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Investigation of the Fibre Loss Effect of Raised 3-Thread Fleecy Fabric

Şardonlu 3 İplik Futter Kumaşlarda Lif Dökülme Etkisinin Araştırılması

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INVESTIGATION OF THE FIBRE LOSS EFFECT OF RAISED 3-THREAD FLEECY FABRIC

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ABSTRACT: In the study, it was aimed at investigation of the fibre loss performance effects of the 3-thread fleecy raised fabric. With this aim, various samples were obtained by changing the Fleecy-Yarn fibre content, the Face-yarn type, the number of Fleecy-Yarn floating, the Fleecy-Yarn pile length, and finishing process called as main parameters. After the raising process, the raising fastness (in-house term) of these fabrics were evaluated. After tests, the data were statistically analysed by variance analysis (ANOVA) to determine the effect of the main parameters on the fibre loss performance of these raised fabrics. The results showed that Fleecy-Yarn fibre content and finishing process were statistically significant. Consequently, it was determined these parameters could be considered to reach better raising fastness.

Keywords: 3-thread fleecy fabric, fiber loss, raising process, raising fastness

ŞARDONLU 3 İPLİK FUTTER KUMAŞLARDA LİF DÖKÜLME ETKİSİNİN ARAŞTIRILMASI

ÖZET*:* Bu çalışmada, şardonlu 3 iplik futter kumaşlarının lif dökülme durumunun araştırılması amaçlanmıştır. Bu amaçla; arka iplik elyaf içeriği, ön iplik tipi, arka iplik atlama sayısı ve arka iplik hav uzunluğu ve farklı terbiye işlemleri ana parametre olarak belirlenmiş ve çeşitli numuneler elde edilmiştir. Daha sonra, bu numunelerin şardon haslıkları (kurum içi standart) ölçülmüştür. Testlerden sonra, ana parametrelerin şardon lifi dökülme performasına etkisini belirlemek için varyans analizi (ANOVA) ile istatistiksel olarak analiz yapılmıştır. Sonuçlar, arka iplik elyaf içeriği ve terbiye işleminin istatistiksel olarak anlamlı olduğunu göstermiştir. Sonuç olarak, daha iyi şardon haslığı sonuçları elde etmek için bu parametrelerin göz önüne alınabileceği belirlenmiştir.

Anahtar kelimeler: 3 iplik futter kumaş, şardon, lif dökülmesi, şardon haslığı,

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1. INTRODUCTION

Fleece is one of the oldest knitted fabric designs which still command huge popularity in today's modern fashion world. It has the unique characteristics of being warm, easy too care, easy to sew, washable and hang to dry. Recently, 2- thread and 3-thread fleecy fabric has been used for sports and outdoor cloths thanks to their good thermal comfort lower air permeability and cold protection.

Two-thread fleecy and three-thread fleecy fabrics are mainly produced on plain circular knitting machines. On the technical back side of these fabrics yarn floats along the rows and is inlay tucked at intervals into the fabric base. Such yarns are called back or fleecy yarns.

In the three-thread fleecy fabric structure, the fleecy yarn is invisible on the technical front even when using yarns with different thickness. The structure is composed of fleecy yarn, binding yarn and face yarn. These knitted fabrics are usually obtained by using thicker fleecy yarn with the same thickness of front and binding yarn. (Figure 1)

In addition to the above-mentioned advantages, the biggest disadvantage of these fabrics is high amount of fiber loss after raising process. When consumer used garment made from these raised fabrics, this high amount fiber loss causes attachment of the fiber on the body or staining the other cloths. This problem affects consumer comfort negatively. In order to identify this problem, the term "raising fastness" is used (In-house term for LCW)

In literature, it was encountered a few studies on 2-thread and 3-thread fleecy raised fabric, which are related to the thermal comfort properties, weight loss depending on fibre blend in the Fleecy-Yarn, twist effect of the Fleecy-Yarn, air permeability, changes of the burst strength and tensile strength of the fabric [2-7]. However, it was not observed any studies about fibre loss performance 3-thread fleecy raised fabric.

Hence, in this study, it was aimed at investigation of the effects some working and structural parameters on the fibre loss performance (raising fastness) of the 3-thread fleecy raised fabrics. For this reason, several samples were gained by changing the Fleecy-yarn fibre content, the Fleecy-yarn pile lengths, the Face-yarn, the number of Fleecy-yarn floating, and finishing process. After the raising process of these samples, the raising fastness (in-house) of these fabrics was assessed. Then, these data were statistically analysed by variance analysis (ANOVA) to define the effect of the main parameters on the fibre loss performance of the 3-thread fleecy raised fabrics.

2. MATERIAL AND METHOD

2.1. Material

In the study, thirty-two samples were obtained by full factorial experimental study given in Table 1. It can be seen that two different face yarns (30/1 Ne compact and combed ring), four different fleecy yarn fibre content, two different the Fleecy-Yarn pile lengths (tight-loosely) and two different the number of Fleecy-Yarn floating (2-4 yarn) were accepted as parameters in the study. The yarn counts of the fleecy fabric were 30/1 Ne for face yarn (Fly), 70 den for binding yarn (By) and ,14/1 Ne for the fleecy yarn (Fly).

2.2. Method

18 different wet processes were applied to these fabrics by using different combinations of standard 3 thread fleecy fabric finishing processes. The applied finishing processes and combinations are given in Table 2. The application conditions of these processes are shown in Tab. 2 - 4 and Fig.2-4.

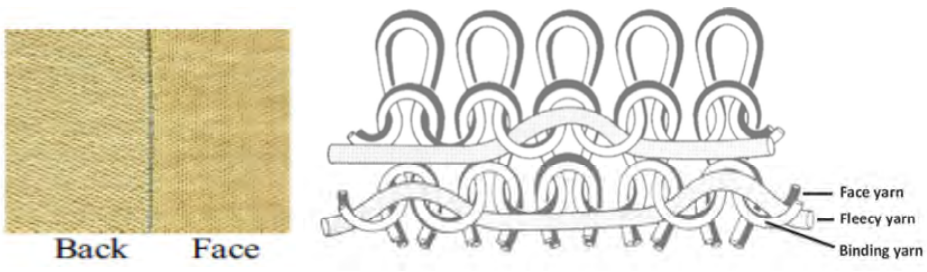

Figure 1. 3-Thread Fleecy Fabric Structure [1]

Table 1. Technical Properties of the Used Fabrics

Fabric Number	Fleecy-Yarn Fibre Content	Face- Yarn	Fleecy-Yarn Floating	Fleecy-Yarn Pile Length	Length of 100 wales in cm Fy/By/Fly	GSM (g/m^2) of the fabric
Raw Fabric 1	H1	Combed Ring	2 yarn	tight	44/28/17	295
Raw Fabric 2	H2	Combed Ring	2 yarn	tight	44/28/17	295
Raw Fabric 3	H3	Combed Ring	2 yarn	tight	44/28/17	295
Raw Fabric 4	H4	Combed Ring	2 yarn	tight	44/28/17	295
Raw Fabric 5	H1	Compact	2 yarn	tight	44/28/17	295
Raw Fabric 6	H2	Compact	2 yarn	tight	44/28/17	295
Raw Fabric 7	H3	Compact	2 yarn	tight	44/28/17	295
Raw Fabric 8	H4	Compact	2 yarn	tight	44/28/17	295
Raw Fabric 9	H1	Combed Ring	4 yarn	tight	44/34/19	300
Raw Fabric 10	H2	Combed Ring	4 yarn	tight	44/34/19	300
Raw Fabric 11	H3	Combed Ring	4 yarn	tight	44/34/19	300
Raw Fabric 12	H4	Combed Ring	4 yarn	tight	44/34/19	300
Raw Fabric 13	H1	Compact	4 yarn	tight	44/34/19	300
Raw Fabric 14	H2	Compact	4 yarn	tight	44/34/19	300
Raw Fabric 15	H3	Compact	4 yarn	tight	44/34/19	300
Raw Fabric 16	H4	Compact	4 yarn	tight	44/34/19	300
Raw Fabric 17	H1	Combed Ring	2 yarn	loosely	44/28/18	305
Raw Fabric 18	H2	Combed Ring	2 yarn	loosely	44/28/18	305
Raw Fabric 19	H3	Combed Ring	2 yarn	loosely	44/28/18	305
Raw Fabric 20	H4	Combed Ring	2 yarn	loosely	44/28/18	305
Raw Fabric 21	H1	Compact	2 yarn	loosely	44/28/18	305
Raw Fabric 22	H2	Compact	2 yarn	loosely	44/28/18	305
Raw Fabric 23	H3	Compact	2 yarn	loosely	44/28/18	305
Raw Fabric 24	H4	Compact	2 yarn	loosely	44/28/18	305
Raw Fabric 25	H1	Combed Ring	4 yarn	loosely	44/34/20	310
Raw Fabric 26	H2	Combed Ring	4 yarn	loosely	44/34/20	310
Raw Fabric 27	H3	Combed Ring	4 yarn	loosely	44/34/20	310
Raw Fabric 28	H4	Combed Ring	4 yarn	loosely	44/34/20	310
Raw Fabric 29	H1	Compact	4 yarn	loosely	44/34/20	310
Raw Fabric 30	H2	Compact	4 yarn	loosely	44/34/20	310
Raw Fabric 31	H3	Compact	4 yarn	loosely	44/34/20	310
Raw Fabric 32	H4	Compact	4 yarn	loosely	44/34/20	310

The Fleecy-Yarn fibre contents in the study were given in below.
H1: 50% Cotton+ %50 Polyester (14/1 Ne Open-end)
H2: 50% Waste cotton +50% Polyester (14/1 Ne Open-end)
H3: 25% Cotton+ 25% Waste cotton+50% Polyester (14/1 Ne Open-end)
H4: 50% Cotton+ %50 Polyester (14/1 Ne Ring)

Table 2. The Applied Process and Combinations

No	Code	Pre-treatment and dyeing	Finishing
P01	01A	Raw fabric	Compacting
P02	01B	Raw fabric	Raising+Compacting
P03	01C	Raw fabric	Raising+2nd softening+ Compacting
P04	02A	Bleaching	Compacting
P05	02B	Bleaching	Raising+Compacting
P06	02C	Bleaching	Raising+2nd softening+ Compacting
P07	03A	Bleaching+ Cellulase enzyme	Compacting
P08	03B	Bleaching+ Cellulase enzyme	Raising+Compacting
P09	03C	Bleaching+ Cellulase enzyme	Raising+2nd softening+ Compacting
P10	04A	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant	Compacting
P11	04B	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant	Raising+Compacting
P12	04C	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant	Raising+2nd softening+ Compacting
P13	05A	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant+ Cotton Dye and Washing	Compacting
P14	05B	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant+ Cotton Dye and Washing	Raising+Compacting
P15	05C	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant+ Cotton Dye and Washing	Raising+2nd softening+ Compacting
P16	06A	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant+ Cotton Dye and Washing+ Pre-softening	Compacting
P17	06B	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant+ Cotton Dye and Washing+ Pre-softening	Raising+Compacting
P18	06C	Bleaching+ Cellulase enzyme+ PES dyeing and Reductant+ Cotton Dye and Washing+ Pre-softening	Raising+2nd softening+ Compacting

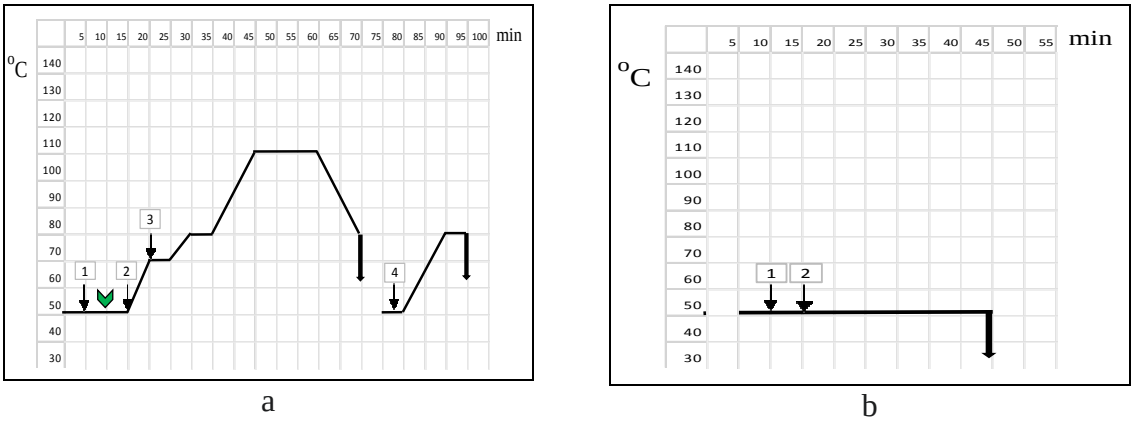

Figure 2. a. bleaching Recipe and Graphic b. Cellulase Enzyme Recipe and Graphic

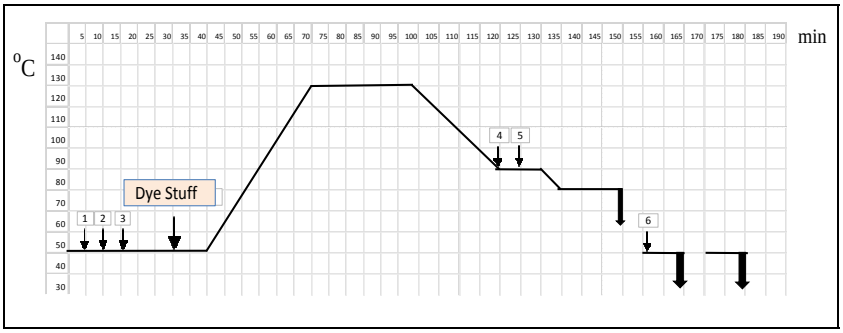

Figure 3. PES Dyeing and Reductive washing and Graphic

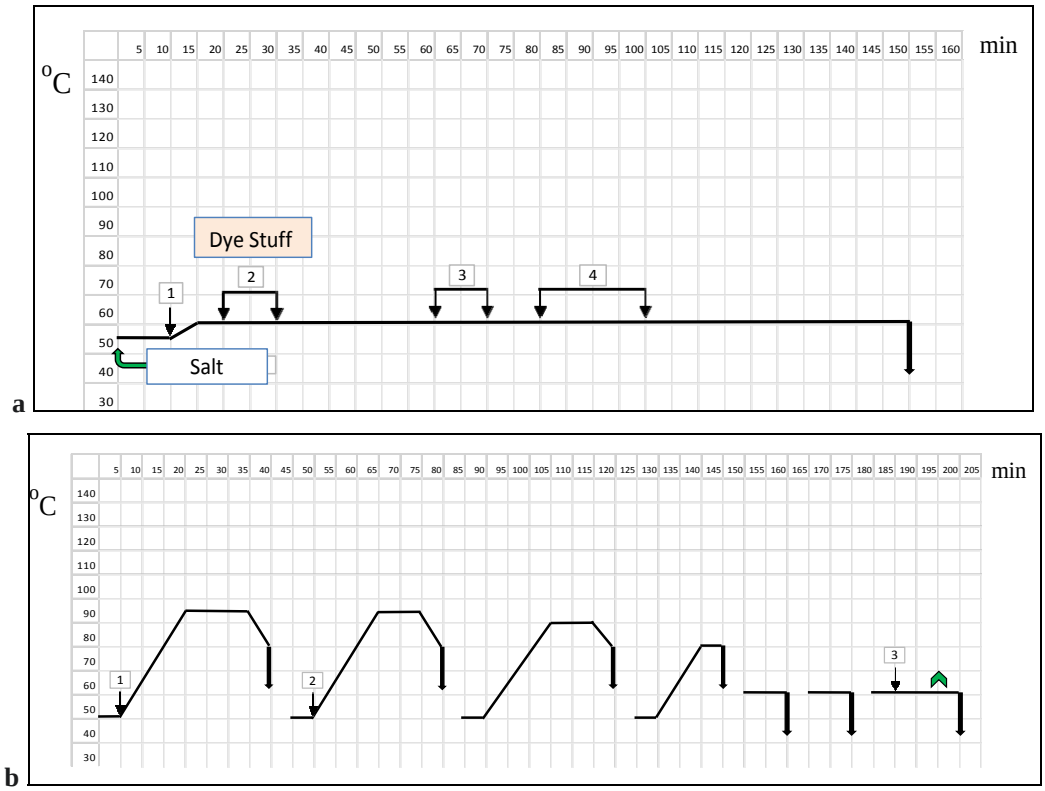

Figure 4 a. Cotton Dyeing Recipe and Graphic **b.** Reactive Dye Washing Recipe and Graphic

Table 3. Presoftening Recipe and Machine's Parameters

Pre-softening	Stenter parameters
125 g/L	pick -up (wet on wet) % 20-30
30 g/L Cationic fixator	width: 180 cm
1 g/L acetic acid	feeding: 40%
	temperature: 130°C
	speed: 15/min

Table 4. The working parameter of finishing processes

Raising	2nd Softening	Compacting
Main drum 1: 15 m/min	Pick-up %80-100	Width: 180 cm
Main drum 2: 15 m/min	50 g/L silicone	Feeding: 17
Fabric speed: 15m/min	Ph: 4.5-5.5	Speed: 20 m/min
Pile raising: 1.1	Width: 180 cm	
Counterpile: 1.3	Feeding: 40	
	Temperature: 130 ℃	
	Speed: 15 m/min	

2.3. Analytical Methods

After whole applications, the samples were tested for the raising fastness. This test was applied according to in- house LCW KMS05 method. According to this method, the raised side of the fleecy fabric and the reference weaved fabric are rubbed together and the level of hair (fibre) is determined on the weaved fabric.

Optical white, carbon brush fabric (40/1-40/1 poplin 52/48, 100% cotton), is used as the top cloth in the test as reference. Then, the raised fabric to be tested is tested in 5 rounds in the Martindale Pilling Tester.

Finally, samples are evaluated by using scale. If the score is 3 or more over the 4-point scala, the test is considered as passed. The test evaluation replicates are given in Fig. 5.

The data were statistically analysed by variance analysis (ANOVA) to determine the effect of the main parameters on the fibre loss performance of these raised fabrics.

3. RESULTS AND DISCUSSION

The SEM images from the study showed that raising process is enormously effective on fleecing of the fibre on the 3-thread fleecy structure regardless of fabric faces and finishing processes (Fig. 6). Moreover, it was encountered that each end of some fibre was separated from the fabric structure so fibre loss and staining was observed.

Figure 5. The Scala of Raising Fastness

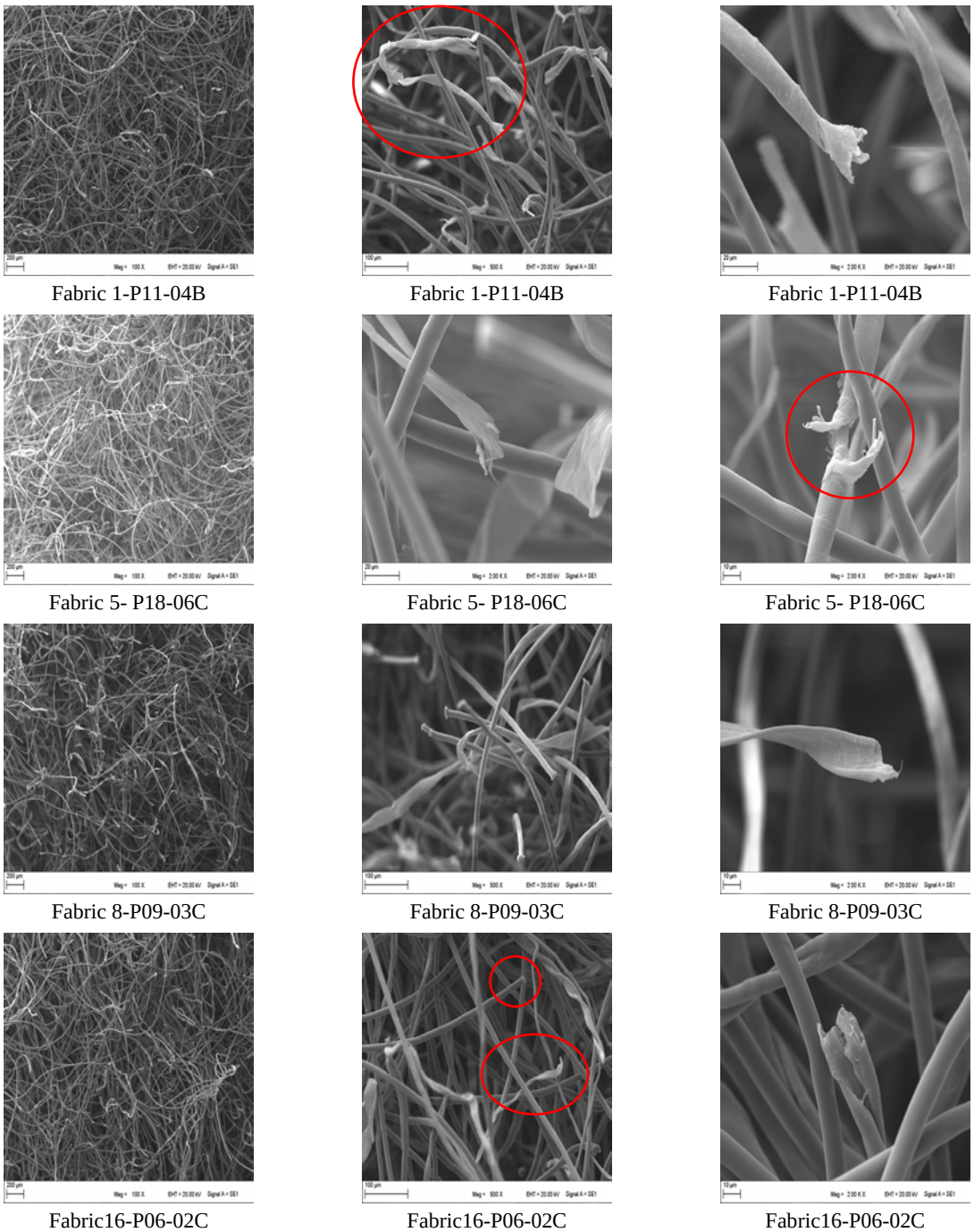

Fig 6. SEM images of the raised fabric with different finishing process

The variance analysis results of the fabrics were given Table 5.

Table 5. The variance analysis of the fabrics on raising fastness

Source	F Value	p-value	
Model	19,1115	< 0.0001	significant
A-Fleecy-Yarn fibre content	41,4127	< 0.0001	significant
B-Face yarn	7,4179	0.0068	significant
C- The number of Fleecy-Yarn floating	1,3048	0.2541	insignificant
D-Fleecy-Yarn pile length	0,8544	0.3560	insignificant
E-Finishing process	35,4227	< 0.0001	significant
AC-interaction between A and C	6,1271	0.0005	significant

It was seen that the model was significant statistically and A, B and E in the main parameters were significant. The analysis of variance (ANOVA) showed that the Fleecy-Yarn fibre content and the finishing process were more effective on the fibre loss of the fabrics. Moreover, it was observed that C was not significant singly while AC interaction was significant depending on fibre content of the Fleecy-Yarn. The best result is observed in H2 content while H4 content is worst. The normal distribution of the data was given in Fig. 7.

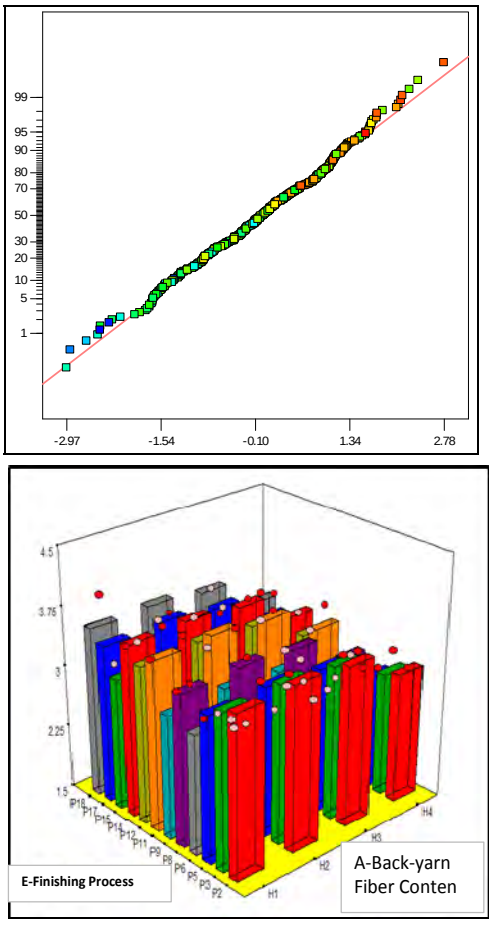

Figure 7. Normal Distribution Graph of The Raising Fastness Data and 3D Model Graph of The Raising Fastness Data

According to the 3D model graph (Fig. 7), it was seen that the Fleecy-Yarn fibre content was the most effective than the other parameters. the fibre content 1 and the fibre content 2 of the Fleecy-Yarn had the best results in terms of the raising fastness while the fibre content 4 was the worst. The finishing process was the second effective parameters on the fibre loss performance of the fabric. The detailed investigation on the finishing process, the bleaching, the enzymatic treatment, the PES dyeing, and the cotton dyeing processes were not significant on the fibre loss of the fabric singly. The effect of the face yarn on the fibre loss of the fabric were less, the fabrics with the compact face yarn showed better raising fastness. The number of Fleecy-Yarn floating, and the Fleecy-Yarn pile lengths were not effective on the raising fastness.

4. CONCLUSIONS

Consequently, it was seen that the fibre content 1 and the fibre content 2 of the Fleecy-Yarn had the best results in terms of the raising fastness while the fibre content 4 was the worst. As for the finishing process, it was seen that the softeners usage before and after raising process were effective on the fibre loss of the fabrics. In addition, it was seen that the Face- Yarn, the Fleecy-Yarn pile lengths and the number of Fleecy-Yarn floating, and the other finishing process were not effective.

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