

Reduction of Fibrillation of Lyocell Knitted Fabric with Defibrillator Process

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ABSTRACT - Fibrillation of lyocell i.e. regenerated cellulosic fibers occurs during its wet processing and usage. This leads to consumer dissatisfaction due to pilling or appearance after repeated home laundering. Fibrillation is the splitting of fibril bundles and its subsequent exposure to the fiber surface. The fibrillation tendency of lyocell fabrics and the degree of fibrillation of lyocell fabrics, can be reduced by either doing wet processing in open width form followed by treating with a cross-linking agent or by enzymatic treatment. In this research study, orthogonal experiments were carried out with a new defibrillator process, considering full factors to invent the low fibrillated Birla Cellulosic Lyocell knitted fabric. We examined various parameters like Bursting strength, Pilling, fibrillation tendency after repeated home washing and fabric hand feel of defibrillator untreated and treated samples. By full factors experiment, it was found that by optimizing the defibrillator process, it is operated successfully having almost clean fabric surface even after repeated home washing with excellent hand feel without affecting the fabric strength.

Keywords: Lyocell knitted fabric, Defibrillator process, Pilling, hand feel, Fabric bursting strength, Home washing etc.

1 INTRODUCTION

Lyocell fibers, produced by cellulose solution in N methyl morpholine N-oxide (NMMO) hydrate[1], attracts much attention owing to better drape and mechanical properties in wet state than other cellulose fibers[2]. Lyocell, a novel cellulosic fiber, has superior mechanical properties along with Sustainability factors [3]. Nevertheless, in some applications, its fibrillation behavior is considered to be a drawback [4]. This behavior can be easily measured by the so-called fibrillation index [5], which is a value indicating the degree of fibrillation. Fibrillation of lyocell fabrics occurs during its wet processing and usage[6]. This leads to consumer fabric dissatisfaction phenomenon such as pilling [7]. Fibrillation is the splitting of fibril bundles and its subsequent exposure to the fiber surface [8]. When abraded in the wet state, these exposed fibrils may form aggregates (as pills) on the fiber surface or break away as lint. This also causes problems during dyeing and finishing processes [9].

Basically fibrillation can be controlled by either doing wet processing in open width form followed by treating with a cross-linking agent or by enzymatic treatment[10]. A novel approach for reducing the fibrillation is a mechanical process where in the lyocell fabric is treated mechanically with or without chemicals [11].

In this paper, a through and systematic study is carried out to compare impact of mechanical process i.e. defibrillator process to get reduced fibrillation in Birla lyocell knitted fabric with best optimum bursting strength, soft hand feel. The fabric utility parameters are also examined against the untreated fabric lyocell fabric.

2 MATERIALS AND METHODS

2.1 Materials and Sample Preparation

Knitted 100% Birla lyocell fabric with spandex was considered for the experiment. The specifications of the grey fabric is listed in Table 1.

Parameter	100% Birla Lyocell with Spandex knitted greige fabric
Material	40s Lyocell + 20D Spandex
Yarn Technology	Ring
WPI x CPI	32 x 96
Weave	Single Jersey

GSM (gms /sq. mt)	190
% Fabric Blend	Lyocell/Spandex 95/5

TABLE 1 SPECIFICATION OF THE FABRICS

2.2 Experimental Process Sequence

Figure 1 shows the Experimental process sequence followed in this experiment.

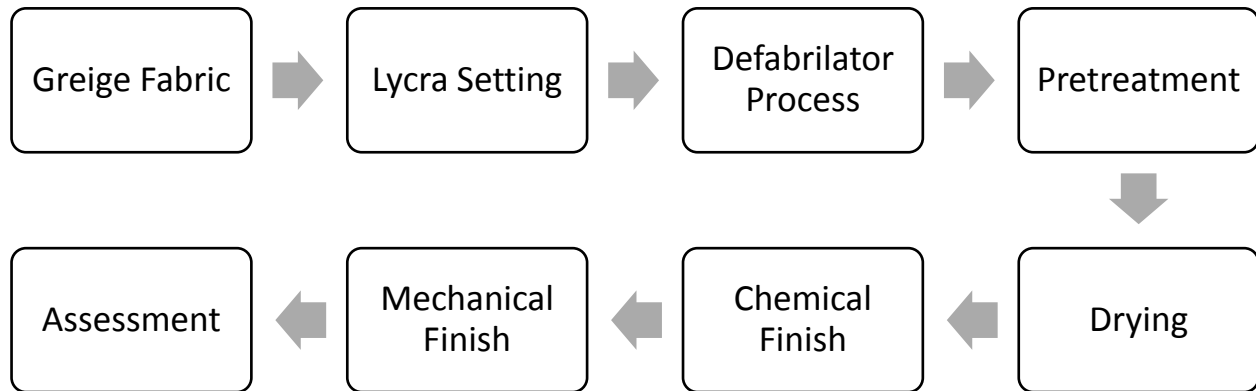


FIGURE 1: OPTIMISED PROCESS SEQUENCE

Lyocra setting process was done on stenter machine, Defibrillation process on Biancalani defibrillator machine (Aquaria), all the wet treatments were done on soft flow dyeing machine, drying & chemical finish on the stenter and mechanical finish on knit compaction machine.

Recipes and conditions are shown in the table 2.

Sr. No.	Process	Condition
1	Lyocra Setting	At 195 -200° C for contact time of 50-60 seconds.
2.	Defibrillation process	Wetting agent – 1-2%, Alkali– 30gpl, Temp – 70° C, followed by enzymatic defibrillation at 55° C with cellulose based enzyme, followed by Washing. Contact time - 25 mins,
3	Pretreatment	Washing agent – 1%, Sequester – 1%, Lubricant – 1%, Peroxide Stabilizer – 0.4%, Soda ash – 2%, Hydrogen Peroxide (50%) – 2%, Temp – 85° C, Time – 30 mins, followed by Washing
4	Drying	110-120° C
5	Chemical Finish	Resin Finish : Cross linking agent – X gms/lit, Catalyst – 1/5 th of the Cross linker quantity, Poly ethylene emulsion – 10- 30 gms/lit , Micro Silicone Softener – 10 - 30 gms/lit, Macro Silicone Softener – 10-30 gms/lit, dry at 110-120° C followed by curing at 160-170° C for 30-40 seconds contact time

		Soft Finish : Poly ethylene emulsion – 10 - 30 gms/lit , Micro Silicone Softener – 10 - 30 gms/lit, Macro Silicone Softener – 10 – 3- gms/lit, dry at 110-120° C
6	Mechanical Finish	Blanket pressure – 4-6 kg, speed 20 – 30 mtr/min

TABLE 2 PROCESS RECIPE AND CONDITIONS USED

The greige fabrics, ready for finishing fabrics and final finish fabrics were evaluated for fabric quality norms like Pilling, Bursting strength, surface appearance, hand feel etc.

3 RESULTS AND DISCUSSIONS

3.1 Physical Fabric Testing

In order to evaluate the impact of defibrillator process on the lyocell knitted fabric, fabric testing of greige, and ready for finishing and finish fabrics were carried out. Table 3 shows the results of all fabrics.

Test	Greige	Ready for Finishing		Final finish			
				Soft Finish		Resin Finish	
		Without Defibrillate process	With Defibrillate process	Without Defibrillate process	With Defibrillate process	Without Defibrillate process	With Defibrillate process
WPI x CPI	48 x 64	52 x 68	54 x 70	52 x 66	54 x 70	52 x 66	54 x 72
GSM in gms	195	215	220	210	218	213	221
Bursting strength in PSI	61.5	58.4	56.6	57.1	56.1	52.3	51
Martindale pilling@ 500 Rev	1	1	3-4	1	3	3-4	4-5
Martindale pilling@ 1000 Rev	1	1	3-4	1	3	3-4	4-5
Martindale pilling@ 2000 Rev	1	1	3-4	1	3	3-4	4-5
%abrasion Weight loss@2000 Rub	1.2	1.5	1.0	1.4	0.9	1.2	0.9

TABLE 3 FABRIC TESTING VALUES

From the table 3, it is seen that

1. Defabrillator process fabrics are showing drastic improvement in pilling rating i.e. 3 in soft finish and 4-5 in resin finish, compare to without defibrillator process fabrics i.e. 1 in soft finish and 3-4 in resin finish even upto 2000 revolution.
2. Defabrillator process fabrics are showing least abrasion weight loss compare to without defibrillator process fabrics
3. Defabrillator process fabrics are showing comparable bursting strength compare to without defibrillator process fabrics

3.2 Fabric surface appearance

In order to check the impact of defibrillator process on the lyocell knitted fabric, fabric surface appearance was visually evaluated. The images are shown in figure 2.



Before Defibrillator Process after Defibrillator Process

FIGURE 3: IMPACT OF DEFIBRILIATOR PROCESS ON LYOCELL FABRIC SURFACDD

From the figure 3, it is seen that, defibrillator process fabrics showing clean fabric surface even after 20 home laundering washes whereas without defibrillator process fabrics are showing heavy hairiness and fibrillation even at unwashed rigid stage.

3.3 Fabric hand feel evaluation

A subjective blind test was carried out with group of persons for the hand feel i.e. softness, smoothness and drape of finish fabrics. Based on the outcome, it is found that defibrillator processed fabrics are softer, smoother and fluid compare to untreated fabrics even after 20 home laundering washes.

4 CONCLUSIONS

The following inferences are drawn from the above experiment,

1. Defibrillator process fabrics are softer, fluid and smoother compare to untreated fabrics.
2. Defibrillator process fabrics show clear fabric surface even after 20 home laundering washes.
3. Defibrillator treated fabrics showing comparable bursting strength to untreated fabrics.
4. Least abrasion weight loss found in defibrillator processed fabrics.
5. Defibrillator processed fabrics are pill free even upto 2000 rub cycle.

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