INVESTIGATION OF SLUB YARN PARAMETERS AND INFLUENCE ON FABRIC COMFORT BEHAVIOR

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ABSTRACT

Slub fancy yarn is widely used in the textile industry in order to produce a primarily denim fabric, clothing and upholstery fabric. Apart from those mentioned, it is being used in wide range of applications such as furnishing industry, home textiles, handy craft industry, woollen knitting industry for creating eye catching designs in fabric. It is known that the main descriptive parameters of slub yarn (slub length, slub distance, slub multiplier, base yarn count, twist level etc.) have an effect on the strength and elongation performance of the yarn as well as fabric. The main aim of this project is to study the properties of yarn and fabric (Mechanical and low stress mechanical properties) and to analyse the effect of yarn linear density, effect of slub length on fabric properties by conducting series of tests in both the stages (in both yarn and fabric stages) and to find the suitable application (Sheeting fabric).

Keyword : *slub yarn, elongation, low stress mechanical properties, yarn linear density, slub multiplier*

1. INTRODUCTION

Slub fancy yarn is widely used in the textile industry in order to produce a primarily denim fabric, clothing and upholstery fabric. Apart from those mentioned, it is being used in wide range of applications such as furnishing industry, home textiles, handy craft industry, woollen knitting industry for creating eye catching designs in fabric. It is known that the main descriptive parameters of slub yarn (slub length, slub distance, slub multiplier, base yarn count, twist level etc.) have an effect on the strength and elongation performance of the yarn as well as fabric. In literatures there have been a few studies investigating the effect of slub parameters on fabric properties. In one of the literature reviews of topic effect of slub yarn descriptive parameters & yarn linear density on upholstery fabric abrasion resistance was studied. Slub yarn samples produced using the compact ring spinning system. Slub yarn used as the weft in woven fabric. The main aim of this project is to study the properties of yarn and fabric (Mechanical and low stress mechanical properties) and to analyse the effect of yarn linear density, effect of slub length on fabric properties by conducting series of tests in both the stages (in both yarn and fabric stages) and to find the suitable application (Sheeting fabric).

2. BACK GROUND OF THE WORK

Slub yarn parameters were measured by using a capacitance-type sensor, and data was expressed as voltage signals through a data acquisition card (DAQ) installed in a PC (1), consequently, a repetition pattern of the slub yarn was determined by analyzing the 2D image using cluster analysis with an amended similarity-based clustering method. To achieve the minimum fabric abrasion with an optimization process on selected control factors of slub yarn descriptive parameters such as slub length, slub distance and slub thickness and yarn linear density (2). To analyze the influence of slub yarn structure on air permeability of woven fabrics. Slub length, slub distance, amplitude of slub and yarn linear density were used as control factors to produce slub yarns with varying properties according to Taguchi L9 orthogonal design. Twill 1/3 woven fabrics were produced with these slub yarns and air permeability results were statistically analysed. Optimum yarn parameters were determined for air permeability which was considered as nominal-the-better property according to the end-use purposes of the fabric. The analysis results showed that slub thickness had the most significant effect on air permeability (3). Slub yarn which is manufactured on a spinning frame having a mechanism to speed up or slow down its roller speed from time to time. In a research work it was theoretically discuss what happens to roller drafting when a roller speed is changed from time to time and found that the formation of the slub portion occurs somewhat later than the change in the roller speed. The correlation among such factors as the size and length of slub portion, the staple fiber length of fed sliver, and the duration of speed-change in the roller has been experimentally computed. Various characteristics of the slub portion, such as the distribution of its twist, its quantitative distribution, its strength and elongation have been experimentally computed (4). Theoretical study of the diameter distribution and the twist distribution along the slub length were established. The effects of the dynamical characteristics of the slub forming mechanism on both of slub diameter and twist distribution were investigated (5). Statistically significant descriptive parameters that have an effect on the breaking force and elongation of slub yarn has been studied using the full factorial design method. Slub yarn samples were produced by using a ring spinning frame on which an original slub attachment was designed and mounted. After the samples were produced, dimensional measurements and image analysis were made (6). The effect of some important parameters like base yarn twist level, number of base yarn, twist direction and injected fibre components on injected slub yarn performance in terms of tensile strength and breaking elongation. In case of single base slub yarn, final yarn tenacity and elongation increases with the reduction of base yarn twist level keeping final yarn twist multiplier constant. However, the effect of base yarn twist level is marginal in case of injected slub yarn made with double base yarn. Yarn tenacity and elongation significantly higher in case of double base injected yarns as compared to single base injected yarn(7). The overall yarn quality can be predicted Using artificial neural networks. The artificial neural network is trained to foresee only one response which is the Slub yarn quality index that includes all yarn responses. The definition of the yarn quality can be modified according to customer demands (8). A novel method for manufacturing a ring-spun slub yarn through multi-channel drafting using a computer numerically controlled (CNC) ring spinning frame. The study reveals that increasing the slub multiplier increases the breaking force and the breaking elongation of the yarn due to the twist transfer from the slub to the base yarn. The increase of the slub length stabilizes the twist distribution and thus increases the breaking force and breaking elongation of the yarn (9). Based on the analysis on the impact of slub fancy yarn parameters on the mechanical and physical properties of flat knitted fabrics, it was found that the slub/meter had the most influence on all studied properties. The friction and bursting performance of the fabrics are improved through increasing the yarn slub/meter while, it decreases fabric pilling performance (10).

3. MATERIALS AND METHODOLOGY

Table 1 Yarn used

1.	30's Ne VSF Compact spun slub yarn – Z twist
2.	40's Ne VSF Compact spun slub yarn – Z twist
3.	16's Ne Cotton Compact slub yarn – Z twist
4.	30's Ne Cotton Compact slub yarn – Z twist
5.	30's Ne Cotton Compact spun yarn – Z twist
6.	20's Ne Cotton Compact spun yarn – Z twist
7.	10's Ne Cotton Compact spun yarn – Z twist
8.	30's Ne VSF Compact spun yarn – Z twist
9.	40's Ne VSF Compact spun yarn – Z twist

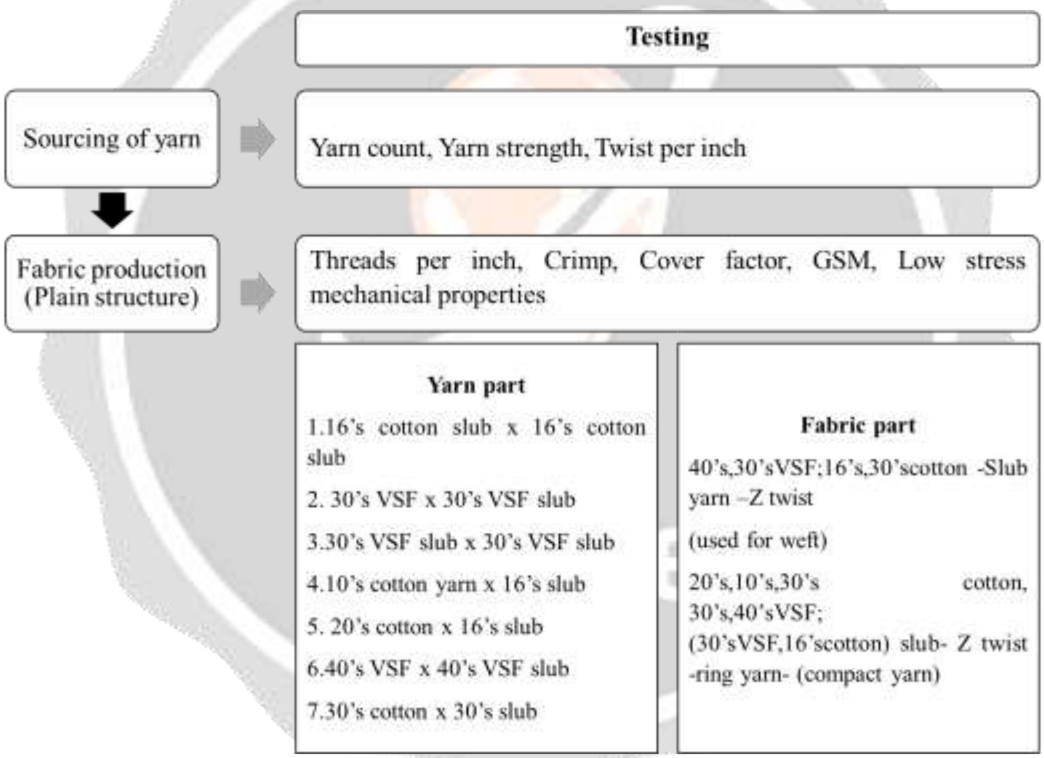
Table 2 Fabric produced pattern

S.NO	WARP	WEFT
1	16's Ne Compact spun slub yarn -Z twist	16's Ne Cotton Compact spun slub yarn -Z twist
2	30's Ne VSF Compact spun yarn -Z Twist	30's Ne VSF Compact spun slub yarn -Z twist

3	30’s Ne VSF Compact spun yarn -Z Twist	30’s Ne VSF Compact spun slub yarn -Z twist
4	10’s Ne cotton Compact spun yarn -Z Twist	16’s Ne Cotton Compact spun slub yarn -Z twist
5	20’s Ne cotton Compact spun yarn -Z Twist	16’s Ne Compact spun slub yarn -Z twist
6	40’s Ne VSF Compact spun yarn -Z Twist	40’s Ne VSF Compact spun slub yarn – Z Twist
7	30’s Ne cotton Compact spun yarn -Z Twist	30’s Ne Cotton Compact spun slub yarn -Z twist

3.1 METHODOLOGY

Initially, VSF Compact spun slub yarn and Cotton Compact spun yarn of different counts has been sourced. Fabric samples with the desired warp and weft have been produced in the Projectile loom. After that we are going to do series of tests in both yarn stage and fabric Stage. These tests are done to study the parameters (Mechanical and low stress Mechanical properties).



3.2 YARN TEST RESULTS

Count of yarn	Strength g/tex	TPI
16s Ne slub yarn	18	16
30s NeVSF	13	21
30s NeVSF slub	12	22
20sNe cotton yarn	16	18
10sNe cotton yarn	20	13
40 s Ne VSF	11	24
40s VSF slub	10	25

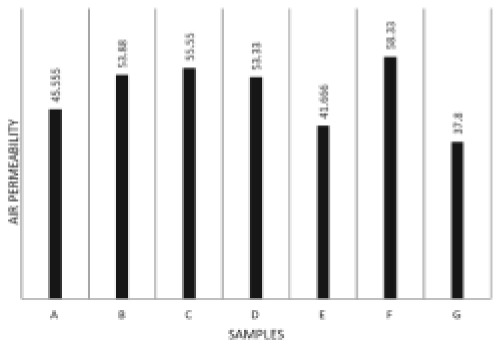
3.3 FABRIC PARTICULARS

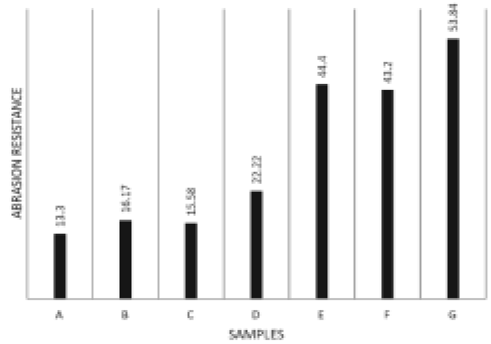
Sample code	Warp count (Ne)	Weft count (Ne)	Warp particular	Weft particular	EPI	PPI	GSM
A	16	16	COTTON SLUB	COTTON SLUB	50	42	400
B	10	16	COTTON	COTTON SLUB	42	36	400
C	20	16	COTTON	COTTON SLUB	76	39	400
D	30	30	VSF	VSF SLUB	68	58	200
E	30	30	VSF SLUB	VSF SLUB	70	56	200
F	30	30	COTTON	COTTON SLUB	72	52	200
G	40	40	VSF	VSF SLUB	69	57	200

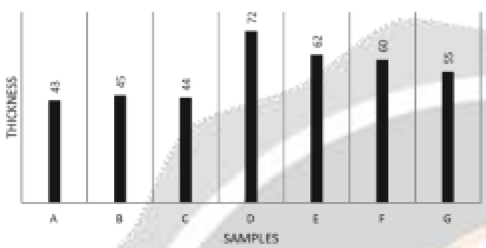
3.4 FABRIC MECHANICAL PROPERTIES

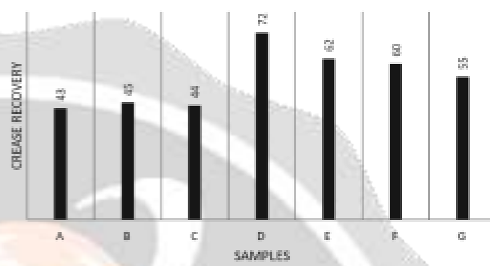
S.no	**Sample code**	**Thickness mm**	**Air Permeability ($cm^3/s/cm^2$)**	**Crease Recovery**	**Abrasion Resistance Wt loss %**	**Bending Length cm (warp)**	**Bending Length cm (weft)**	**Flexural rigidity(g)**	**Bending Modulus**	**Tearing strength (Warp way) Kg**	**Tearing strength (Weft way) Kg**	**Drape Coefficient**
1.	A	0.48	45.555	43	13.3	2.78	2.92	0.2003	0.0001869	44.6	44.3	57.35
2.	B	0.48	53.88	45	16.17	2.63	2.88	0.2132	0.0002884	47.2	43.1	61.01
3.	C	0.48	55.55	44	15.58	2.65	2.83	0.2421	0.0001154	48.3	44,7	62.8
4.	D	0.38	53.33	72	22.22	3.35	3.9	0.37416	0.000310177	39.2	36.6	54.21

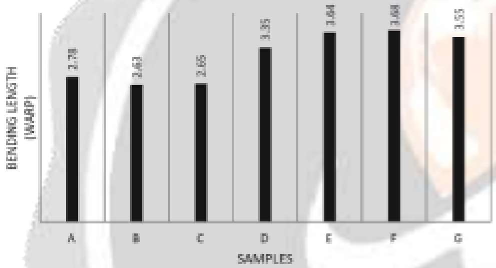
S.no	Sample code	Thickness mm	Air Permeability (cm^3/s/cm^2)	Crease Recovery	Abrasion Resistance Wt loss %	Bending Length cm (warp)	Bending Length cm (weft)	Flexural rigidity(g)	Bending Modulus	Tearing strength (Warp way) Kg	Tearing strength (Weft way) Kg	Drape Coefficient
5.	E	0.38	41.666	62	44.4	3.64	4.12	0.41079	0.000459622	41.7	37.1	57.21
6.	F	0.38	58.33	60	43.2	3.68	4.53	0.43162	0.00047406	43.2	38.3	56.41
7.	G	0.33	37.8	55	53.84	3.55	3.76	0.637	0.0002127	37.3	32.1	34.21

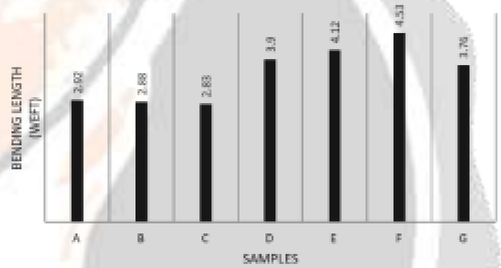

AIR PERMEABILITY
45.555
53.88
55.55
53.33
41.666
58.33
37.8
A
B
C
D
E
F
G
SAMPLES

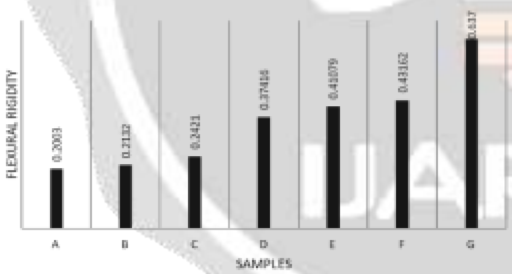

ABRASION RESISTANCE
13.3
16.17
15.58
22.22
44.4
43.2
53.84
A
B
C
D
E
F
G
SAMPLES

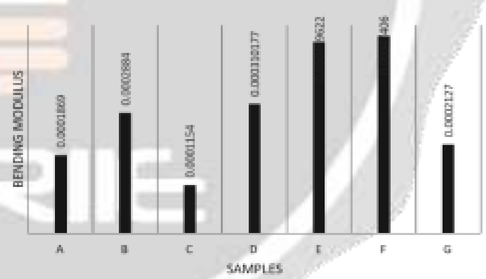

THICKNESS
43
45
44
72
62
60
55
A
B
C
D
E
F
G
SAMPLES

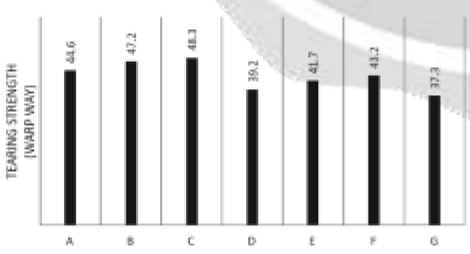

CREASE RECOVERY
43
45
44
72
62
60
55
A
B
C
D
E
F
G
SAMPLES

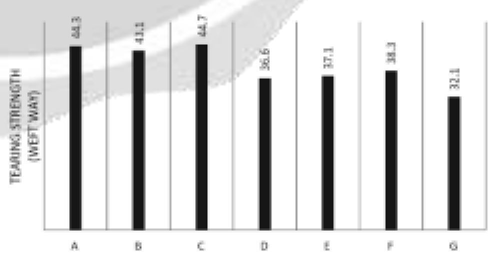

BENDING LENGTH (WARP)
2.78
2.63
2.65
3.35
3.64
3.68
3.55
A
B
C
D
E
F
G
SAMPLES

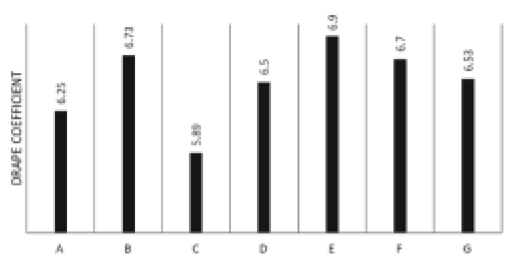

BENDING LENGTH (WEFT)
2.92
2.88
2.83
3.9
4.12
4.53
3.76
A
B
C
D
E
F
G
SAMPLES


FLEXURAL RIGIDITY
0.2003
0.2132
0.2421
0.37416
0.41079
0.43162
0.637
A
B
C
D
E
F
G
SAMPLES


BENDING MODULUS
0.0001869
0.0002884
0.0001154
0.000310177
0622
406
0.0002127
A
B
C
D
E
F
G
SAMPLES


TEARING STRENGTH (WARP WAY)
44.6
47.2
48.3
39.2
41.7
43.2
37.3
A
B
C
D
E
F
G
SAMPLES


TEARING STRENGTH (WEFT WAY)
44.3
43.1
44.7
36.6
37.1
38.3
32.1
A
B
C
D
E
F
G
SAMPLES

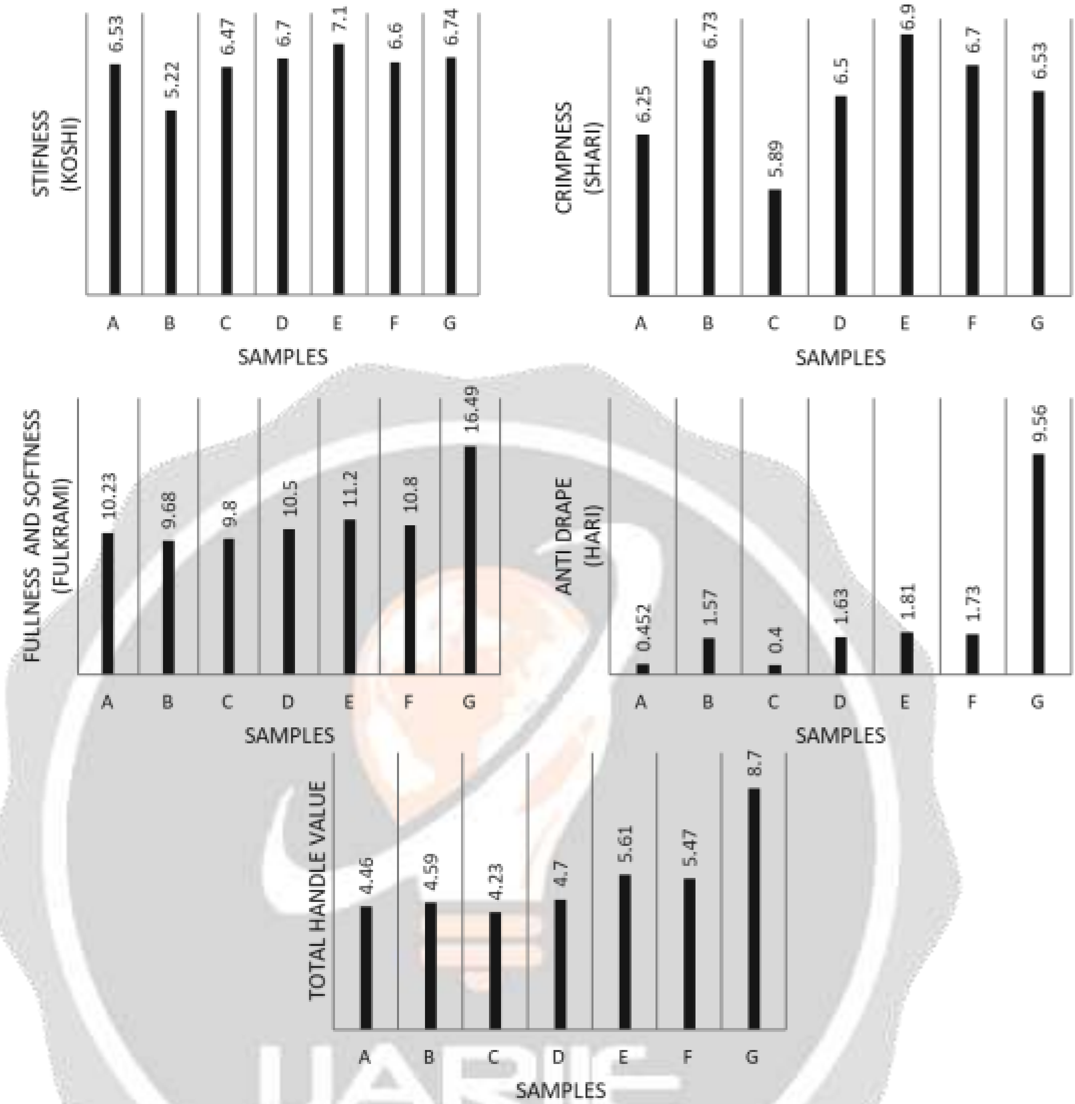

DRAPE COEFFICIENT
6.25
6.73
5.88
6.5
6.9
6.7
6.53
A
B
C
D
E
F
G
SAMPLES

3.5 LOW STRESS MECHANICAL PROPERTIES

S.no		Tensile				Bending		Shear			Surface			Compression			T&W	
	Sample	EMT %	LT (-)	WT (g.cm/cm2)	RT %	B (g*cm2/cm	2HB (g*cm/cm	G (g/cm.deg)	2HG (g/cm)	2HG5 g/cm	MIU (-)	NMD (-)	SMD (-)	LC (-)	WC (g.cm/cm2)	RC (%)	T (mm)	W (mg/cm2)
1.	A	3.5	0.934	8.32	59.05	0.127	0.0927	1.07	2.75	4.86	0.157	0.0458	5.04	0.209	0.498	47.39	1.416	10.181
2.	B	3.38	0.91	7.7	61.21	0.71	0.0975	0.88	3.41	4.44	0.153	0.0369	7.37	0.181	0.569	46.57	1.743	9.759
3.	C	4.14	0.931	9.95	58.4	-0.144	-0.0199	1	3.76	5.36	0.164	0.0369	5.3	0.343	0.498	45.78	1.079	10.855
4.	D	4.34	1.51	8.53	66.92	-0.4295	-0.7257	-3.46	7.38	-10.3	0.142	0.0315	5.42	3.314	1.45	40.74	0.998	11.63
5.	E	4.73	3.243	7.05	57.14	-0.3915	-0.7704	-3.17	10.33	-9.52	0.158	0.0392	9.03	2.29	1.62	46.9	1.23	10.21
6.	F	5.95	0.811	11.23	61.58	-0.227	-0.322	0.87	3.72	4.32	0.199	0.0479	4.2	0.172	0.444	40.77	1.533	10.409
7.	G	8.54	0.467	9.82	40.83	0.067	0.0523	0.27	0.41	0.46	0.179	0.0115	4.57	0.317	0.306	42.48	0.957	12.657

3.6 TOTAL HANDLE VALUE (THV)

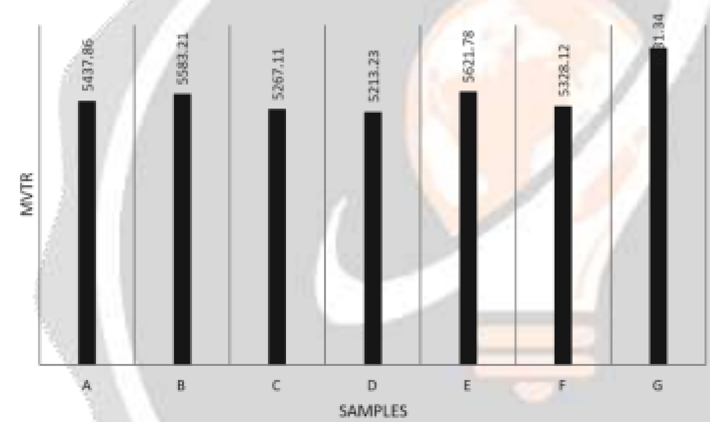
Details	Sample code						
	A	B	C	D	E	F	G
KOSHI (Stiffness)	6.53	5.22	6.47	6.7	7.1	6.6	6.74
SHARI (crimpiness)	6.25	6.73	5.89	6.5	6.9	6.7	6.83
FUKURAMI (Fullness & softness)	10.23	9.68	9.8	10.5	11.2	10.8	16.49
HARI (Anti drape)	0.452	1.57	0.4	1.63	1.81	1.73	9.56
TOTAL HANDLE VALUE	4.46	4.59	4.23	4.7	5.61	5.47	8.7



The total handle value of the fabric sample is determined by analysing the results obtained using the KWBES method which gives the behaviour of the fabric on low stress mechanical properties. The total handle value obtained by considering the Stiffness, crimpiness, Fullness & softness, Anti drape properties.

3.6 MOISTURE VAPOUR TRANSMISSION RATE- (MVTR)

Sample code	Transmission Rate g/m^2/Day
A	5437.86
B	5583.21
C	5267.11
D	5213.23
E	5621.78
F	5328.12
G	6531.34



CONCLUSION:

1. The strength of the slub yarn is less compared to normal yarn.
2. The tensile strength of the fabric is reduced in case of fabric made by using slub yarn.
3. The drape of the fabric is improved when slub yarn is used for making fabric.
4. The abrasion resistance of slub yarn fabric is drastically reduced when compared to normal fabric.
5. The low stress mechanical properties of slub fabric found to be equivalent when compared with normal fabric.
6. The total handle value of the slub fabric has got good results.
7. MVTR rate has been improved in case of slub yarn fabric.

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