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THE EFFECT OF REPEATED WASHINGS ON THE TOTAL HAND VALUE OF COTTON FABRIC

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Abstract: *Washings are required during its useful life of fabric and it alters the dimension and fabric factors which ultimately affect the hand value of fabric. In this paper the effect of repeated washings in hand value of cotton fabric has been studied. The result shows that: the fabric used for sample is suitable for winter shirting. The total hand value progressively increases after increase in washing cycles.*

Key words: *Cover Factor, Fabric thickness, Fabric weight, Washing, Total hand value*

1. INTRODUCTION

Textile products are essential material that we use every day to obtain physiological and psychological comfort and, more fundamentally, to insure physical conditions around our body suitable for survival. Comfort using textiles entail three main considerations psychological, sensorial/tactile comfort and thermo-physiological. *Psychological Comfort* is a psychological feeling of a person wearing clothing under certain environmental conditions. Consumer prejudice, colour and prevalent fashion generally influence this aspect. *Tactile comfort or Sensorial Comfort* comfort is based on distribution of stress generated in fabric over the skin. It is mainly related to fabric's mechanical properties, handle and surface characteristics of the fabric. This aspect of comfort depend upon fibre, yarn and fabric structural properties, as well as the finishing, coating, laminating, etc processes applied to the fabric. *Thermo-physiological Comfort* means that the ambient body temperature of ~37°C is maintained.. This type of comfort entails both thermoregulation and moisture management. [1-4]

The effect of repeated washings on thermo-physiological properties of cotton fabrics were discussed in our previous work [5-8]. The total hand value is a measure of tactile comfort.

The researchers, textile producers and consumers have subjectively evaluated the quality of fabric by means of “hand touch” such as soft, smooth, harsh, limp, crisp. This evaluation is called hand evaluation and the fabric property related to it termed as fabric hand. In general, the assessment of fabric hand can be done by two methods: subjective and objective methods. In a subjective assessment, hand is treated as a psychological reaction obtained from the sense of touch. In an objective assessment the tendency is to find the relationships between fabric hand and some physical or mechanical properties of fabric objectively. Fabric hand is quantitatively described by using translation results from some measure values of relevant attributes of fabric [9-10]. The most accurate and reliable method used for objective evaluation of fabric hand is Kawabata Evaluation System for Fabrics (KES–F) developed by Kawabata to determine the fabric mechanical properties relating to hand [11-12].

Washing is required for many textile articles. During washing, the fabric is subjected to complex physical, mechanical and thermal actions which leads to change structure of yarn and fabric; hence performance of the fabrics. Therefore, research on ‘effect of repeated washings on the Total Hand Value of the fabric’ has fundamental meaning. In this paper the effect of repeated washings on Total Hand Values are accessed in a plain woven cotton fabric.

2 MATERIAL & METHOD

2.1 Material

The cotton fabric was prepared using 100% cotton yarn. J-34 cotton used for making the ring spun yarn. The parameter of yarn has given in Table 1.

Table 1 Yarn parameter

Fibre type	Varity of cotton	Warp count	Weft count	Twist per inch	
Cotton	J-34	$2/40^{s}$	20^{s}	Warp single = 26	Weft single = 18

As in practice, in small scale industry for production of fabric; the yarn in the hanks form firstly scoured, bleached, anti-chlorine and optical brightened. This yarn is used for production of woven fabric for sale in domestic market. This is cost effective process. The details recipes of scouring, bleaching, anti-chlorine and optical brightening treatments are given in the Table 2, Table 3, Table 4 and Table 5 respectively.

Table 2 Recipe for Scouring

Material to liquor	1:20
HCL	5cc/lit
Temp	27˚±1˚
Time	15 min

Table 3 Recipe for Bleaching

Bleaching powder ($Caocl^2$)	7gm/lit
By caustic soda drops PH	10.8 - 11
Wetting agent (Turkey red oil)	1gm/lit
Temp	27˚±1˚
Time	90 min
Material to liquor	1:20

Table 4 Recipe for Anti-chlorite

Sodium hydro-sulphite	1gm/lit
Temp	27˚±1˚
Time	15 min
Material to liquor	1:20

Table 5 Recipe for Optical Brightening

Tinopol	0.50%
Material to liquor	1:20
Temp	27˚±1˚
Time	5 min

Fabric Preparation

The plain woven fabric has been prepared in Cimco over pick power loom for shirting fabrics using processed yarn (scoured, bleached, anti-chlorine and optical brightened). In this loom shuttle is used for carrying the weft. It inserts 140 picks per minute. The loom width is 44". Fabric constructional particular are given in Table 6.

Table 6 Fabric constructional particulars

Fabric Sample	Weave	Linear density (Ne)		Thread Density	
		Warp	Weft	Ends per inch	Picks per inch
100% Cotton Fabric	Plain	2/40s	20s	52	48

Preparation of washed fabric samples

To study the effect in various five stages of washings, the five fabric samples were prepared by washing the fabric at various stages, i.e. 0-wash, 4-wash, 8-wash, 12-wash and 16-wash cycles (Table 7).

The fabrics were washed at 27°C in semi automatic washing machine using 0.75 g/l solution of non-ionic detergent (96% concentration) while material to liquor ratio was kept as 1:40. One washing cycle completes in 12 minutes. Fabrics were washed, rinsed in clean water and water is extracted by drier and samples were dried in sun light.).

Table 7 Fabric processing particulars

S. No.	Fabric sample code	Number of washing Cycles
1	A	0-wash
2	B	4-wash
3	C	8-wash
4	D	12-wash
5	E	16-wash

2.2 Methods

1. **Thread Density:** The ends and picks per inch of woven fabric samples were assessed visually by using a pick glass according to the (IS: 1963-81) standard test method [13].
2. **Fabric Cover Factor:** Fabric cover factor was evaluated by Peirce formula expressed as: $Fabric\ cover\ factor(K_c) = K_1 + K_2 - \frac{K_1 \times K_2}{28}$ Where, K_1 = Warp cover factor, K_2 = Weft cover factor [14].
3. **Fabric Thickness:** The Kawabata Evaluation System was used for fabric thickness determination [15] at 0.5 g-f/cm^2 pressure.
4. **Fabric Weight:** Fabric weight was measured by Kawabata evaluation system [16]. The unit is taken in [mg/c^{m2}].
5. **Hand Value:** Various parameters for hand value were measured using four KES instruments [16].
   i. **KES-FB1 Tensile and shearing tester:** In this instrument seven parameters namely elongation, linearity, energy, resilience, shear rigidity, hysteresis at 0.5° and hysteresis at 5.0° were measured.
   ii. **KES-FB2 Pure Bending Tester:** By using this instrument two parameters namely bending rigidity and bending moment were measured.

iii. **KES-FB3 Compression Tester:** In this instrument four parameters namely linearity, energy, resilience and thickness of fabric at 50 gf/cm^2 & 0.5 gf/cm^2 were measured.

iv. **KES-FB4 Surface Property Tester:** By using this instrument three parameters namely co-efficient of friction, mean deviation of co-efficient of friction and geometrical roughness were measured.

v. **Total Hand Value:** Data from the mechanical properties were put into a transform formula to determine the fabric "Total Hand Value".

3. RESULT AND DISCUSSION

The fabric was evaluated for primary hand values using KES system for Men's suiting winter, Men's suiting summer, Men's shirting winter and Men's shirting summer.

The primary hand values namely Koshi (stiffness), Numeri (smoothness), Fukurami (fullness and softness), Shari (crispness) and Hari (anti-drape) have been tested. Results of primary and total hand value are tabulated in Table 8.1, 8.2, 8.3 and 8.4.

Primary hand values are graded by using a scale of 1-10 where 1 indicates the weakest feeling & value 10 indicates the strongest with regards to the particular descriptor.

Table 8.1 Men's Suiting winter

Men's Suiting (Winter)	A	B	C	D	E
Koshi	0.92	1.31	0.70	1.18	0.87
Numeri	2.59	2.27	3.37	3.32	4.21
Fukurami	4.90	5.33	6.25	6.08	6.47
Total Hand Value (THV)	0.93	1.39	1.31	1.55	1.63

Table 8.2 Men's Suiting summer

Men's Suiting (Summer)	A	B	C	D	E
Koshi	1.49	2.39	1.07	1.90	2.30
Shari	-0.31	1.06	0.74	0.30	0.43
Fukurami	3.76	2.81	2.37	2.55	3.22
Hari	1.97	2.44	1.72	1.96	2.53
Total Hand Value (THV)	0.18	0.96	0.52	0.29	0.65

Table 8.3 Men's Shirting winter

Men's Shirting (Winter)	A	B	C	D	E
Koshi	6.11	6.22	5.64	5.96	5.90
Shari	0.32	0.18	-1.28	-1.17	-0.39
Fukurami	15.01	15.67	16.01	16.02	16.21
Hari	5.55	5.36	4.96	5.06	5.12
Total Hand Value (THV)	8.84	9.32	9.38	9.46	9.64

Table 8.4 Men's Shirting summer

Men's Shirting (Summer)	A	B	C	D	E
Koshi	6.11	6.22	5.74	5.96	5.90
Shari	0.32	0.18	-1.32	-1.17	-0.39
Fukurami	15.01	15.67	16.11	16.02	16.21
Hari	5.55	5.36	5.04	5.06	5.12
Total Hand Value (THV)	-2.06	-2.43	-2.83	-2.80	-2.74

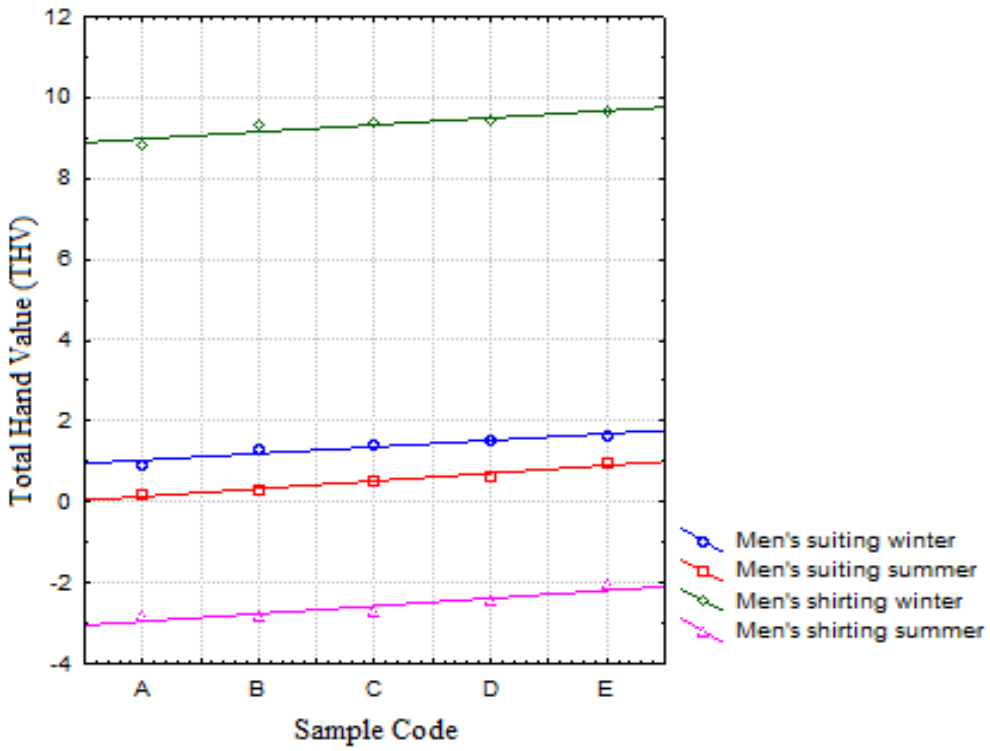

Figure 1 Contour plot of Sample code Vs Total Hand Value

The total hand value of the fabric is estimated from by putting the data of the mechanical properties into a transform formula. From the observation of Table 8.1, 8.2, 8.3, 8.4 and

Figure 1, THV index reflecting the suitability of the fabric for men's winter shirting. In comparison to without wash fabric sample, the washed samples have high THV. There are progressive increases in Total Hand Value (THV) as the number of washing cycle increase from 0 to 16 wash cycles.

4. CONCLUSION

- Total Hand Value index is reflecting the suitability of the fabric for men's winter shirting.
- The total hand value progressive increases with the increase in number of washing cycle.

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