Fabric Cover: An Important Property Affecting the Aesthetic Appearance of The Fabric

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Abstract

Since the beginning, when the fabric was started to be manufactured in bulk quantity, there have been many changes that have taken place in the fabric structure by varying the different fabric parameters. A single change in fabric parameters can create a different fabric. In this modern era, quality plays an important role. But at the same time, the look or appearance of fabric also has equal importance. Fashion has become a buzz word in the fashion industry. The fabric properties like crease resistance, wrinkle recovery, and durable press are related to the fabric's aesthetics. In this scenario, this study was conducted by changing the thread spacing but keeping the yarn counts the same to check the effect of fabric cover on the aesthetic attributes of fabric.

In this study, 100% cotton fabric samples with same count but different cover factors were manufactured. The fabric samples were tested for aesthetic properties like tensile strength, tear strength, durable press rating, flexural rigidity, and crease recovery angle before as well as after the finishing process. This research work revels that, better crease recovery is achieved after resin finishing treatment for less covered fabric due to the easily removal of creases formed over the fabric surface, which improves the aesthetics of the fabric.

Keywords: *Count, Crease Recovery Angle, Cover factor, Durable Press Rating, Flexural rigidity, Seam strength*

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1. Introduction

Nowadays, the textile market is filled with many varieties of fabrics. These have their own unique structure. Grey fabric has a number of issues with its appearance, but after proper treatment, it can be changed into the desired one [1]. Wrinkling and creases are common problems with cotton fabric, but in this case, the creases recovery rate is quick, whereas the wrinkles remain as it is and are difficult to remove so, these wrinkles can be overcome by the application of a resin finish [1, 2]. In this way, one can say that by changing the properties of fabric along with their yarn properties, the aesthetics of fabric may be changed. Cover factor is one of the important properties of fabric, and when fabric thread spacing is altered, there will be a change in the cover factor as well as in the fabric appearance. When the cover of fabric is changed, many changes come under this [3]. Everyone knows that one of the most important end-use performance parameters of fabrics and other textile products are the fabric hand and fabric aesthetics. Cover factor is a measure of how much of a fabric's surface is covered by a single set of threads. For any woven fabric, there are two cover factors: warp cover factor and weft cover factor, which gives the fabric cover when added together. This cover depends upon thread density and thread count [4, 7]. Hence, taking different fabric samples having different covers, which is possible by varying the thread spacing of the fabric, and proper testing, will give the results. With these results, the effects of fabric cover on the aesthetic properties of fabric can be obtained with informative conclusions.

2. Material and Method

a. Selection of raw material

Raw materials play a vital role in the characteristics of the end product. Here, 100 % cotton fabric is used for this project, whose end use is shirting. This research work is carried out on sample weaving machine at textile department of D.K.T.E Textile Engineering College Ichalkaranji. The material was manufactured and tested on April 2021.

As cotton is a natural fibre, it can have good comfort properties, but at the same time, wrinkles are the main problem with cotton fabric, so it was decided to use this as a raw material [6].

b. Manufacturing of Fabric Samples

A total of three fabric samples of different properties were manufactured on sample loom and those samples were denoted as S1, S2 and S3. Fabric sampling of the raw material is described in the following table.

Table 1- Fabric sampling

Sr. No.	Fabric Samples	Count (Ne)	EPI	PPI	Cover Factor
1.	**S1**	60	86	84	17.66
2.	**S2**	60	80	72	16.2
3.	**S3**	60	64	63	13.84

With the use of following mentioned process parameters in table 2, resin finishing treatment is applied on the above manufactured fabric samples.

Table 2- Resin finishing process parameters

Resin Concentration		Temperature			Dwell Time (sec)	SPEED (Mt/min)
Materials	Content (gpl)	Chamber		(^{0} C)		
DMDHEU	40	Drying	1	140		30
MgCl2 (Catalyst)	09		2	140		
SILIGEN PE	20	Curing	3	170	45	
HOSTAPAL MRZ	02		4	170		
Acetic Acid	0.3		5	170		
Silicon Softener	20		6	170		
			7	170		
			8	170		

c. Testing

Before and after the resin finish total seven fabric tests were carried out as per the ASTM testing standards. List of tests and ASTM standards for woven fabric testing is given in the following table.

Table 3 - List of ASTM standards for woven fabric testing

Sr. No.	Fabric Testing	Testing Standard	Measurement unit
1	TENSILE STRENGTH	ASTM D5035 - 11(2015)	Kg-f
2	TEAR STRENGTH	ASTM D1424 - 09(2013) e1	gm-f
3	SEAM STRENGTH	ASTM D1683	Kg-f
4	DP RATING	AATCC 124	Rating
5	FLEXURAL RIGIDITY	ASTM D1388-14e1	mg-cm
6	DRAPE	ASTM D4032-94	Drape Percentage
7	CREASE RECOVERY ANGLE	IS6359:1971 SP-15	Degrees

3. Result and Discussion:

With the same count of 60s Ne, fabric samples with different cover factors were manufactured. By using the above manufactured samples, various tests were conducted and the obtained results were analysed to find the relationship between cover factors and fabric properties.

a. ***Fabric Tensile Strength and Elongation –***

The manufactured fabric samples were tested for tensile strength and its elongation and the obtained results are tabulated in the following Table 4.

Table 4 - Fabric tensile strength and elongation before and after finishing process

Fabric Samples	Fabric Tensile Strength			Fabric Elongation		
	S1	S2	S3	S1	S2	S3
Before Finish	215.3	333.2	170.8	29.43	30	27.64
After Finish	183.5	292.4	131.7	26.75	28.5	24.84
Percentage Reduction	14.77	12.24	22.89	9.1	5	10.13

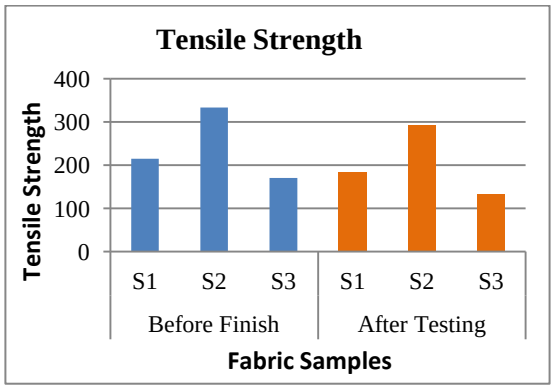

Figure 1- Fabric tensile strength

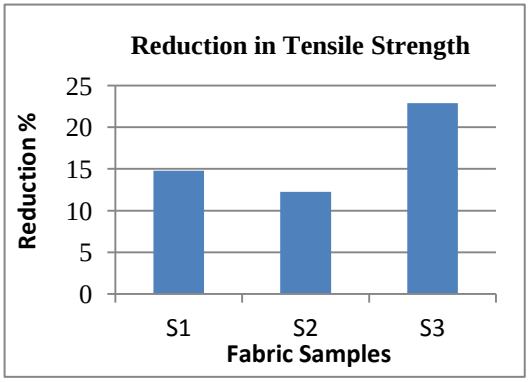

Figure 2 - Reduction in tensile Strength

Above figure 1 revels that, after the resin finishing the tensile strength of all the fabric samples decreases due to the acid treatment of cotton fibres. While the figure 2 shows that fabric sample with less cover factor has more percentage reduction in tensile strength. This is due to the combined effect of less number of threads in tensile direction and with more resin absorption leading to the more cotton fibre degradation during finishing.

By statistical analysis it is found that before and after the resin finish there is significant difference in tensile strength of all fabric samples which is proved by the 'P' value of *2.625E-44* and *1.6645E-27* respectively which are less than *0.05*.

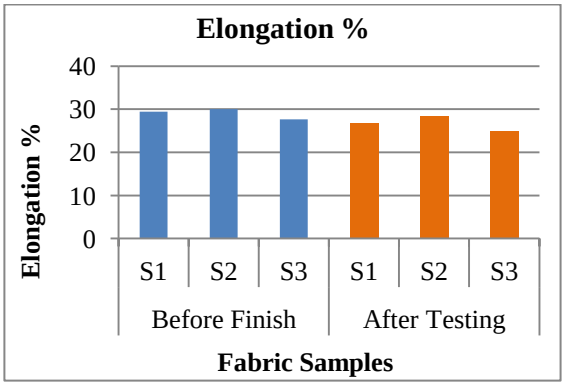

Figure 3 - Fabric Elongation %

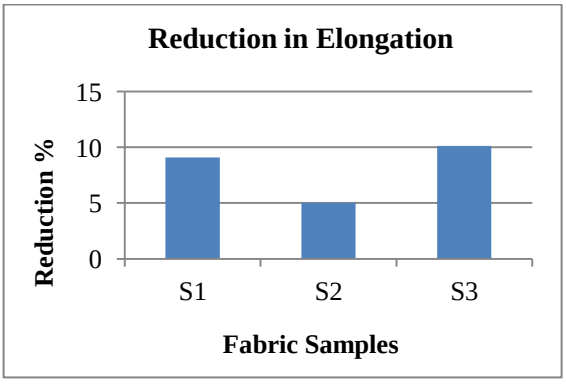

Figure 4 - Reduction in elongation %

Above figures 4-5 shows that, elongation also shows the similar trend like the tensile strength. This trend has been changed after resin finish, elongation percent of S3 sample is reduced by 10.13 % which is more than other two samples S1 and S2. This is because, after resin finish yarn becomes rigid so the elongation reduces.

b. Tear Strength

The fabric samples were tested for their tear strength and the obtained results are tabulated in the following Table 5.

Table 5 - Tear strength of fabric samples before and after finishing process

Fabric Samples	S1	S2	S3
Before Finish	724.27	855.73	2184.8
After Finish	348.6	633.27	1731.8
Percentage Reduction	20.73	26	51.86

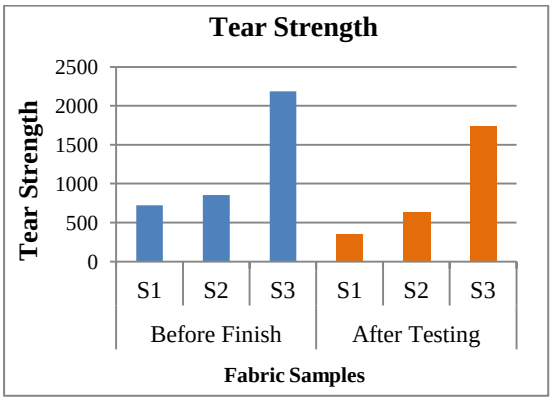

Figure 5 - Fabric Tear Strength

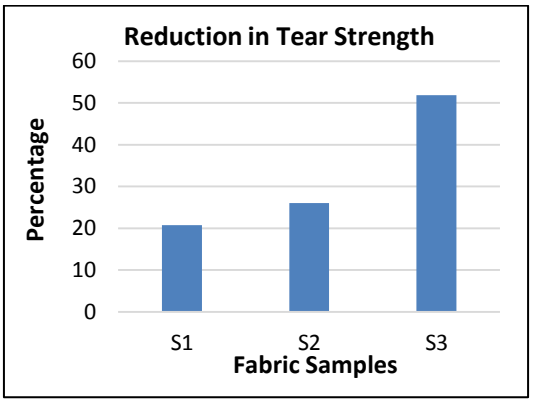

Figure 6 - Reduction in Fabric Tear Strength

Above figure 6 reveals that with reduction in fabric cover the tear strength of fabric increases. This trend has obtained because, in case of less cover factor thread gliding effect is more and at the time of tearing of such fabric, other yarns from that fabric comes together and forms a bundle like structure which cannot be tear easily. After the resin finishing, there is significant decrease in the fabric tearing strength because of acid treatment during resin finishing process. Before finish, the tear strength of S3 sample is good and it is decreased by 20.73 % after resin finish treatment. Figure 7 reveals that, in case of Sample S3 the reduction in fabric tear strength is high i.e., 51.86%, this is because of its less cover factor among all three and hence it absorbs more resin which could be the reason of more reduction in tear strength.

By statistical analysis it is found that before and after the resin finish there is significant difference in tear strength of three different cover factors which is proved by the 'P' value of 6.9659E-51 and 6.8183E-46 respectively which are less than 0.05.

c. Crease Recovery Angle

The fabric samples were tested for CRA and the obtained results are tabulated in the following Table 6.

Table 6 - CRA of fabric samples before and after finishing process

Fabric Samples	S1	S2	S3
Before Finish	79.6	65.94	108.47
After Finish	83.2	72.36	120.83
Percentage Increase	4.33	8.87	10.23

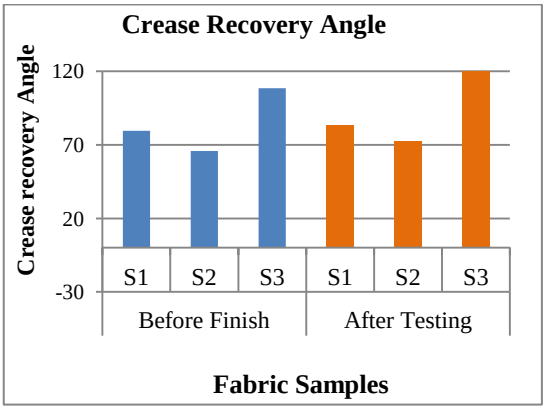

Figure 7- Fabric Tear Strength

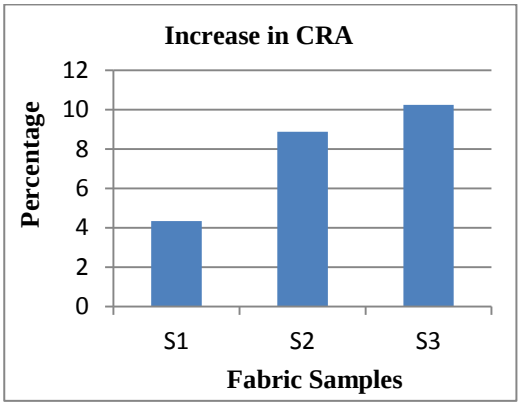

Figure 8 - Increase in Fabric Tear Strength

After the resin finishing, application of resin finish results in increase in fabric crease recovery angle because the resin finishing leads to the cross linking of cotton cellulose molecules of and this results in to increase in fabric CRA. Before finish, the CRA of S3 sample is highest. The reason for more crease recovery is thread gliding i.e., in case of less cover factor fabric; the threads can easily glide so that recovery is higher. Figure 9 reveals that, CRA of sample S1, S2 and S3 is increased by 4.33%, 8.87% and 10.23% respectively. In case of less cover factor thread density is also less and resin absorption is more which leads to increase the formation of covalent bonds. Due to increase in covalent bonds, the rate of crease recovery is more.

By statistical analysis it is found that before and after the resin finish there is significant difference in tear strength of three different cover factors which is proved by the P value of 1.1086E-26 and 2.1403E-33 respectively which are less than 0.05.

d. Flexural Rigidity

The fabric samples were tested for flexural rigidity and the obtained results are tabulated in the following Table 7.

Table 7 - Flexural Rigidity of fabric samples before and after finishing process

Fabric Samples	S1	S2	S3
Before Finish	62.98	26.7	58.59
After Finish	72.51	36.31	94.51
Percentage Reduction	13.14	26.4	38

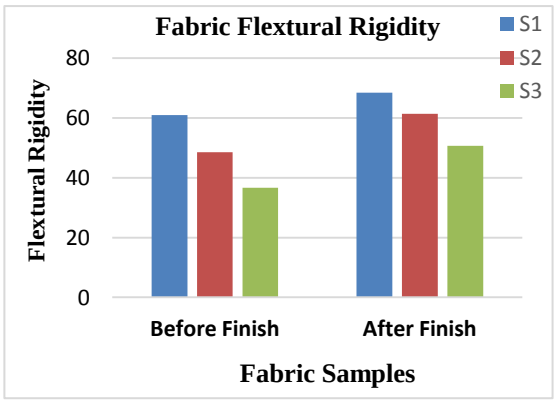

Figure 9 - Fabric Flexural Rigidity

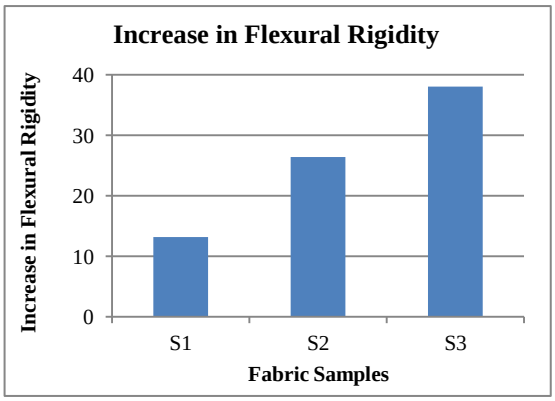

Figure 1 - Increase in Flexural Rigidity

Resin finish treatment enhances the Flexural rigidity because there is increase in yarn rigidity after resin finishing which leads to increase flexural rigidity of fabric. Before finish, the rigidity of S3 sample is least. Before resin finishing due to highest cover factor among the all samples the sample S1 has more flexural rigidity but less percentage increase after resin finish as compare to other two samples. This is because of less resin absorption of high-density threads in the fabric.

According to statistical analysis, there is a substantial difference in flexural rigidity of three separate cover components before and after the resin finish, as evidenced by P values of 1.8065E-25 and 4.8016E-18, both of which are less than 0.05.

e. Seam Strength of Fabric

The fabric samples were tested for fabric seam strength and the obtained results are tabulated in the following Table 8.

Table 8 - Seam Strength of fabric samples before and after finishing process

Fabric Samples	S1	S2	S3
Before Finish	75.73	86.8	92.97
After Finish	66.98	75.27	76.65
Percentage Reduction	11	13.28	17.55

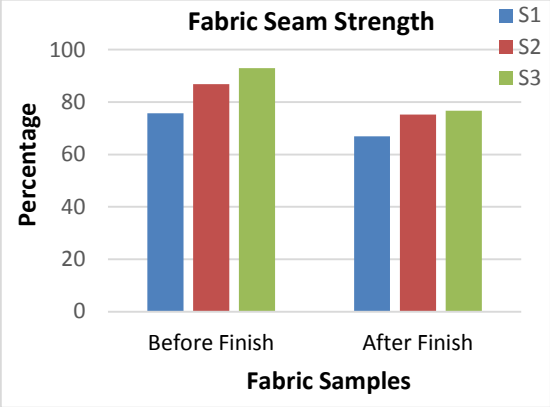

Figure 11 -Fabric Seam Strength

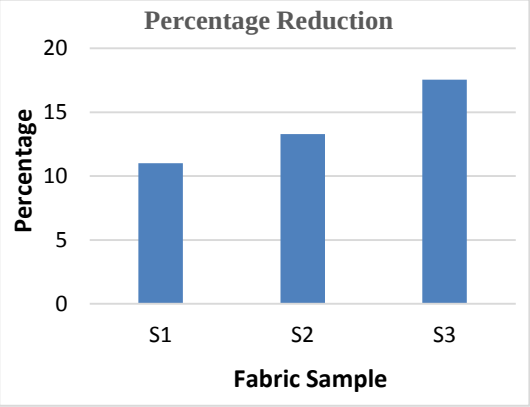

Figure 12 -2 Reduction in seam strength

Above figure 12 reveals that, the seam strength of the S3 sample is highest before finishing. This is because the least flexural rigidity of S3 sample enhances the fabric seam strength. However, it is found to be lowered by 11 % after resin finishing. After resin finishing treatment, sample S2 and sample S3 exhibit a comparable decrease trend. The stiffness of all fabrics improves after the resin treatment, preventing seam development during sewing. According to statistical analysis, there is a significant difference in seam strength of fabric of three distinct cover factors before and after the resin finish, as evidenced by P values of 1.3811E-16 and 1.5834E-17.

f. Fabric Drape –

The fabric samples were tested for fabric drape and the obtained results are tabulated in the following Table 9.

Table 9 - Drape of fabric samples before and after finishing process

Fabric Samples	S1	S2	S3
Before Finish	54.83	48.97	38.65
After Finish	58.82	53.37	42.57
Percentage Increase	7.27	8.98	10.15

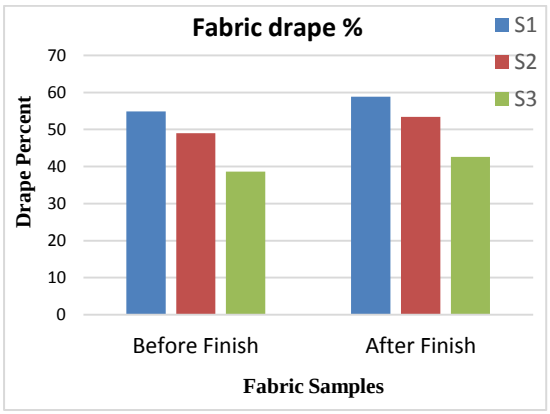

Figure 3 Fabric Drape

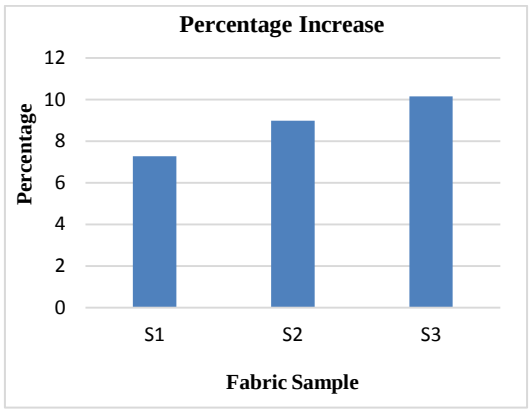

Figure 4 Increase in Fabric Drape

Above Table 9 and figure 14 reveals that, the fabric drape increases with fabric resin finishing process due to the increased yarn stiffness. Figure 15 shows that after resin finishing, with reduction in fabric cover the percentage increase fabric drape is higher. This is because of the increased resin absorption in less cover factor fabric.
According to statistical analysis, there is a significant difference in the fabric drape of three separate cover components before and after the resin finish, as evidenced by 'P' values of *0.00086621* and *0.00367312*, both of which are less than 0.05.

g. Durable-Press rating of fabric –

The fabric samples were tested for fabric DP rating and the obtained results are tabulated in the following Table 10.

Table 10 - DP rating of fabric samples

DP rating of Fabric			
Fabric Samples	**S1**	**S2**	**S3**
DP rating of fabric	2.5	3.15	3.5

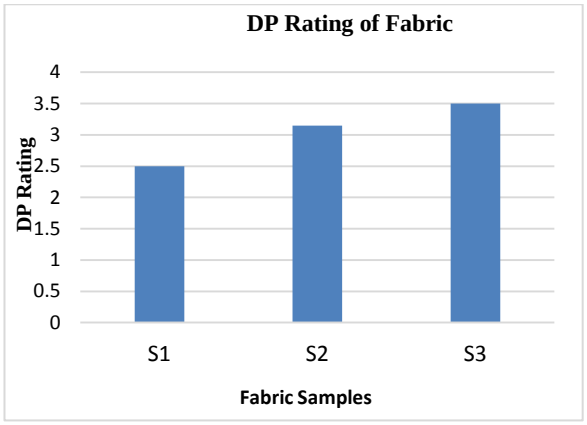

Figure 5 - Fabric Drape

Above Table 10 and figure 16 shows that, after the resin finishing process the Durable press rating value of the fabric increases with the reduction of fabric cover factor. This is because with reduction in fabric cover the resin absorption increases resulting to the increase in cross links between the cotton molecules which helps in recovery of fabric creases.

4. Conclusions

According to the findings, the tensile strength of cloth reduces as the cover factor falls. This is true both before and after resin finishing. Fabric with a resin finishing treatment has a lower elongation percentage. Before resin finishing, the tear strength of the fabric improves as the cover factor decreases, the tendency stays the same for after resin finishing treatment. With a lower cover factor, the fabric's crease recovery angle improves. Fabric with

a resin finishing treatment has a higher flexural stiffness. After the resin finishing process, the fabric seam strength decreases. The resin finishing treatment improves cloth drape. As the fabric cover factor diminishes, the cloth drape reduces. This tendency is observed both before and after resin finishing. The fabric DP rating rises as the cover factor is reduced. The same trend is followed for the fabric samples both before and after the resin finishing treatment.

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