery design on the mechanical properties and the tactile properties of the fabrics before, after ten washes and thirty washes. The relation between the properties tested and the factors under study was determined by regression analysis. Finally it is important to ask; can the embroidery reduce the comfort of the fabric? The aim of this research work is to answer this question by testing the comfort properties of embroidered fabrics.

Materials and Methods

Table 1 displays the classifications of the different parameters under study; fabric type, needle, stitch density, fabric weight and embroidery yarn.

Table 1: Material specifications

Codes	Parameter	Level	
		1	2
X1	Fabric Type	Woven	Knitted
X2	Fabric Weight	Heavy	Light
X3	Embroidery yarn type	Viscose 120/2	Polyester 120/2
X4	Needle Size	10 (70/10)DBX1	11 (70/11) DBX1

X5	Stitch Length	0.75	0.5

In this research work a half factorial design of experiment was used, with 16 samples. Several experimental tests were carried on the studied samples, such as; Creasy recovery, stiffness and hand tests which were studied according to ASTM (D1295-53T), ASTM (D1388-55T) and ASTM (D123) respectively [9-13]. These tests were applied at samples before and after 30 times washing to evaluate the performance of these samples after using them for long time. Letters (A) and (B) refer to After washing and Before washing test results.

Results and Discussion

Testing the effect of washing on comfort properties:

The following tables show the Crease recovery for the studied samples before (B) and after wash (A). It is clear that the crease recovery increased after washing for both woven and knitted fabrics as shown by figures 1(a) and 1(b). Crease recovery for knitted fabric is less than that of woven fabrics for both cases; before and after washing. This can be explained because knitted fabrics are formed from one yarn but woven fabrics are formed from two yarns, so it has a higher mobility than woven fabric. In addition, embroidery motif gripped woven and knitted fabrics preventing them re-covering the previous state. Therefore, this embroidery motif reduced their recovery before washing. In contrast, washing affected the embroidery motif which makes knitted fabric more free and increases its crease recovery as shown by figures 1(a) and 1(b). The outcome P-values by tables [2(a), 2(b) and (5)] confirm the significant effect of washing on crease recovery of woven and knitted.

Table (2): T-paired test results of Crease Resistance between (before & after) washing:

(a):for woven samples

	WOVEN	
	crease A	*crease B*
Mean	134.5625	84.33333
Variance	140.1027	107.0159
t Stat	8.19816722	
P(T<=t) one-tail	3.89696E-05	

(b):for knitted samples

	Knitted	
	crease A	*crease B*
Mean	132.9375	72.91667
Variance	48.31696	96.75397
t Stat	20.16941039	
P(T<=t) one-tail	9.22226E-08	

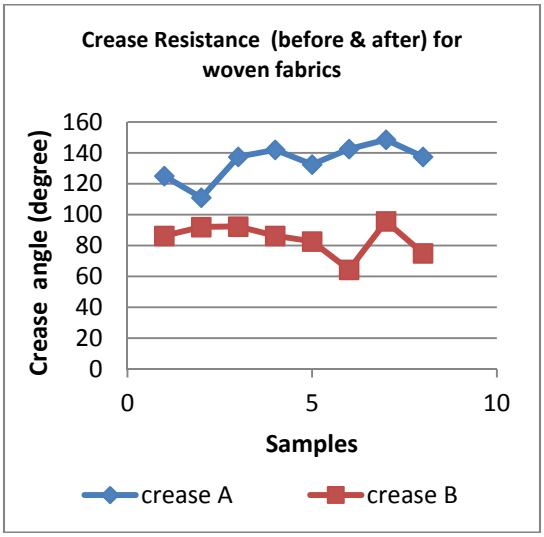

Figure (1-a) Crease Resistance (before & after) washing for woven fabrics

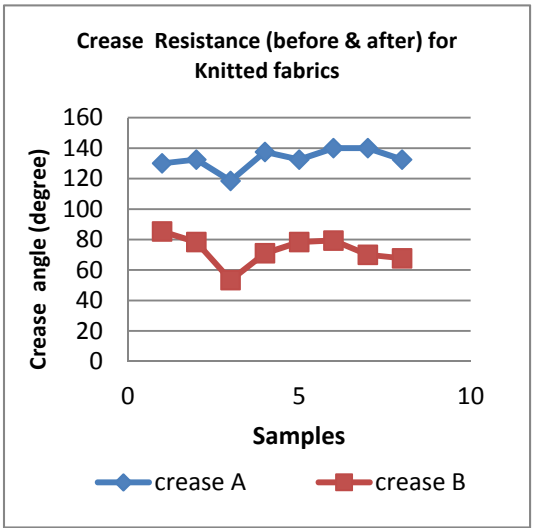

Figure (1-b)Crease Resistance (before & after) washing for knitted fabrics

It was found that the Stiffness decreased after washing for both woven and knitted as shown by figures 2(a) and 2(b). The outcome P-values by tables 3(a) and 3(b) confirm the significant effect of washing on stiffness of woven and knitted. The stiffness decreased after washing because the fabrics and the embroidery yarn lost the finishing materials applied on its surface after several washes making the fabric less stiff.

Table (3): T-paired test results of Stiffness between (before & after) washing:

(a):for woven samples

	WOVEN	
	stiffness A	*stiffness B*
Mean	3.140625	6.1625
Variance	0.583203	1.26744
t Stat	-8.375348104	
P(T<=t) one-tail	3.39688E-05	

(b):for knitted samples

	Knitted	
	stiffness A	*stiffness B*
Mean	2.628125	6.889583
Variance	0.061685	0.129598
t Stat	-35.50341723	
P(T<=t) one-tail	1.82545E-09	

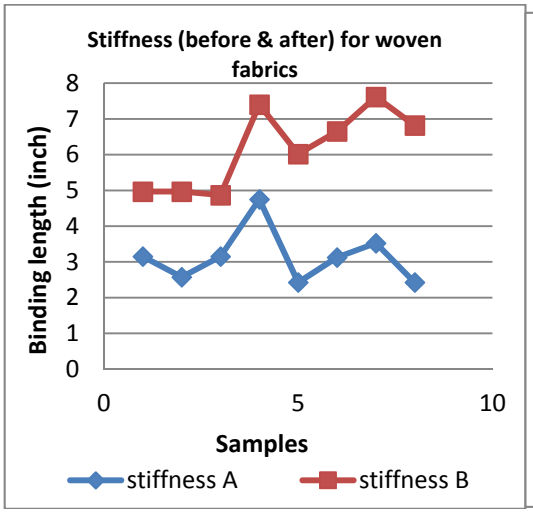

Figure (2-a) Stiffness (before & after) washing for woven fabrics

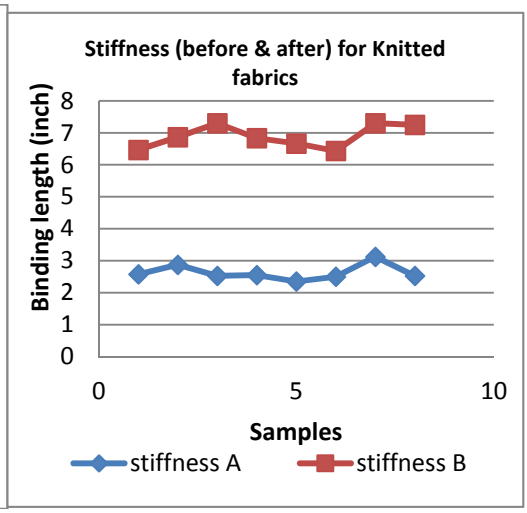

Figure (2-b) Stiffness (before & after) washing for knitted fabrics

The punching force for the hand test increased, slightly after washing , although the stiffness decreased , for both woven and knitted fabrics as shown by figures 3(a) and 3(b). The outcome P-values by tables 4 (a) and 4(b) confirm that washing had a non-significant effect on hand property. This could be explained because hand value was evaluated based on punishing technique which presses the samples, including the effect of embroidery motif, through a ring with 2.5 cm. Therefore, the embroidery yarn motive on the fabric overcame the effect of washing on the studied samples and was more dominate.

Table (4): T-paired test results of hand value (kg f) between (before & after) washing:

(a):for woven samples

	WOVEN	
	handle A	*handle B*
Mean	0.580125	0.470991
Variance	0.035073	0.036616
t Stat	3.948514	
P(T<=t) one-tail	0.005433	

(b):for knitted samples

	Knitted	
	handle A	*handle B*
Mean	0.529125	0.405917
Variance	0.024781	0.013986
t Stat	3.4145686	
P(T<=t) one-tail	0.005608958	

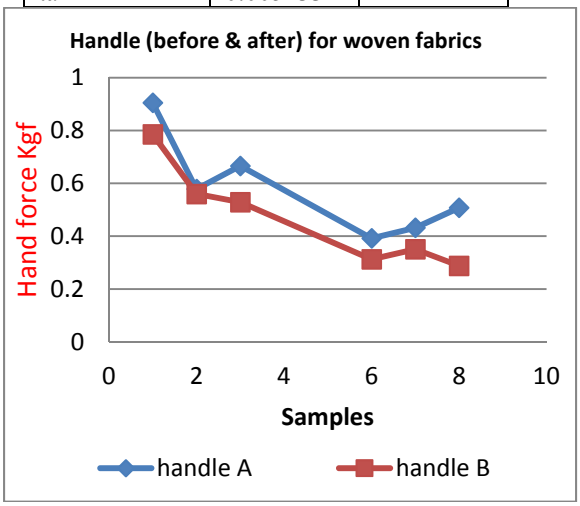

Figure (3-a) Handle (before & after) washing for woven fabrics

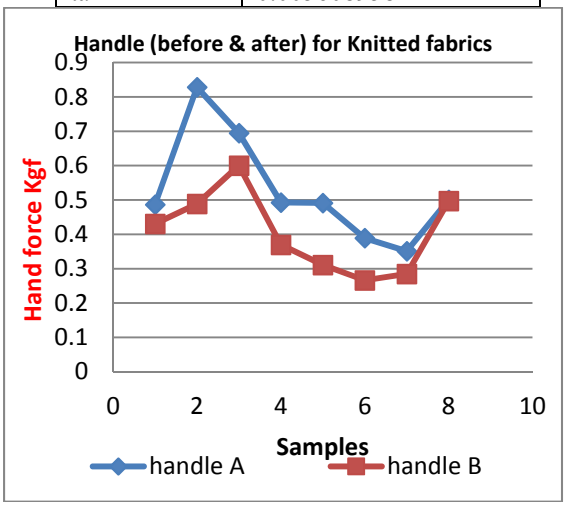

Figure (3-b) Handle (before & after) washing for knitted fabrics

From the last analysis it is clear that washing has a significant effect on all testes properties; crease recover and stiffness, but had a limited effect on hand properties for both woven and knitted fabrics.

Testing the significance of difference between" before & after washing "for woven and knitted fabrics:-

The following table (5) shows t-test for the differences between knitted and woven samples studied before and after washing, for the three properties under study (Crease Recovery, Stiffness and Hand) .

Table (5): Two-Sample Assuming Unequal Variances

	Difference in Crease recovery for Woven fabrics	Difference in Crease recovery for knitted fabrics	Difference in stiffness for Woven fabrics	Difference in stiffness for knitted fabrics	Difference in Handle for Woven fabrics	Difference in Handle for Knitted fabrics
Mean	50.23	60.02	-3.02	-4.26	0.11	0.12
Variance	300.31	70.84	1.04	0.12	0.00	0.01
df	10.00		9.00		12.00	
t Stat	-1.44		3.26		-0.31	

P(T<=t) one-tail	0.09	0.0049	0.38

As seen from table (5) there is a significant difference between the woven and knitted fabrics only with the stiffness property. This may be due to the presence of embroidery on the sample, in which the embroidery effect overcomes the effect of fabric manufacture technology (Woven or Knitted).

Regression analysis results:

This section shows the results of the regression analysis equations for the studied properties. The most dominant factor before washing was the fabric weight ($X_{1)}$. While after washing was the interaction between the fabric weight and the stitch length (X_1X_5).

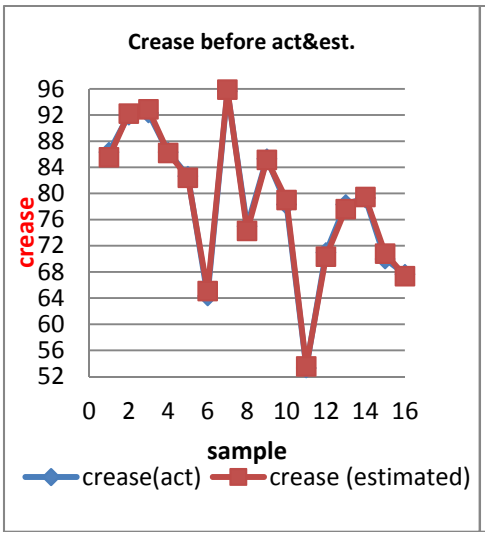

Figure (4-a) Actual and estimated crease Values before washing

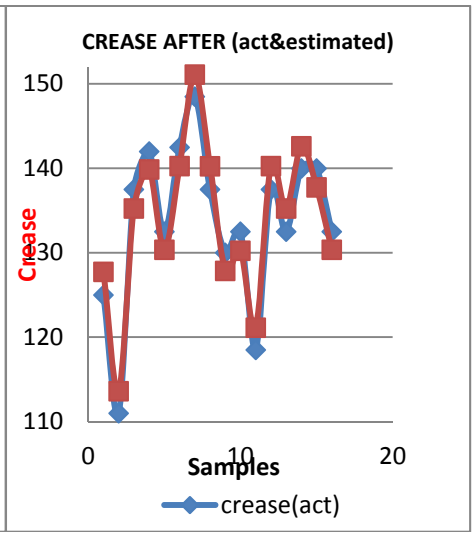

Figure (4-b) Actual and estimated crease Values after washing

The last figures 4 (a-b) verifies the great relation between the actual and estimated crease recovery which confirmed by the least error values. On the other hand, in case of after washing, error values between estimated and actual crease recovery increased which is confirmed by correlation factor(R Square=0.93) outcomes by regression analysis (eqn.2) which illustrates the effect washing on crease recovery for both woven and knitted samples. In more details, measured crease recovery of knitted samples is more than that of woven samples because of the higher mobility between yearns at knitted fabrics which make yarns move easily.

From the regression results it is clear that the embroidery yarn type (X_3) is the most dominant factor affecting the stiffness before washing, as the polyester yarn is more stiff than the viscose embroidery line. While after washing the affect of the fabric weight become more dominate. This may be due to the remove of the surface finish material on surface of the embroidery yarn during washing, which made the fabric weight more dominate after washing.

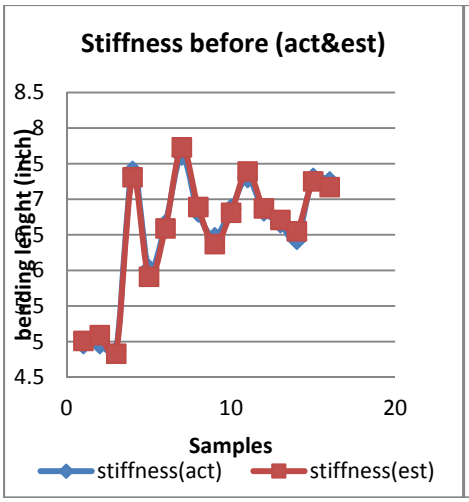

Figure (5-a) Actual and estimated stiffness Values before washing

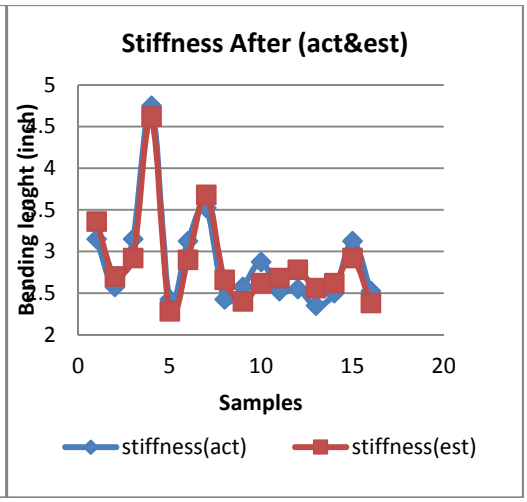

Figure (5-b) Actual and estimated stiffness Values after washing

Figures (5) a & b shows the differences between the weaving and knitting stiffness values. Stiffness decrease because of interlacing between yarns in knitting fabric is lower than weaving fabric. When changing yarn type from viscose to polyester, stiffness increases because the polyester yarn is stiffer than viscose yarn.

The following figures show the regression analysis for hand property before and after wash. There were no significant difference when the factor effect before and after washing for hand property. But it is clear that the fabric weight (X_1) is the more dominate factor.

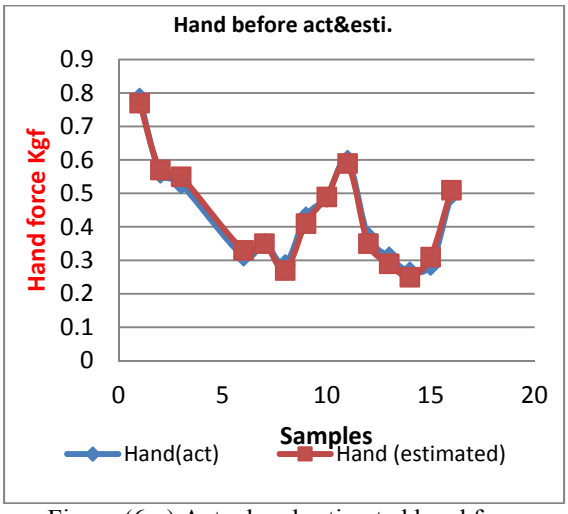

Figure (6-a) Actual and estimated hand force Values before washing

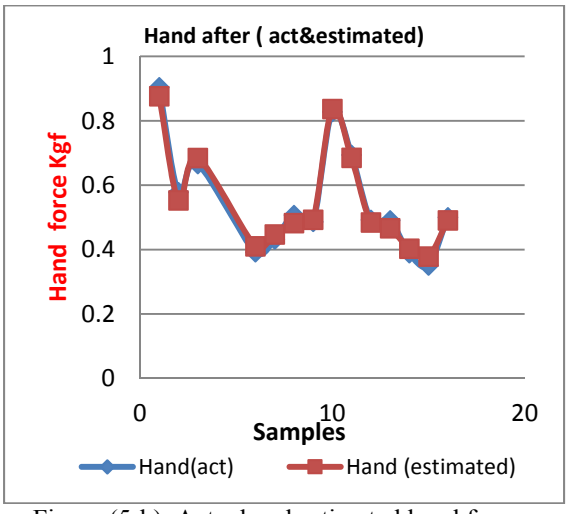

Figure (5-b) Actual and estimated hand force Values after washing

Summary

The comfort of textile material is a complex phenomenon to study; applying embroidery stitches on the fabric makes the subject more complicated. In this research the effect of embroidery parameters on the comfort related properties (crease recovery, stiffness and hand tester) were studied before and after washing. Washing affects the properties of knitted fabrics more than woven fabrics. Thus, it affects both the crease recovery and stiffness of knitted fabrics more than that of woven fabrics. Since, Hand is evaluated based on punishing technique which is pressing the samples including the effect of motif, so washing had a non-significant effect on hand property.

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