RESEARCH ARTICLE OPEN ACCESS

To Study the Handle Properties & Crease Recovery of Some Functional Fabrics

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ABSTRACT
The effect of functional finishes of fabrics on handle&crease properties are very useful for the performance assessment of the garment.Different types of functional finishes are applied on cotton Woven fabric and study the influences of these finishes on drape &bending, crease recovery fabrics properties. In case of aroma, stain release, soil release, soft, antistatic, stain release, wrinkle-free and soft - wrinkle-free finish, there is a decrease in bending modulus, flexural rigidity and bending length. there is an increase in the Crease Recovery and also increases for stain release+ wrinkle free and flame-retardant finish. While a decrease in the Crease Recovery is observed for the soil release, stiff, water repellant finish. Marginal change in Crease Recovery is observed for the soft, wrinkle free and soft+ wrinkle free finish. It is observed that in case of cotton fabrics, there is an increase in the drapability coefficient and the same time for the stiff and flame retardant, water repellent and soil release finish significant decrease in the drapability coefficient.
KEYWORD: Woven fabric, Bending properties, Crease recovery & Drape coefficient.

Date of Submission: 23-03-2020 Date of Acceptance: 11-04-2020

I. INTRODUCTION

In a broader sense, 'finishing' includes any dry andor wet processing operation carried out on the grey fabric- singeing, cropping, desizing, mercerization, bleaching, dyeing, printing and the final finishing [1]. But from a focused angle, finishing denotes the processing operations aimed at enhancing the fabric's aesthetic and for functional properties. Fabric finishing assumes immense importance for domestic or export market. Finishing is an important step in the production of technical textiles that currently have a big market, with high growth potential [2].

Fabrics are finished to increase their attractiveness and serviceability and to impart certain desirable properties. Fibers used in apparel usually lack useful properties such as high moisture regain, resistance to static and pilling, and stability towards hot alkaline launderings [3-4]. Cotton fibers suffer from the drawbacks of low crease recovery and poor dimensional stability. Synthetic fibers have desirable properties such as high strength, high elasticity and thermosetting character, but on the other hand have drawbacks of low moisture regain, tendency to pilling and static accumulation. In order to minimize the drawback of different fibers without adversely affecting as far as possible, their useful properties, and thefibers are imparted finishing treatment. Cellulosic fabrics and cellulosic rich polyester blended fabrics can be imparted chemical finishing. It is defined as the use of chemicals to achieve a desired fabric property [5].

Chemical finish is a solution or emulsion of the active chemical in water. Finishes can be durable, that is, undergo repeated launderings or dry cleanings without losing effectiveness, or non-durable, that is, intended when only temporary finishes are needed or when the finished textile typically is not washed or dry cleaned, for example some technical textiles [6].

Although these finishes intend to improve the functional properties, some useful mechanicalproperties such as bending properties of fabric can be adversely affected. Bending property is a most important property of fabrics that are subjected to considerable mechanical stresses in service and this is especially true when the fabric is liable to undergo outside exposure for any length of time [7-8]. In most of the practical situation,the emphasis is given on the use of finish for the improvement of handle properties of fabric. On the other hand,the flexibility is theproperty of prime importance that differentiates textile materials from other types of structures and make them suitable to be used in a wide variety of applications acquiring extremely low bending rigidity like clothing [9-10]. Different end uses of the textile material require different level of bending stiffness.The finishes imparted to fabrics are water repellent, stiff, wrinkle free, aroma, stain release, soil release, soft, flame retardant, antistatic, antipilling, combination of stain release - wrinkle free, water repellent -wrinkle free, soft - wrinkle Free and water repellent - flame retardant [11-12]. An experimental investigation on handle properties of dyed, finished and laundered stage are reported in the research work.

II. MATERIAL AND METHODS

2.1 Material

The fabrics have been procured from JCT Mills Ltd., Phagwara, India. TheCottonfabrics are processed follow, in the process sequence mentioned below. All the fabricsamples are subdivided into four groups. The tearing strength and bending properties of fabrics treated with 14 types of functional finishes was studied. The tearing strength and bending properties of functional fabrics after laundering was also studied. The constructional parameters of dyed, finished and laundered fabric. The various steps of manufacturing dyed fabric from grey stage to finished. Fabrics are desized in Osthoff Singe machine (Germany). Desized fabrics are scoured and simultaneously bleached with the recipe given below, in a continuous pretreatment range (PTR) machine (Benninger AG. Switzerland) followed by neutralization with acetic acid. The bleached fabrics are mercerized in Bendimenza (Benninger AG., Switzerland) followed by neutralization with acetic acid. The bleached fabrics are dyed with combination of dyes in a continuous dyeing range machine (Benninger AG., Switzerland) followed by neutralization with acetic acid. The dyedfabrics are then finished with different types of functional finishes in Stenter machine (T.Maniklal). In the continuous process, the dyed samples are sanforised in a sanforizing machine. The finished fabric samples are subjected to laundering process in a domestic twin tub washing machine as per the ASTM Standards (D13 1950) using a 0.5 Oft. solution of Non-ionic detergent. The entire specimens are given a seven-laundering cycle at 45°C temperature which is followed by drying in the open space during day light.

2.1.1.Recipe for finishing of fabrics

Table 1. water repellent finish and concentration level

S.no.	Water repellent finish	Concentration (gpl)
1.	Phovotex JVA	60
2.	Oleophobol CO	25
3.	Knitex FEL	30
4.	Sapanine KL	10
5.	iso-propyl alcohol	2
6.	Acetic acid	2

Table 2. Stiff finish and concentration level

S.no.	Stiff finish	Concentration (gpl)
1.	Apprantan E M	40
2.	Apprantan MBX	20
3.	Polyethylene	10
4.	Sirix N	1
5.	Acetic acid	2

Table 3. Wrinkle free finish and concentration level

S.no.	Wrinkle free finish	Concentration (gpl)
1.	VLF finish	80
2.	MgCl2	20
3.	PE2	15
4.	Ceraperm MW	15
5.	Acetic acid	2

Table 4. Aroma finish and concentration level

S.no.	Aroma finish	Concentration (gpl)
1.	Lexroma	15
2.	Cellbinder	5

Table 5. Strain release finish and concentration level

S.no.	Stain release finish	Concentration (gpl)
1.	Oleophobol ZSR	60
2.	Ultraphil HSD	20
3.	Iso-propyl alcohol	10
4.	Sapamine KL	20
5.	Acetic acid	1

Table 6. Soil release finish and concentration level

S.no.	Soil release finish	Concentration (gpl)
1.	Oleophobol ZSR	60
2.	Ultraphil HSD	40
3.	Knitex FEL	30
4.	MgC12	10
5.	Acetic acid	1

Table 7. Chemical softening finish and concentration level

S.no.	Chemical softening finish	Concentration (gpl)
1.	Recosoft	10
2.	Ceraperm MW	8
3.	Ceranine	1
4.	Acetic acid	2

Table 8. Flame retardant finish and concentration level

S.no.	Flame retardant finish	Concentration (gpl)
1.	Pyrovatex CP	400
2.	Alcoprint PFL	30
3.	Knitex FEL	50
4.	Ultraphil DCW	40
5.	Sapamine KL	40
6.	Iso-propyl alcohol	15
7.	Phosphoric acid	25

Table 9. Stain release wrinkle free finish and concentration level

S.no.	Stain release - wrinkle free finish	Concentration (gpl)
1.	Oleophobol ZSR	60
2.	Ultraphil HSD	20
3.	Sapamine KL	20
4.	Iso-propyl alcohol	10
5.	Oleophobol ZSR	60
6.	Ultraphil HSD	20
7.	Sapamine KL	20
8.	Iso-propyl alcohol	10
9.	Acetic acid	1
10.	Knitex FEL	40
11.	MgC12	13
12.	Megasoft Jet	10
13.	Acetic acid	1

Table 10. Water repellent wrinkle free finish and concentration level

S.no.	Water repellent - wrinkle free finish	Concentration (gpl)
1.	Oleophobol CO	50
2.	Megasoft Jet	10
3.	Knitex FEL	30
4.	MgCl2	10
5.	Hydrophobol XAN	10

6.	Iso-propyl alcohol	10
7.	Acetic acid	1

Table 11. wrinkle free- soft finish and concentration level

S.no.	Wrinkle free - soft finish	Concentration (gpl)
1.	Finish VLF	40
2.	MgC12	8
3.	PE2	15
4.	Ceranine MW	15

Table 12. Flame retardant - water repellent finish and concentration level

S.no.	Flame retardant - water repellent finish	Concentration (gpl)
	First step	
1.	Pyrovatex C P	400
2.	alcoprint PFL	30
3.	Knitex FEL	50
4.	Ultraphil DCW	40
5.	Sapamine K L	40
6.	Iso-propyl alcohol	15
7.	Phosphoric acid	25
	Second step	
8.	Phovotex JVA	60
9.	Oleophobol CO	30
10.	Knitex FEL	30
11.	Sapamine KL	10
12.	Iso-propyl alcohol	10
13.	Acetic acid	2
14.	Hydrophobol XAN	15

2.2. Methods

2.2.1. Measurement of bending length

Shirley stiffness tester is used for testing of samples. A 25 cm * 2.5 cm rectangular fabric strip is mounted on a horizontal platform in such a way that it overhangs like a cantilever and bends dovtimarth, 1 he overhangs length, l and the angle *. made by the free end of fabric with the horizontal is used to calculate the fabric bending length, flexural rigidity) and bending modulus.

Bending length, C of a fabric is defined as the length of a fabric when it bends under its own weight to a definite extent.

C= I x f(*)

F(*) =[cos*/8tan*]1/3

Flexural rigidity, G is a measure of stiffness associated with handle.

$G=W^2 *C^3 *10$ 3mg/cm

here. W^2= cloth weight in grams per square centimeters

Bending modulus. q is called as intrinsic stiffness. This value is used to compare the

stiffness of fabrics of different thickness.

= $1(12\ 6\quad 1\ 0^{-4})$ I g^2 kg $ical^2$

Where. g^2 = cloth thickness in cms

2.2.2. Crease Recovery: Creasing of a fabric during wear is no change in appearance that is generally desired. The ability of a fabric to resist creasing is in the first instance dependent on the type of fiber used in its construction.

Wool and silk have a good resistance to creasing whereas cellulosic materials such as cotton, viscose, and linen have very poor resistance to creasing.

2.2.2.1. Shirley Crease Recovery test:

The instrument consists of a circular dial which carries the clamp for holding specimen (see figure).

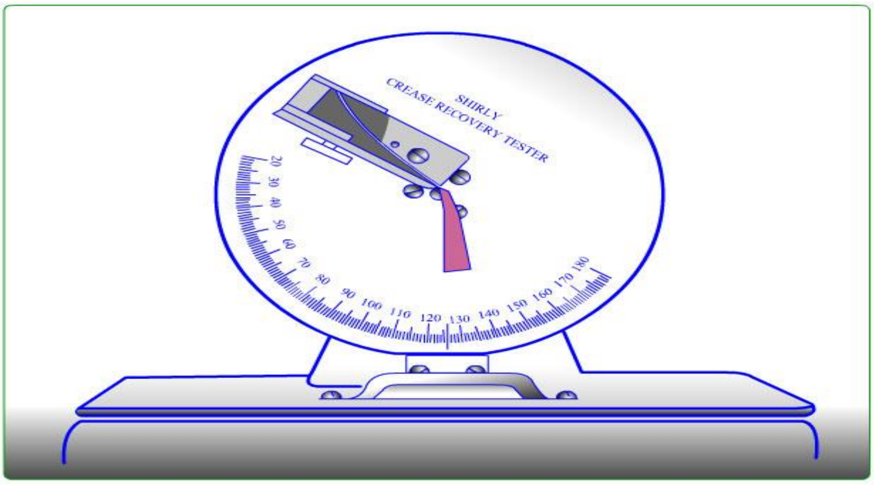

Figure 1. Crease Recovery test

Procedure

- Directly under the centre of the dial are a knife edge and an index line for measuring the recovery angle.
- The scale of the instrument is engraved on the dial.
- A specimen is cut from the fabric with a template, 2-inch-long by 1 inch wide. It is carefully creased by folding in half, placing it between two glass plates, and adding 2 kg weight.
- After one minute the weight is removed and the specimen is transferred to the fabric clamp on the instrument and allowed to recover from the crease.
- As it recovers, the dial of the instrument is rotated to keep the free edge of the specimen in line with the knife edge.
- At the end of the time period allowed for recovery, usually one minute, the recovery angle in degrees is read on the engraved scale.
- The load, time of creasing, and recovery time may be altered to suit particular cases.

2.2.3. Drape tester

It is the ability of a fabric to form pleating folds when deformed under its own weight.

2.2.3.1. Factors affecting drape of fabric

Drapability of a fabric is combined effect of several factors such as stiffness, flexural rigidity, weight, thickness etc. Stiffness, an attribute of fabric hand is one of the most important factors determining draping quality of fabric e.g. soft fabric drapes closer to the body forming ripples whereas stiff fabric drapes away from the body. Stiffness of fabric itself depends upon geometrical parameters of the fabric.

Pprocedure

Drape meter testing equipment is defined as the extent to which a fabric will deform when it is allowed to hang under its own weight. It is one of the subjective performance characteristics of fabric and contributes considerably to its aesthetic appeal. It is a complex characteristic involving both bending and shearing deformation. One of the methods of determining the drape characteristic in which both the warp and weft way characteristics interact to produce a graceful fold uses a circular support over which a specimen of the fabric in form of a circular piece is placed with an annular section overhanging the support. The horizontal area covered by the shadow left by the overhanging portion of the fabric is determined and compared against its actual area to obtain the drape co-efficient.

III. RESULT AND DISCUSSION

Table 13. Bending properties for the cotton woven fabrics

S.No.	Sample type		Bending length	Flexural rigidity	Bending modulus
1.	Soft	Warp	0.9162	30.76	0.00170
		weft	1.221	72.81	0.00404
2.	Wrinkle	warp	1.323	92.62	0.00514
		weft	1.119	56.04	0.00311
3.	Soft+ Wrinkle free	warp	1.119	56.04	0.00311
		weft	1.170	64.04	0.00355
4.	Flame retardant+ water repellent	warp	1.018	41.21	0.00289
		weft	1.170	64.04	0.00355
5.	Stain release +Wrinkle free	warp	1.170	64.04	0.00355
		weft	1.221	72.81	0.00404
6.	Water repellent	warp	1.425	115.74	0.00643
		weft	1.170	64.06	0.00355
7.	Soil release	warp	1.628	172.59	0.00958
		weft	1.323	92.62	0.00514
8.	Stiff	warp	1.425	115.74	0.00643
		weft	1.527	142.42	0.00791

Effect of finish on fabric bending behaviour

The different functional finishes can affect the bending properties of fabrics. The bending modulus is an intrinsic property of the material which is derived from flexural rigidity. On the other hand, flexural rigidity values are derived from bending length. Fabric flexural rigidity is associated with fabric handle whereas bending length determines the drying quality of fabric. In the following section, the effect of finishing treatment on bending modulus has been discussed initially followed by the effect on flexural rigidity and bending length. The bending properties of dyed, finished and laundered fabrics are presented in tables 13 and figures4 to 6.

Effect of finishon bending modulus

It is observed from tables that there is an increase in the bending modulus in case of water repellent, stiff, wrinkle free, flame retardant, water repellent - wrinkle free and water repellent - flame retardant finish while all the other finishes cause a decrease in bending modulus. Stiff finish causes large increase in bending modulus whereas soft finish cause decrease in bending modulus to a large extent.The increase in fabric stiffness in case of water repellent finish can be explained as water repellent finishing chemicals polymerize and lead to hard brittle surface film on the fibrous material. On the other hand, stiff finish leads to an increase in the bending stiffness due to the use of film forming polymers of high molecular weight and cross-linked stiffening agents that coat fibre assemblies. The constituent yarn becomes rigid because of the surface film. At the cross-over points of yarn, degree of adhesion will be more. Although in wrinkle free finish the rigidity of the fabric usually increases due to penetration of resin inside the yarn and cross linking, however, it is observed that the bending modulus marginally changes due to the use of textile softeners which serve to lubricate the fibre surface. It is further observed that flame retardant compositions stiffen the hand of fabrics. High application levels of flame retardants can adversely influence fabric handle, drape and appearance. In case of soft finish, use of softeners and lubricating agents cause smooth surface and thus reduce the bending modulus.

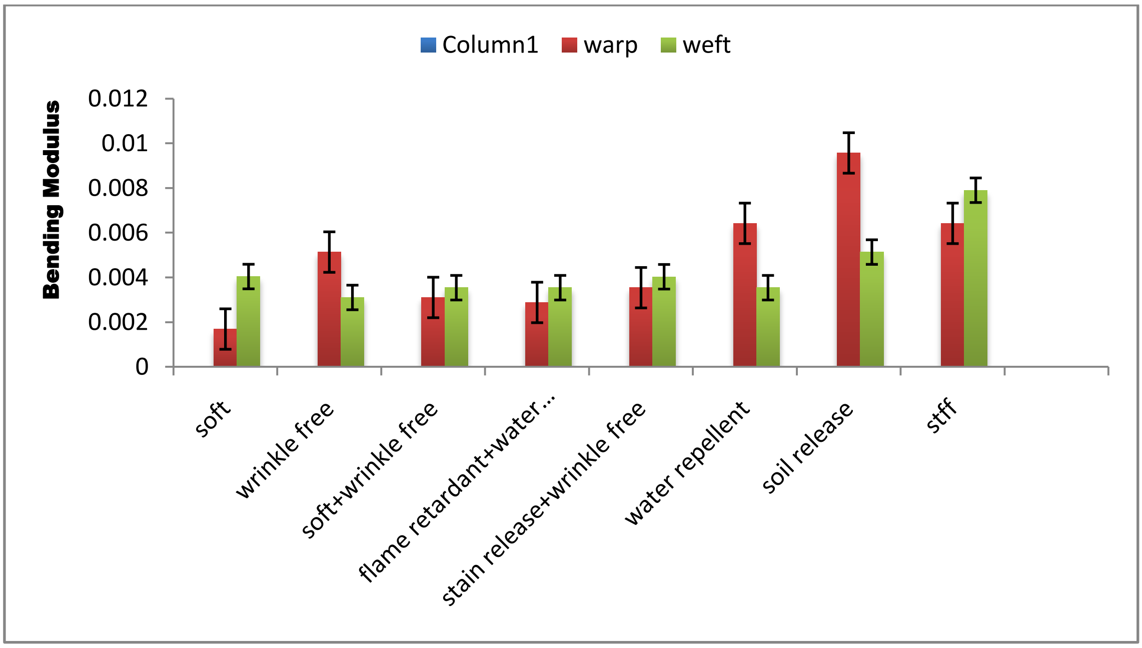

Figure 4. Bending modulus properties for the woven fabrics

Effect of direction (warp / weft)
Higher changes in bending modulus are observed along warp as compared to the weft wise sending modulus in cotton fabrics. This is due to greater warp density than weft density.

Effect of finish on flexural rigidity
It is observed (figure 5) that in case of cotton fabrics, there is an increase in the flexural rigidity in case of stiff and flame-retardant finish while a decrease in the flexural rigidity is observed in aroma, stain release, soil release, soft, stain release - wrinkle free and soft - wrinkle free finish. Marginal change in flexural rigidity is observed in case of water wrinkle free finish. Marginal change in flexural rigidity is observed in case of water repellent, wrinkle free, water repellent - wrinkle free and water repellent - flame retardant finish. Flexural rigidity is affected by fabric bending modulus and thickness. It is due to finish. It is due to the change in thickness of the fabric after the application of finish. When there is an increase in both bending modulus and fabric thickness, the flexural rigidity increases. However, the decrease in bending modulus can cause a decrease in flexural rigidity.

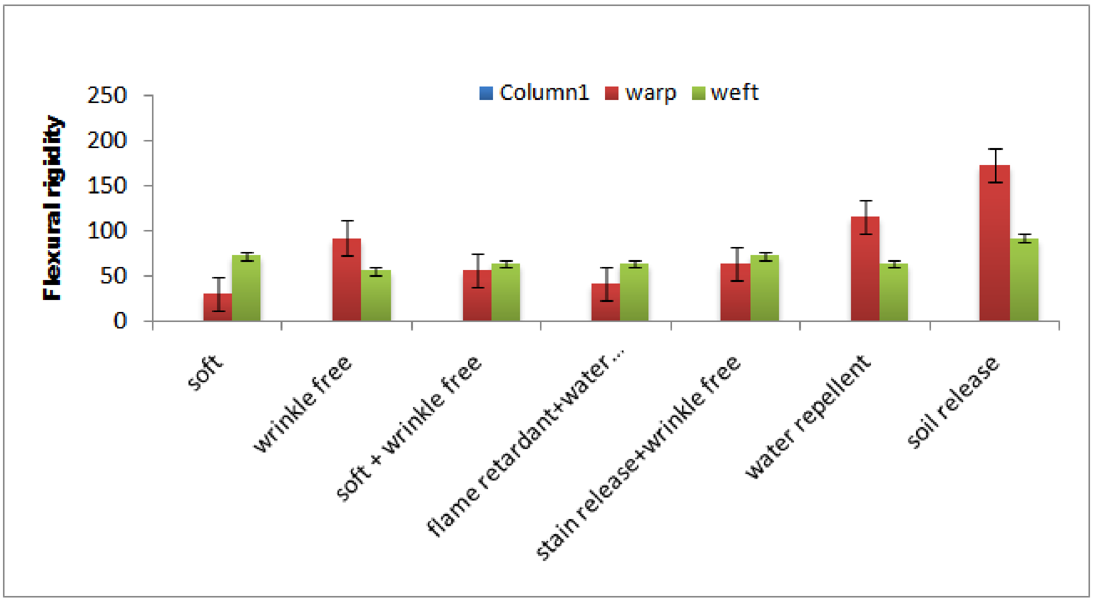

Figure 5. Flexural rigidity properties for the woven fabrics

Effect of finish on bending length

It is observed (figure 6) that in case of aroma, stain release, soil release, soft, stain release, wrinkle free and soft +wrinkle free finish, there is a decrease in bending length. In case of water repellent, stiff, wrinkle free, flame retardant, water repellent - wrinkle free, water repellent - flame retardant finish, an increase in bending length is observed. Bending length is influenced by fabric flexural rigidity and fabric weight. An increase in fabric weight (grams per square cm) during finishing causes a reduction in bending length. High inter yarn friction arises as a result of relative movement of yarns which causes a decrease in bending length. Bending length can increase if there is an increase in flexural rigidity while the change in weight is marginal.

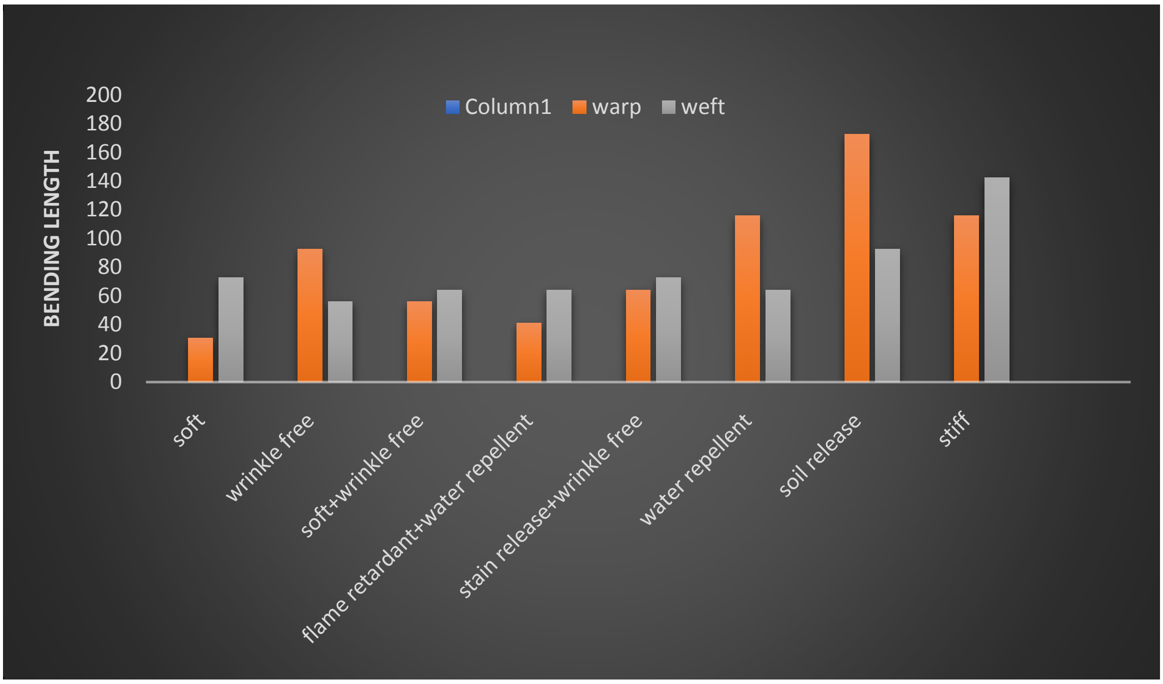

Figure 6. Bending length properties for the woven fabrics

Effect on Drapability

Table 14. Drape coefficient properties for the cotton woven fabrics

S. No.	Sample type	Drape Coefficient
1.	Soft	0.61
2.	Wrinkle	0.62
3.	Soft+ Wrinkle free	0.61
4.	Flame retardant+ water repellent	0.73
5.	Stain release +Wrinkle free	0.61
6.	Water repellent	0.71
7.	Soil release	0.67
8.	Stiff	0.73

Effect of finish

It is observed (figure 7& table 14) that in case of cotton fabrics, there is an increase in the drapability coefficient in case of stiff and flame retardant,water repellent and soil release finish while a decrease in the drapability coefficient is observed in soft, soft+wrinkle free, wrinkle free +stain release finish. Marginal change in drapability coefficient is observed in case of wrinkle free finish. drapabilitycoefficient is affected by fabric bending modulus and thickness. It is due to finish. It is due to the change in thickness of the fabric after application of finish. When there is an increase in both bending modulus and fabric thickness, the drapability coefficient decreases. However, the decrease in bending modulus can cause an increase in drapability coefficient.

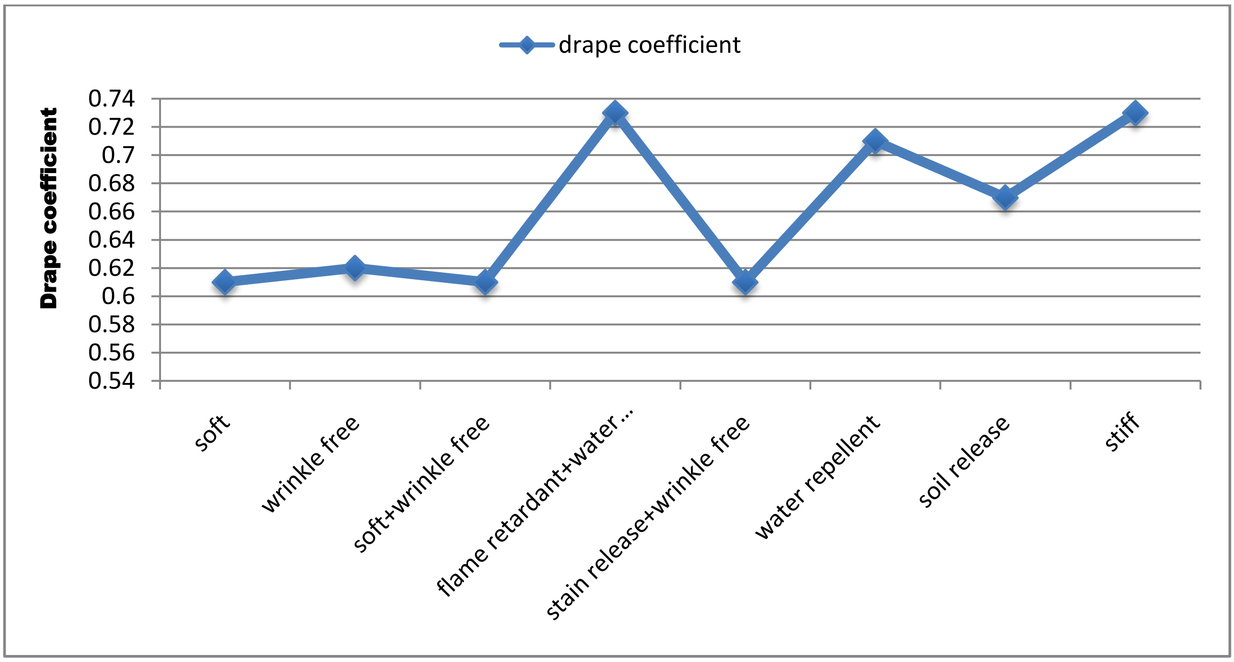

Figure 7. Drape coefficientproperties for the woven fabrics

Effect on crease recovery

Table 15. Crease recovery properties for the cotton woven fabrics

S. No.	Sample type	Average crease recovery angle
1.	Soft	62
2.	Wrinkle	60
3.	Soft+ Wrinkle free	60
4.	Flame retardant+ water repellent	83
5.	Stain release +Wrinkle free	90
6.	Water repellent	50
7.	Soil release	48
8.	Stiff	49

Effect of finish

It is observed (figure 8 & figure 15) that in case of cotton fabrics, there is an increase in the crease recovery in case of stain release+wrinkle free and flame-retardant finish.while a decrease in the crease recovery is observed in soil release,stiff, water repellant finish. Marginal change in crease recovery is observed in case of soft,wrinkle free and soft+wrinkle free finish.

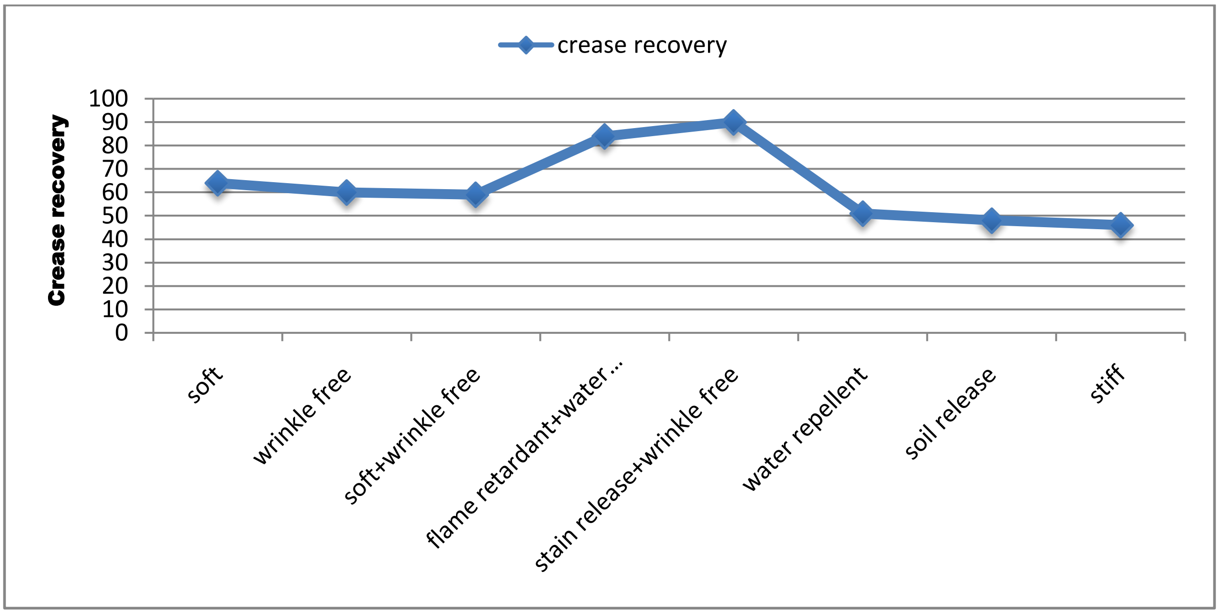

Figure 8. Crease recovery properties for the woven fabrics

IV. CONCLUSIONS

The based on the studies of impact of functional finishes on the fabric handle and bending properties, the following conclusions have been obtained:

- That in warp direction, soil release finish fabric is more resistant to bending while soft fabric is easily bendable. While in weft direction, stiff finished fabric is maximum resistant to bending while wrinkle free is easily bendable
- Drapability- more the drapability coefficient more the fabric will be stiffer and during working with samples drapability of stiff and combination of flame retardant-water repellent is coming out to be maximum (i.e.0.73). While soft finished has the minimum drapability (0.61).
- Crease recovery-crease recovery angle for combination of stain release and wrinkle free is comes out to be maximum (i.e.90).

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