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Effect of Different Softening Agents on Khadi

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Abstract
The effect of different synthetic softeners viz anionic, nonionic, and cationic softeners on physical properties i.e., stiffness, crease recovery and drape ability of cotton khadi fabric has been presented in this study. Effect of different concentration of finishing agents and thickness of fabric on stiffness, crease recovery and drapeability has been analyzed.
It was found that alteration in softness of fabric application depends, to an extent (in part) upon amount of finish used. As on increasing the concentration of finish there was decrease in bending length and drape coefficient. It also depends upon type of finishing agents used. Maximum decrease in drape coefficient and stiffness was seen in fabrics. After treatment of various softeners drape coefficient of khadi fabrics have been decreased and fabric becomes very lumpy. Highest decrease in drape coefficient has been found in mediun weight khadi fabrics treated with all softeners. As the concentration of softeners increased drape coefficient was decreased simultaneously. Maximum increases in crease recovery were seen in fabric treated with anionic softener at concentration of 4% and were seen minimum in nonionic softener.
Keywords: Softeners, cationic, anionic, nonionic, drape, stiffness, crease recovery.

I. Introduction

Khadi is a hand spun and hand woven fabric made of cotton, wool, silk and their blends. Khadi is an Indian fabric also known by another name khaddar. It is made by spinning the threads on instrument known as charkha that is used to create khadi. Ambar Charkha is the latest spinning wheel that is still hand operated. Khadi was used and produced for years, by the middle and working classes of subcontinent in the 19th century especially during swadeshi movement.

There are many attributes associated with khadi, in particular cotton khadi. It keeps wearer cool in summer and warm in winter. Its weave structure allows ample amount of air to pass over and around the body. It has capacity to absorb moisture. It is 100% natural and therefore, not harmful to skin as compared to manmade synthetic fabrics.

However, cotton khadi has some drawbacks. Cotton khadi wrinkles easily. It has poor color fastness, dimensional stability, and drapeability property. Drape is the most important aesthetic property of fabrics, garments and other textile structures. Fabric drape can be defined as a description of the deformation of the fabric produced by gravity when only part of it is directly supported. This unique characteristic provides a sense of fullness and a graceful appearance that distinguishes fabrics from other sheet materials.

Ability of fabric to all under its own weight into wavy folds is called drapeability. The drape relieves monotony of shape and enhances the beauty of garment and its appreciation.

One of the advances in textile finishing has been application of resin finishing agents. Resin finishing in general alters fabric characteristics like appearance, resilience, drape, and shrinkage and crease resistance**. (Marsh, 1979)**

In resin finishing certain synthetic polymers are applied, which may be located on the surface or may penetrate inside the fiber **(Sadov, 1978).** Finishing agents may also be used to modify fabric stiffness. If stiffness vs. softness and drape of khadi fabric is changed by application of finishing agents, its use can be multiplied in designing garment of different styles. Present study is a step in this direction.

Softeners give very smooth and attractive look for garments. Softeners is a chemical that, when applied to textile materials, bring about an alteration in handle, resulting in goods being more pleasing to the touch than before applying it. Softening finishes are among the most important of textile chemical after treatments, with chemical softeners; textiles can achieve an agreeable, soft hand (supple, pliant, sleek and fluffy), some smoothness, more flexibility and better drape and pliability. An effective softener must be readily dispersible or miscible in rinse water and readily absorbed by the materials so that uniform deposition can occur within a relatively short treatment time.

Thus to improve fabric hand and supplying various types of softeners are used commercially which may be classified into four categories:-

- Anionic softeners (sulphated oils, sulphated alcohols, soaps, oil emulsions etc.)

- Nonionic softeners (polyethylene emulsion, silicone emulsion, polyoxyethylene derivatives etc.)
- Cationic softeners (quaternary ammonium and other cationic products.)
- Reactive softeners (methylolstearmide, octadecyl ethylene urea etc.)

The main aim of the study is to improve crease recovery, drapeability and dimensional stability of khadi fabric by treating with selected softeners.

II. Methodology

Material

Fabric- Commercially available khadi fabrics in different weight and thickness were used. Three categories of cotton khadi fabrics were selected for this study- two fabrics of thick, one of medium and three of fine thickness were used.

Method

Before application of softening finishes fabrics were scoured and desized by standard recipes.
Application of finishing agents and determination of percent add on% of the finish-

Different softeners were applied to cotton khadi fabric by pad dry cure method with the help of padding mangle. Following recipes were used for application of softener-

Anionic Softener- 5gm/l glycerin was used with different concentration of anionic softener i.e. 2%, 4%, and 6%. Water liquor was boiled for 10 min and softener and glycerin were added and stirred properly. Fabric was dipped in this solution and left for 30 min and then passed through the padding mangle.

Nonionic Softener- 1gm/l acetic acid used with different conc. of nonionic softener i.e. 2%, 4%, 6%. Temp of water was raised to 50^0C and the nonionic softener was added in the water and stirred properly. The fabric was soaked in this solution and left for 30 min and then passed from the padding mangle.

Cationic Softener - The softener paste was mixed with its own weight of water at 60°C by stirring and then diluted with the required amount of cold water. Fabric was left in this solution for 30 min and then passed through the padding mangle**.** Finish was applied individually with three concentration of each finish.

S.No.	Name of softener	Concentration of treatment (W/W)
1.	Cationic softener	2%, 4%, 6%
2.	Anionic softener	2%, 4%, 6%
3.	Nonionic softener	2%, 4%, 6%

The material liquor ratio was taken 1:20.Pick up percentage and Add on percentage was calculated.
The following selected properties were measured as per standard test methods:
Stiffness (IS: 6490-1971), Percent Drape Co-efficient (IS: 8357-1977), Crease recovery (IS: 4681-1968).

III. Result and Discussion

Table1: Stiffness, crease recovery and % drape coefficient of cotton khadi fabrics treated with varying concentration of anionic softener

Cotton khadi	**Conc. of finish (w/w)**	**%add on**	**Bending length (cm)**		**Crease recovery (^{0})**		**% drape coefficient**
			Warp	Weft	Warp	Weft	
Thick (a)	0%	0%	3.7	3	109.2	122.2	78.59
	2%	3.96%	2.48	2.32	121.8	117	77.54
	4%	7.47%	2.39	2.14	119.2	117	75.75
	6%	4.38%	1.48	2.05	107.2	106.6	73.26
(b)	0%	0%	2	3	105.2	113.8	71.27
	2%	2.75%	2.05	2.28	118.8	117.2	70.75
	4%	6.66%	1.99	2.37	121.4	123.8	69.89
	6%	3.35%	1.21	1.81	110.4	111.2	68.46
Medium	0%	0%	2.16	2.5	123.6	129.6	73.36
	2%	3.29%	1.97	1.72	117	118	72.99
	45	12.765	2.24	1.94	123.8	121.8	71.03
	6%	7.84%	1.75	1.98	110.4	111	69.12
Fine (a)	0%	0%	2.7	2.4	124.2	118.6	68.67
	2%	9.75%	1.72	1.68	107.8	105.2	67.82
	4%	31.75%	1.84	1.63	105.8	105.8	65.12
	6%	14.76%	1.5	1.93	99	111.6	63.08
(b)	0%	0%	1.8	1.8	130.4	136.6	67.39

	2%	3.79%	1.94	1.87	110.4	107	69.11
	4%	19.45%	1.80	1.82	115.2	102.8	64.37
	6%	13.28%	1.33	2.17	106.6	104.6	64.28
(c)	0%	0%	2.43	2.14	123.6	110.6	66.53
	2%	8.75%	2.09	2.08	107.6	109	64.37
	4%	44%	1.91	1.73	108	107.6	63.25
	6%	13.66%	1.4	1.96	106.6	102.4	66.77

Effect of anionic softener on stiffness, drape and crease recovery of cotton khadi fabrics

In this study three types of cotton khadi fabrics varying in thickness i.e. thick, medium and fine were treated with three different concentrations of softeners. The change in stiffness, drape and crease recovery was determined.

Stiffness

Data in table 1 shows the effect of different concentration of anionic softener on stiffness of cotton khadi fabrics of varying thickness.

It is clear that bending length of controlled sample of thick (a) khadi fabric was 3.7 cm in warp direction and 3 cm in weft direction, which decreased considerably on application of 2% softener in sample, whereas in sample (b) of thick khadi fabric bending length increased in warp direction and decreased in weft direction on increasing the concentration upto 4% bending length in both the sample of thick khadi cotton fabric decreased. On increasing the concentration of softener to 6%, bending length further decreased in both the sample (a) & (b) of thick cotton khadi fabric. This trend was observed in the warp as well as weft directions.

In case of medium weight khadi fabric, similar results were obtained. Bending length of controlled sample was 2.16 cm in warp and 2.5 cm in weft direction, which decreases sharply on application of 2% concentration of softener.

In case of fine khadi fabrics, bending length of controlled sample (a) was 2.7 cm in warp and 2.4 cm in weft direction which kept on decreasing in case of sample (b) of fine cotton khadi fabric bending length was increased when 2% concentration was applied and in sample (c) bending length was decreased. On increasing the concentration to 4% bending length increased in warp direction and it decreased in weft direction, whereas in sample (b) & (c) bending length decreased in both the direction, when the concentration of softener upto 6% bending length decreased in all the three samples of fine cotton khadi fabric.

Decreases in stiffness of thick and medium of cotton khadi fabric are more in warp direction than in weft. Where as in fine fabric it is increases in warp in comparison to weft. Decrease in bending length is due to additive and adhesive nature of softener which makes fabric soft.

Drapeability

Drapeability is expressed in term of drape co-efficient; however the drape quality of the same fabric may be evaluated subjectively and expressed in terms of number of nodes.

Drape coefficient of controlled sample of thick cotton khadi fabric (a) was 78.59% and the drape co-efficient of sample (b) was 71.27%.It decreased considerably on application of anionic softener. On increasing the concentration of softener to 4% and 6%, the drape co-efficient further decreased.

In case of medium weight khadi fabric similar results were obtained. The drape coefficient of controlled sample was 73.36% which decreased to 72.99% on application of 2% concentration of softener and decreased continuously on increasing the concentration of softener up to 6%.

In case of fine khadi fabric, the drape co-efficient of controlled sample(a) was 67.82%, sample (b) was 67.39% and sample (c) was 66.53% which decreased in sample (a) & (c) and increased in sample (b), but on increasing the concentration to 4% drape co-efficient decreased in all the three samples of fine cotton khadi fabric. On increasing the concentration of softener up to 6% sample (a) and (b) again decreased and in case of sample (c) of fine cotton khadi fabric drape co-efficient increased.

Thus in general it is noticed that anionic softener treated cotton khadi fabrics exhibit decrease in drape coefficient compared to control sample.

According to the Cusick there is a significant co-relation between stiffness and drape co-efficient. As stiffness decreases, drape coefficient also decreases. Here also the order of decrease in drape co-efficient inis turns with the order of decrease in stiffness of cotton khadi fabrics.

Crease recovery

Crease recovery of controlled sample (a) of thick cotton khadi fabric was 109.2° in warp direction and 122.2° in weft direction and; of sample (b) was 105.2° in warp direction and 113.8° in weft direction which increased considerably on application of anionic softener in both the sample. On increasing the concentration of softener to 4% crease recovery decreased in sample (a) and it increased in sample (b) of thick cotton khadi fabric. But on increasing the concentration upto 6% the crease recovery decreased in both the samples.

In case of medium weight khadi fabric similar results were obtained. The crease recovery angle of controlled sample was 129.6° which decreased to 118° on application of 2% concentration of anionic softener and it increased when fabric was applied to 4% concentration and when fabric was treated to 6% concentration of anionic softener it decreased again.

In case of fine khadi fabrics, crease recovery angle of controlled sample was 124.2° in warp direction and 118.6° in weft direction, in sample (b) 130.4° in warp direction and 136.6° in weft. Continuous decrease in all the three samples on increasing the concentration of anionic softener was observed.

Table 2: Stiffness, crease recovery and% drape coefficient of cotton khadi fabrics treated with varying concentration of nonionic softener

Cotton khadi	Conc. of finish (w/w)	%add on	Bending length (cm)		Crease recovery (^{0})		% drape coefficient
			Warp	Weft	Warp	Weft	
Thick (a)	0%	0	3.7	3	109.2	122.2	78.59
	2%	2.63%	1.97	2.1	97.6	104.8	75.15
	4%	3.07%	1.46	1.75	105.4	105	73.42
	6%	2.12%	1.57	1.89	105	102.2	70.37
(b)	0%	0	2	3	105.2	113.8	71.27
	2%	2.43%	3.16	3.2	105.8	105.6	71.29
	4%	2.18%	2.59	2.87	107.6	104	72.29
	6%	2.46%	3.62	3.31	100.8	99.2	70.59
Medium	0%	0	2.16	2.5	123.6	129.6	73.36
	2%	2.82%	1.89	1.95	108.6	108.8	74.72
	4%	11.42%	1.40	1.70	104.4	112.2	73.08
	6%	8.53%	1.66	1.75	105.2	107.6	72.67
Fine (a)	0%	0	2.7	2.4	124.2	118.6	68.67
	2%	13.76%	1.63	1.89	96.9	97	67.39
	4%	9.42%	1.91	2.13	99.6	101.2	66.01
	6%	10.1%	1.69	1.16	100.2	94.4	64.45
(b)	0%	0	1.8	1.8	130.4	136.6	67.39
	2%	16.46%	1.62	1.8	97	103	65.24
	4%	14.31%	1.95	1.88	99	102.4	65.30
	6%	12.36%	1.6	1.34	105.6	108	66.44
(c)	0%	0	2.43	2.14	123.6	110.6	66.53
	2%	2.76%	1.77	1.97	96.2	102	65.67
	4%	23.38%	1.86	1.95	102.2	104.4	64.72
	6%	10.48%	1.81	1.74	103.8	105.4	65.01

Effect of nonionic softener on stiffness, drape and crease recovery of cotton khadi fabrics

Stiffness

Table 2 shows effect of varying concentration of nonionic softener, on stiffness of cotton khadi fabrics. It is clear from table that stiffness of thick (a) cotton khadi fabric decreased with increase in concentration of softener whereas bending length of thick (b) cotton fabric was increased after application of nonionic softener to 2% and it decreased when thick cotton khadi fabric was treated with 4% of concentration of nonionic softener but on increasing the concentration to 6% bending length of thick (a) and (b) was increased.

In case of medium cotton khadi fabric the similar results were obtained. On the application of softener to 2% the bending length was decreased and it continuously decreased to 4% but on increasing the concentration of nonionic softener to 6% the bending length was increased.

In case of thick cotton khadi fabric on the application of softener to 2% the bending length was decreased and it increased to 4% but on increasing the concentration of nonionic softener to 6% the bending length was decreased in all the three samples of cotton khadi fabric.

Drapeability

Table 2 showed the effect of varying concentration of nonionic softener on drapeability of cotton khadi fabric it is clear from the table that drape co-efficient of thick (a) cotton khadi fabric were decreased continuously on increasing the concentration of softener 2% to 6% whereas in sample (b) it decrease when 2% of softener was applied and increased on increasing the concentration

to 4% and again decreased when 6% nonionic softener was applied.

In case of medium weight of khadi fabrics similar results are obtained. And the drape co-efficient of medium weight cotton khadi fabric were decreased continuously on increasing the concentration of softener to 6%.

In case of fine (a), (b) & (c) khadi fabric drape co-efficient decreased with increasing concentration of softener up to 4% and as the concentration of softener was increased to 6% drape co-efficient of fine cotton khadi fabric was increased in all the three samples.

Crease recovery

Table 2shows crease recovery of cotton khadi fabric after finishing with nonionic softener. It is clear that crease recovery of thick cotton fabric decreased in both warp and weft direction up to 2% in both the sample. It increase when concentration of nonionic softener was increased to 4% and then it decreased when concentration of softener was increased to 6% in both warp and weft direction and in both the sample of thick cotton khadi fabric.

In case of cotton khadi fabric of medium thickness crease recovery was continuously decreased upto 4% and it was increased on increasing concentration to 6% in both the direction warp way and the weft way.

In case of fine cotton khadi fabric it decreased from the control sample but it increased on increasing the concentration of nonionic softener upto 6% in all the samples of fine khadi fabric.

Table 3: Stiffness, crease recovery and % drape coefficient of cotton khadi fabrics treated with varying concentration of cationic softener

Cotton khadi	Con. of finish (W/W)	%add on	Bending length (cm)		Crease recovery (^{0})		% drape coefficient
			Warp	Weft	Warp	Weft	
Thick (a)	0%	0	3.7	3	109.2	122.2	78.58
	2%	0.43%	1.49	1.76	115.2	118	75.35
	4%	0.86%	1.35	1.38	108.2	108.4	75.15
	6%	0.71%	1.30	1.29	106.4	106.2	76.10
(b)	0%	0	2	3	105.2	113.8	71.27
	2%	0.59%	3.46	3.49	106.8	105.6	71.61
	4%	1.68%	3.60	3.64	103.4	99.8	72.99
	6%	2.41%	3.25	3.48	97.4	97	71.30
Medium	0%	0	2.16	2.5	123.6	129.4	73.36
	2%	0.93%	1.37	1.8	113.6	118.6	73.51
	4%	1.34%	1.42	1.58	110.6	109.6	69.65
	6%	1.06%	1.36	1.42	107.4	103	65.23
Fine (a)	0%	0	2.7	2.4	124.2	118.6.	68.67
	2%	2.5%	1.77	1.58	100	99.8	66.87
	4%	10.71%	1.61	1.67	95.6	96.6	63.51
	6%	8%	1.55	1.5	96	100	61.82
(b)	0%	0	1.8	1.9	130.4	136.6	67.39
	2%	3.80%	1.51	1.62	106.8	109	63.85
	4%	12.6%	1.57	1.56	101.6	95.4	62.51
	6%	10%	1.52	1.65	97.8	95.4	60.72
(c)	0%	0	2.43	2.14	123.6	110.6	66.53
	2%	1.9%	1.55	1.72	103.6	105.4	64.75
	4%	1.34%	1.46	1.45	101.8	99.2	63.8
	6%	0.63%	1.43	1.12	97.8	97.4	61.30

Effect of cationic softener on stiffness, drape and crease recovery of cotton khadi fabric

Stiffness

Data given in table 3 shows the result of stiffness of cotton khadi fabric finished with cationic softener. In case of thick (a) cotton khadi fabric bending length is continuously decreased on increasing the concentration of cationic softener to 6% whereas in sample (b) of thick cotton khadi fabric it increase when 2% concentration was applied and then it further increased on increasing the concentration to 4% but it decreased when 6% concentration of cationic softener was applied.

In case of medium weight cotton khadi fabric bending length decreased on increasing the concentration to 2% and on increasing the

concentration to 4% it decreased but after increasing the concentration to 6% it increased.

In case of fine cotton khadi fabric the bending length was sharply decreased on increasing the concentration to 6% in all the three samples of cotton khadi fabric.

Drapeability

Table 3 shows drape co-efficient of cotton khadi fabric after finishing with cationic softener. It is clear that drape coefficient of thick (a) cotton khadi fabric decreased when concentration of softener to 2% and it again decreased on increasing the concentration to 4% but on increasing the concentration to 6% drape coefficient increased, whereas in sample (b) drape co-efficient was similar to the controlled sample and on increasing the concentration to 4% drape co-efficient was also increased but as the concentration was increased to 6% drape co-efficient decreased.

In case of medium weight cotton khadi fabric drape coefficient was continuously decreased on increasing the concentration up to 6%.

In case of fine cotton khadi fabric same results are obtained and the drape co-efficient of cotton khadi fabric was continuously decreased on increasing the concentration up to 6% in all the three samples of fine cotton khadi fabric.

Crease recovery

Data shows that the crease recovery of thick cotton khadi fabric was increased after the application of cationic softener in both the samples at 2% concentration and on increasing the concentration to 4% crease recovery decreased and crease recovery was again decreased as the concentration of the softener increased to 6% in both the samples of thick (a) & (b) cotton khadi fabric.

In case of medium weight cotton khadi fabric crease recovery was decreased and crease recovery of thick cotton khadi fabric was decreased after the application of cationic softener at 2% concentration, on increasing the concentration to 4% crease recovery again decreased and it further decreased as the concentration of the softener increased to 6% crease recovery.

In case of fine cotton khadi fabric the crease recovery was continuously decreased on increasing the concentration upto 4% in all the three samples (a), (b), and (c), on increasing the concentration to 6% sample (b) and (c) was decreased and crease recovery of sample (a) was increased as compared to the 4% concentration.

IV. Conclusion

Anionic softener, nonionic softener, and cationic softener each have different chemical composition and characteristics, so they influenced stiffness, drape, crease recovery of cotton khadi fabric in different way.

All the softeners decreased stiffness but cationic softener was most effective in decreasing stiffness of cotton fabrics of all types.

Percent drape co-efficient of fabrics finished with anionic, nonionic, and cationic softeners decreased continuously on increasing the concentration of softener upto 6% in all the samples of cotton khadi fabric.

On the other hand, no particular trend was observed with respect to crease recovery of fabrics.

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