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Effect of fabric thickness on abrasion resistance of khadi fabric

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ABSTRACT

Present study was undertaken to find out the effect of fabric thickness on abrasion resistance of khadi fabrics. For this purpose, different varieties of khadi fabrics of cotton, silk, wool, cotton-polyester blend were used. After abrading with Emery paper and Canvas fabric for 100, 200, 300, 400, 500 rubbing cycle, thickness of khadi fabric were assessed. Thickness increased initially in all the fabrics after that it decreased with increase in rubbing cycles. Emery paper was more severe in action. Effect of fabric thickness was found on abrasion resistance of khadi fabric.

KEY WORDS : Abrasion, Khadi fabric, Fabric thickness, Abradant

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One of the most important physical properties of a textile fibre in relation to durability is its ability to withstand abrasion. Abrasion is rubbing away of component fibres and yarns of fabric (Booth, 1968).

Fabrics are subjected to three type of abrasion namely, flat, flexed and edge. In flat abrasion, a flat of material is abraded, edge abrasion for example, the kind of abrasion which occurs at collars and folds. In flex abrasion rubbing is accompanied by flexing and bending (Agrawal, 1987).

Many factors influence abrasion. Some fibres which are inherently tough have better abrasion resistance than do the others. Yarn construction is also an influencing factors. Loosely twisted yarns abrade more easily than do tight twisted yarns. In the loosely twisted yarns, the individual fibres are more likely to be subjected to being pulled out from the body of yarn on to the surface of fabric (Sumanthi *et al.*, 2004).

Smooth fabric constructed of firm yarns with optimum yarn interfacing and relatively compact yarn arrangement are less subjected to damage by flat abrasion than fabric with irregular surface, low yarn count and minimal yarn interlacing. Pile fabric, loop yarn (complex yarn) are subjected to abrasion damage. Knit structure tends to abrade more easily than woven fabric. Size of yarn also influences abrasion resistance. Thick yarn resist damage from abradant where as fine yarns may abrade easily. Yarn uniformity is also important for irregular yarn may show wear very quickly in selected location (Kalaoglu, 2003).

Khadi is a hand spun and hand woven fabric. It has a rugged texture, a unique look and feel and makes the wearer look different. On the other hand, machinery woven fabrics are uniform and appear monotonous and lifeless.

As khadi is hand spun and hand woven fabric, its yarn structure is different from machine spun and woven fabric. Spinning is done on charkha and weaving is done on handloom. Hand spun yarns are not very uniform and fabric surface is uneven and textured.

Due to difference in fabric quality, abrasion resistance of khadi will be different from mill made fabric. It is on the basis of above consideration that an attempt was made to assess the abrasion resistance of khadi fabrics. Effect of fabric thickness on abrasion resistance of khadi fabric was studied.

RESEARCH METHODS

Commercially available fourteen different varieties of khadi fabrics varying in constructional parameters were selected. Two type of abradant material *i.e.* emery and canvas were used in the study. First of all, fabrics were tested to determine constructional details *viz.,* thickness, fabric count, yarn count, amount of twist, cloth cover. Eureka abrasion tester (Martindale type) was used to abrade the fabrics. It has multidirectional rubbing movement. The fabrics were given 100, 200, 300, 400, 500 rubbing cycles. Fabrics samples were abraded separately with canvas fabric and emery paper. Evaluation of abrasion damage was done by calculating thickness. Before and after every 100, 200, 300, 400, 500 rubbing cycles, thickness was taken.

RESEARCH FINDINGS AND DISCUSSION

Findings obtained from the present study have been

discussed in the following sub headings.

Preliminary data of khadi fabrics:

The preliminary data of selected khadi fabrics has been given in Table 1. Fabrics were simply structured with plain weave, with a wide weight range and various fibre content *viz.,* cotton, wool, silk, polyester-cotton blend. Some were loosely constructed and some were of tight construction. Thickness of fabrics was also different.

Fabrics construction details:

Fabric construction details like amount of twist in yarn, yarn count and cloth cover factors have been presented in Table 2.

One of the methods for evaluation of abrasion damage is measurement of fabric thickness. In this work, effect of rubbing on thickness of khadi fabrics was determined using ordinary thickness tester under 5g/cm^2 pressure.

Effect of different abradants on thickness at different rubbing cycles has been shown in Tables 3 and 4.

Thickness of fabric changed due to abrasion. The change in thickness as observed from the given table were not only due to variation in the abrasion forces applied on

Table 1: Preliminary data of fabrics used

Fabric code	Thickness(mm)	Threadcount		Weight Ounce/square yard
		No. of warp/cm	No. of weft/cm	
C_1	52.6	37	32	5.66
C_2	29.6	46	55	3.92
C_3	27.7	64	44	3.96
C_4	35.6	42	53	3.69
C_5	52	17	37	5.37
C_6	34	59	42	3.5
C_7	35	42	47	3.2
C_8	67.8	53	25	6.2
C_9	58.6	24	31	5.8
W_1	68.8	1		8.5
W_2	68.7	12	18	6.4
Pc_1	30.7	46	54	3.2
Pc_2	31	43	60	3.7
S	13.3	88	92	3.4

Table 2 : Fabric constructional details

Fabric code	Yarn count denier		Amount of twist (turns/inch)		Cloth cover
	Warp	Weft	Warp	Weft	Warp
C_1	504	427	4	4	16.9
C_2	277.7	148.3	25	24	16.3
C_3	26	256	25	24	12.7
C_4	271.8	165.9	10	10	15.8
C_5	262.9	1029	10	10	17.7
C_6	214.4	208	40	40	16.6
C_7	316.1	172	4	4	15.5
C_8	182.7	715	25	30	15.8
C_9	1120	400.13	10	10	16.2
W_1	6897.6		10	8	1.14
W_2	1259	1399	14	10	13
Pc_1	225	216	26	22	16.7
Pc_2	247.1	271.9	25	20	18.4
S	3.06	49.19	20	18	10.23

Cotton – C
Wool and silk –W and S
Polyester-cotton blend- Pc

them but also due to various parameters associated with the construction of the fabric structure including the material constituting the fabric itself.

Fabric exhibited increases in thickness after abrasion. With the increase in rubbing cycle, there was a change in thickness of fabrics with each type of abrader used. Initial increase in thickness was followed by decrease in thickness but it was still higher than the original thickness. In addition, change in thickness was not consistent for all the fabrics.

Rubbing caused teasing out of fibre ends from yarns on fabric surface. Presence of nap and fuzz on fabric surface affected thickness *i.e.* fabric thickness increased during the initial abrasion stage.

After that decrease in thickness occurred due to severe abrasion (increase in rubbing cycles) of fabric, which caused fracturing and cutting or breaking of the ends from the surface.

Influence of abradant type on fabric thickness was found. It was observed that in almost all the fabrics the use of emery paper showed maximum change in all the fabrics.

Analysis of relationship between thickness and abrasion resistance of khadi fabrics:

Influence of thickness:

Increased fabric thickness and large yarn diameter are related and provide marked improvement in abrasion resistance of textiles structure.

On comparing the cotton fabrics of different thickness, it was found that highest abrasion resistance was shown by fabric C_8 which was thickest among all the cotton fabrics selected. Similarly wool fabrics which were also thick, exhibited good abrasion resistance (Table 3 and 4).

Silk fabric was thinnest among all the fabrics. It may be one of the causes of poor abrasion resistance of silk (Table 4). Silk fabric was made of single fine yarn. Single fine yarn may show poor abrasion resistance (Pai *et al.*, 1988) than coarse yarn. Single yarn abrasion resistance depends upon linear density.

Thick yarns resist damage from abradants where as fine yarns may abrade easily. C_2, C_3 also made of thin yarns showed more abrasion loss than C_4. In C_3 warp yarn was very fine, although it has compact construction so it may abrade easily. C_4 exhibited good abrasion resistance. It may be because of balance crimp in yarn, due to smoothness of fabric construction, firm, even yarn interlacing (Table 3).

In general, it was found that fabric made of thick and loosely twisted yarn (low twist) like C_5 and C_9 exhibited more change in thickness. Canvas being mild in severity brought more and more fibres on fabric surface. On the other hand, emery paper after initial increase, decreased the thickness (-) of fabric (Table 3).

Change in thickness was not as high in fabric composed of thin yarn with high amount of twist when abraded with canvas for example C_6, in this fabric fibres were tightly held so canvas, being mild, was unable to bring much fibres on the surface. But when abraded with emery paper thickness dramatically decreased.

In C_8, thick yarns with moderate amount of twist were used. Thickness did not fall down below the original thickness.

C_2, C_3 fabrics have yarns with moderate amount of twist. They also showed same trend with regard to change

Table 3: Effect of abrasion on thickness of cotton khadi fabrics

Abradant	No. of cycle	Thickness(mm)								
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
Canvas fabric	0	.53	.30	.28	.36	.52	.34	.35	.68	.59
	100	.54	.34	.42	.38	.60	.36	.39	.77	.66
	200	.60	.38	.38	.40	.63	.40	.47	.73	.70
	300	.79	.37	.33	.45	.89	.39	.44	.79	.68
	400	.59	.35	.31	.51	.82	.35	.34	.80	.66
	500	.55	.31	.29	.48	.85	.34	.32	.70	.70
Emery paper										
	0	.53	.30	.28	.36	.52	.34	.35	.68	.59
	100	.61	.41	.57	.40	.65	.37	.51	.76	.68
	200	.49	.55	.50	.43	.70	.42	.54	.80	.65
	300	.51	.60	.46	.43	.69	.38	.50	.78	.81
	400	.47	.55	.37	.59	.50	.34	.47	.70	.79
	500	.50	.42	.43	.54	.45	.30	.27	.66	.76

Table 4: Effect of abrasion on thickness of wool, polyester-cotton blend and silk

Abradant	No. of cycle	Thickness				
		W_1	W_2	Pc_1	Pc_2	S
Canvas fabric	0	.69	.69	.31	.31	.13
	100	.90	.76	.35	.36	.17
	200	.89	.79	.47	.38	.15
	300	.86	.78	.39	.31	.14
	400	.85	.86	.33	.34	.15
	500	.84	.78	.34	.32	.15
Emery paper						
	0	.69	.69	.31	.31	.13
	100	.82	.69	.50	.46	.17
	200	.90	.80	.58	.40	.20
	300	.86	.74	.59	.46	.24
	400	.72	.71	.56	.50	.23
	500	.62	.69	.48	.55	.18

in thickness *i.e.* thickness did not fall below original thickness.

Quite high increase in thickness in some fabrics is due to fabric distortion during rubbing and shrinkage *i.e.* threads came close together during rubbing. In polyester-cotton fabrics, polyester fibres being smoother than cotton came out easily on the surface increasing fabric thickness significantly (Table 4).

Conclusion:

It was found that as the number of cycle increased, thickness increased initially. Canvas being mild in severity brought more and more fibres on fabric surface but emery paper after initial increase decreased thickness (-) of fabric. Blend of polyester- cotton fabrics polyester fibre being smoother than cotton came out early on the surface increasing fabric thickness significantly. The study revealed that abrasive wear of khadi fabrics is affected by yarn/ fabric thickness.

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