7.0 Introduction

To study the effect of various machine parameters, testing parameters, etc are always a matter of interest for any research work. Therefore, in the similar line of thought, some of the variables that were identified during the development of the present fabric feel tester are nozzle material, testing speed, effect of treatment on fabric, etc.. Based on the experience and understanding in the process of development not much effort are given in this direction.

7.1 Materials and Methods

To study the effect of nozzle diameter, speed of testing and nozzle material three suiting fabric samples namely SS1, SS14 and SS29 were selected. Three different chrome plated nozzle diameter 15, 20 and 25 mm were used for this purpose with testing speed of 200 mm/min. To study the effect of speed of testing three speeds 100, 200 and 400 mm/min were selected with chrome plated nozzle of 20 mm diameter. To study the effect of nozzle material two types of nozzles were used chrome plated nozzle and the nozzle made up of nylon.

Instead of market samples it was planned to produce fabric samples on CCI rapier loom in our laboratory and apply different finish. Constructional parameters of woven fabric sample that produced by using CCI rapier m/c.are given in Table No. 7.1.

Table No. 7.1: Sample particulars prepared on CCI loom

S No.	Design	weave	Warp	Weft	EPI	PPI	Thickness (mm)	GSM
P	Plain	1/1	Cotton (13Ne)	PC(16 Ne)	50	42	0.53	217
T	Twill	2/1	Cotton (13Ne)	PC(16 Ne)	50	42	0.52	215
S	Satin	8 end	Cotton (13Ne)	PC(16 Ne)	50	42	0.58	178

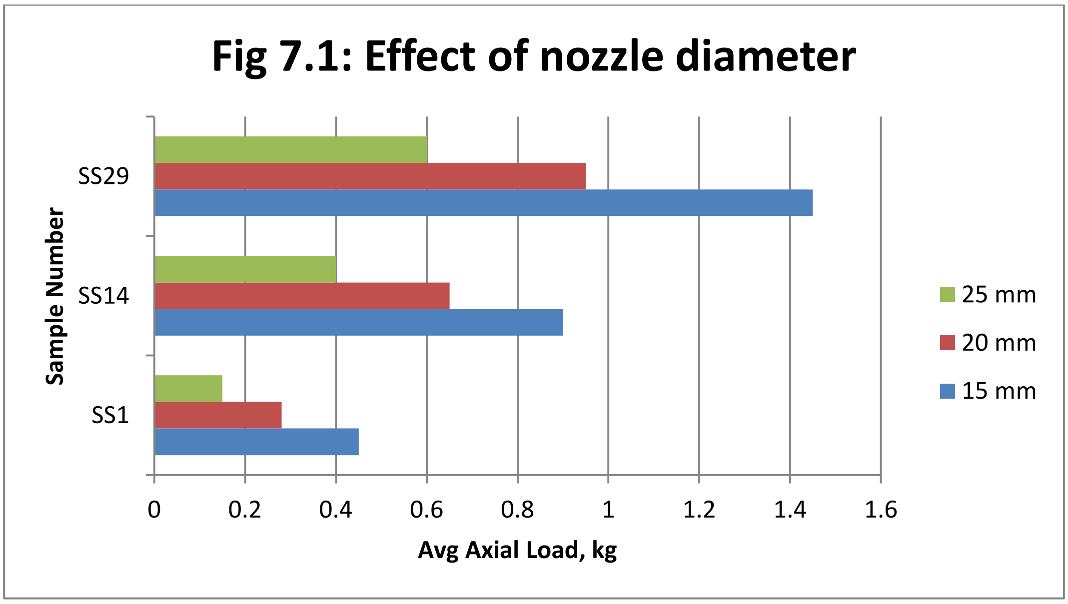
The above mentioned fabric samples are given soap treatment with non-Ionic Detergent, 2 gpl for 10 min. Soaped samples are identified as PS, TS and SS respectively for plain, twill and satins fabric samples. Also to study the effect of softening treatment, the said fabric samples were treated with silicon softener (Levofin) 30 gpl for 20 min at room temperature. Softened fabric samples were identified as PSO, TSO and SSO respectively for plain, twill and satins fabric samples.

7.2 Results and Discussions

As mentioned above three fabric samples viz. SS1, S14 and SS29 were tested with three different nozzle diameters. To compare the effect of nozzle diameters only average axial load is recorded which is having maximum bearing on nozzle extraction behaviour, as mentioned earlier. The test result of the same is given in Table No. 7.2. The bar diagram representation of the data given in Table No. 7.2 is given in Fig. 7.1

Table No. 7.2: Effect of nozzle diameters

Nozzle Dia	Avg Axial Load, kg		
	Sample Number		
	SS1	SS14	SS29
15 mm	0.45	0.9	1.45
20 mm	0.28	0.65	0.95
25 mm	0.15	0.4	0.6

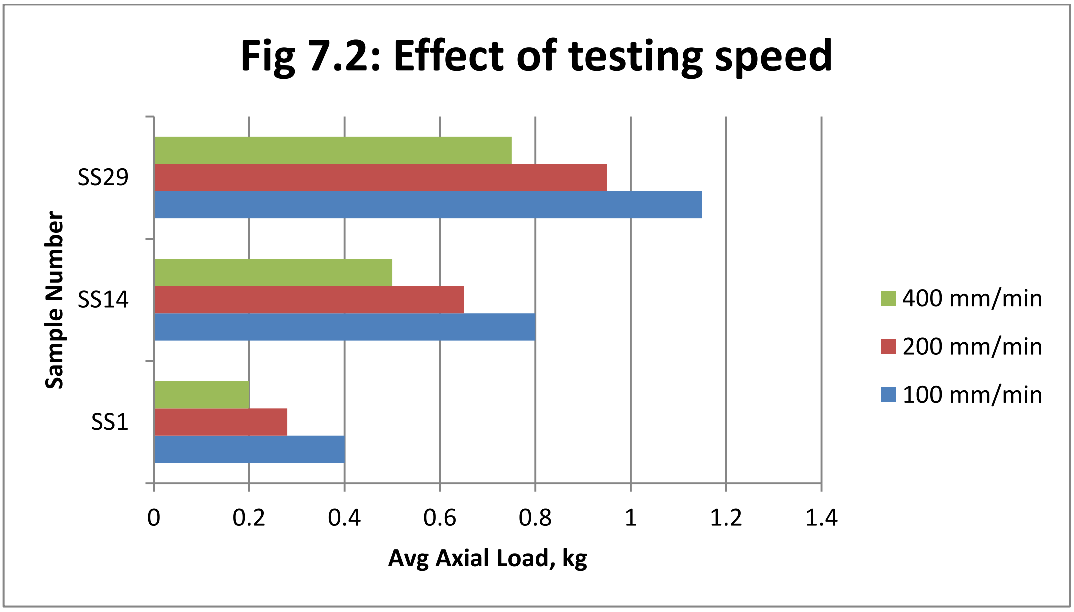


From the above mentioned Table No. 7.2 and the Fig 7.1, it can be seen that average extraction load for nozzle diameter 15 mm is maximum for all three fabric samples and it is minimum for 20 mm nozzle diameter. The observed phenomenon is perfectly alright; as the passage of fabric through nozzle is narrow it will resist more during extraction.

To understand the effect of testing speed three testing speed were selected 100 mm/min, 200 mm/min and 400 mm/min and the fabric samples are tested. The test result of the same is given in Table No. 7.3. The bar diagram representation of the data given in Table No. 7.3 is given in Fig. 7.2

Table No. 7.3: Effect of testing speed

Nozzle Dia	Avg Axial Load, kg		
	Sample Number		
	SS1	SS14	SS29
100 mm/min	0.4	0.8	1.15
200 mm/min	0.28	0.65	0.95
400 mm/min	0.2	0.5	0.75



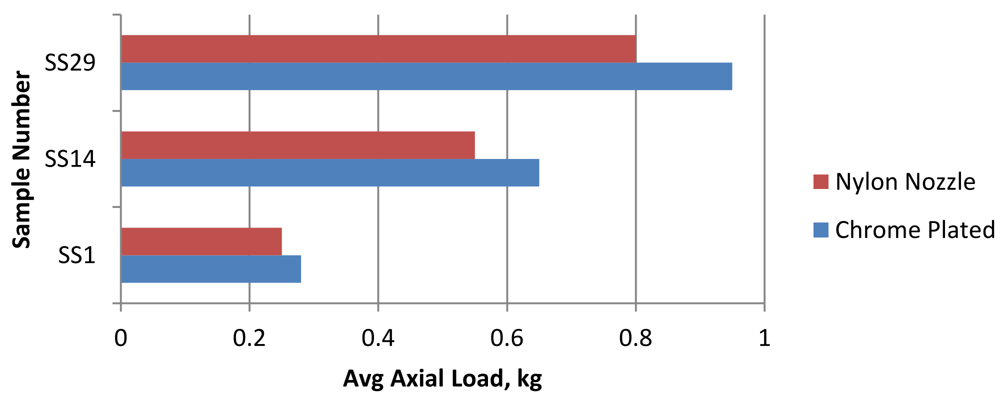
From the above mentioned Table No. 7.3 and the Fig 7.2, it can be seen that there is marginal difference in average extraction load for the three testing speed for all the three fabric samples. It can also be seen that in all three cases maximum extraction load is for 100 mm/min and minimum is for 400 mm/min testing speed. The said phenomenon is better explained by the physicist in book of the theory of dynamics.

To study the effect of materials, the above mentioned fabric samples were tested with two type of nozzle chrome plated metallic and the nozzle made up of nylon both are of 20 mm diameters. The fabric samples are tested at 200 mm/min speed. The test result of the same is given in Table No. 7.4. The bar diagram representation of the data given in Table No. 7.4 is given in Fig. 7.3

Table No. 7.4: Effect of nozzle material

Nozzle Material	Avg Axial Load, kg		
	Sample Number		
	SS1	SS14	SS29
Chrome Plated	0.28	0.65	0.95
Nylon Nozzle	0.25	0.55	0.8

Fig 7.3: Effect of nozzle material



From the above mentioned Table No. 7.4 and the Fig 7.3, it can be seen that like the case of testing speeds in this case also there is marginal difference in average extraction load with the two types of nozzles for all the three fabric samples. It can also be seen that in all three cases chrome plated nozzle exert more force than nylon nozzle. As all other parameters remain constant, the only probable reason could be the frictional properties of the two nozzle surface.

The fabric samples prepared on CCI rapier loom are tested on IITD Fabric Feel Tester. The extraction curve parameters for the said test are given in Table No. 7.5. The test data as per the parameters given in Table No. 7.5 are given in Table No. 7.6.

Table No. 7.5: Extraction Curve Parameters Notations

Extraction curve parameters	Notation	Unit
Peak load height for extraction curve	H_E	Kg
Peak load distance for extraction curve	D_E	mm
Area under the extraction curve	A_E	Kg.mm
Peak load height for radial curve	H_R	Kg
Peak load distance for radial curve	D_R	mm
Area under the curve for radial curve	A_R	Kg.mm

Table No. 7.6: Extraction Curve Parameters

Sample No.	Extraction Curve Parameters						Feel Factor
	H_E	D_E	A_E	H_R	D_R	A_R	
P	1.5383	22.573	31.7	1.7485	25.451	33.5	2.22
T	1.843	24.4065	33.6	2.0371	26.3175	35.5	3.51
S	1.222	21.138	18.9	1.218	23.08	20.7	2.89
PS	1.7413	22.1675	31.2	1.8463	23.946	31.7	4.95
TS	2.212	24.508	39.1	2.3911	26.715	39.4	6.3
SS	1.6258	23.4315	31.5	1.655	25.285	32.1	5.84
PSO	1.9264	23.135	33.4	2.0915	24.9055	35.1	7.48
TSO	2.0323	23.74	38.1	2.1948	26.598	40.3	8.84
SSO	2.059	23.4935	38.5	2.027	25.5525	39.9	8.38

The test data given in Table No. 7.6 regressed and are given in the Table No. 7.7. Regression Statistics given in Table No. 7.7 (a), ANOVA in Table No. 7.7(b), Residual Output in Table No. 7.7(c) and Probability Output in Table No.7.7(d) are given.

From the regression analysis it can seen that multiple R is very good among the variable of the curve parameters. It can also be seen that in most of the cases, the residuals are evenly scattered with low band width. The observed phenomenon is in agreement with good regression behaviour.

Table No. 7.7: SUMMARY OUTPUT

Table No. 7.7(a): *Regression Statistics*	
Multiple R	0.896
R Square	0.802
Adjusted R Square	0.210
Standard Error	2.129
Observations	9

Table No. 7.7(b): ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	36.81	6.13	1.35	0.48
Residual	2	9.06	4.53		
Total	8	45.87			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	6.21	28.61	0.22	0.85	-116.89	129.31	-116.89	129.31
X Variable 1	19.60	14.26	1.37	0.30	-41.76	80.97	-41.76	80.97
X Variable 2	-0.67	2.64	-0.25	0.82	-12.03	10.69	-12.03	10.68
X Variable 3	-0.71	1.25	-0.57	0.63	-6.07	4.66	-6.08	4.66
X Variable 4	-11.49	10.20	-1.13	0.38	-55.36	32.38	-55.36	32.38
X Variable 5	-0.07	2.78	-0.02	0.98	-12.02	11.88	-12.02	11.88
X Variable 6	0.78	1.30	0.60	0.61	-4.78	6.34	-4.78	6.34

Table No. 7.7(c): RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*Standard Residuals*
1	3.01	-0.79	-0.74
2	4.59	-1.08	-1.01
3	3.14	-0.25	-0.23
4	5.19	-0.24	-0.23
5	6.79	-0.50	-0.46
6	4.29	1.55	1.46
7	6.38	1.10	1.04
8	7.46	1.38	1.29
9	9.55	-1.17	-1.10

Table No. 7.7(d): PROBABILITY OUTPUT

Percentile	*Y*
5.56	2.22
16.67	2.89
27.78	3.51
38.89	4.95
50	5.84
61.11	6.3
72.22	7.48
83.33	8.38
94.44	8.84

As mentioned, fatigue phenomenon or in other word repeated loading and unloading of any textile material is always a matter of interest for any textile person. Fatigue failure is very much concern for textile manufacturing operations. The performance of finished fabric is also an intrinsic importance and the same is grossly associated with fatigue phenomenon of handle characteristics of fabric.

It is, therefore, decided to do an observation of fatigue effect on handle characteristic of fabric using nozzle extraction method. Four fabric samples viz. SS2, SS14, SS28 and SH27 were selected for this purpose. The fabric samples were tested repeatedly for extraction force up to 20 times with laundering after every test and are also tested the same fabric without laundering. The test results are given in Table No. 7.8, 7.9, 7.10 and 7.11 respectively. The graphical representations of the said data are given in Fig 7.4, 7.5, 7.6 and 7.7 respectively.

The abovementioned test results reveal some interesting phenomenon here. With laundering fabric samples did not give significant different extraction force. But the without laundering fabric samples extraction forces were declined initially for few cycles and then subsequently it increased. The amplitude of the fluctuations of average extraction force in this case also eye catching.

Table No. 7.8: Sample No. SS2: Effect on repeat test

Test No.	Avg Axial Load, kg	
	With Laundering	Without Laundering
1	0.240	0.230
2	0.245	0.215
3	0.235	0.200
4	0.240	0.200
5	0.230	0.190
6	0.230	0.185
7	0.230	0.215
8	0.235	0.230
9	0.240	0.210
10	0.225	0.230
11	0.220	0.245
12	0.225	0.230
13	0.235	0.220
14	0.240	0.210
15	0.220	0.240
16	0.210	0.230
17	0.215	0.220
18	0.250	0.240
19	0.230	0.210
20	0.220	0.200

Table No. 7.9: Sample No. SS14: Effect on repeat test

Test No.	Avg Axial Load, kg	
	With Laundering	Without Laundering
1	0.340	0.355
2	0.365	0.340
3	0.350	0.300
4	0.350	0.295
5	0.340	0.280
6	0.345	0.295
7	0.360	0.320
8	0.350	0.335
9	0.340	0.350
10	0.365	0.320
11	0.335	0.360
12	0.340	0.350
13	0.350	0.345
14	0.360	0.365
15	0.330	0.330
16	0.340	0.370
17	0.355	0.380
18	0.340	0.350
19	0.325	0.340
20	0.330	0.345

Table No. 7.10: Sample No. SS28: Effect on repeat test

Test No.	Avg Axial Load, kg	
	With Laundering	Without Laundering
1	0.490	0.510
2	0.480	0.490
3	0.510	0.465
4	0.480	0.450
5	0.490	0.430
6	0.500	0.470
7	0.470	0.475
8	0.480	0.490
9	0.485	0.460
10	0.510	0.495
11	0.490	0.520
12	0.475	0.525
13	0.480	0.500
14	0.470	0.495
15	0.465	0.485
16	0.490	0.510
17	0.495	0.525
18	0.480	0.480
19	0.475	0.475
20	0.500	0.495

Table No. 7.11: Sample No. SH27: Effect on repeat test

Test No.	Avg Axial Load, kg	
	With Laundering	Without Laundering
1	0.095	0.145
2	0.120	0.130
3	0.105	0.110
4	0.125	0.085
5	0.130	0.075
6	0.145	0.070
7	0.150	0.125
8	0.135	0.100
9	0.125	0.120
10	0.130	0.125
11	0.125	0.100
12	0.140	0.150
13	0.115	0.130
14	0.125	0.165
15	0.135	0.140
16	0.090	0.130
17	0.080	0.110
18	0.085	0.100
19	0.105	0.080
20	0.085	0.145

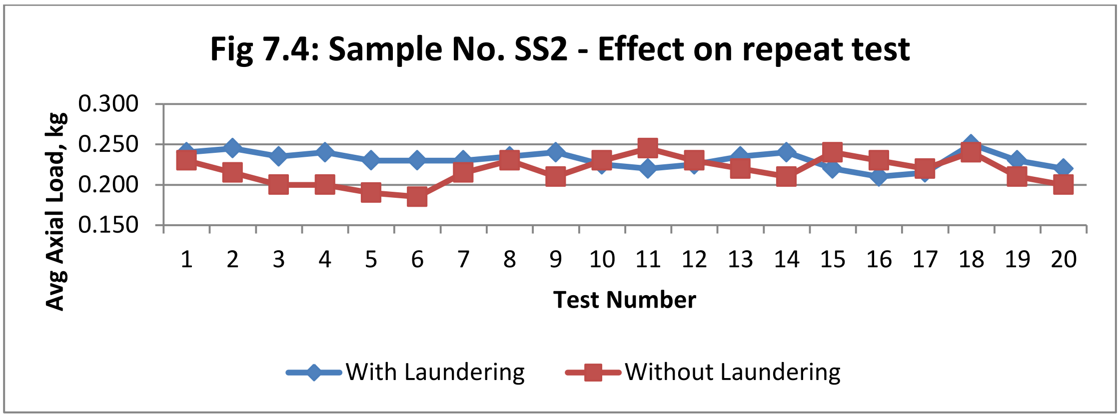


Fig 7.4: Sample No. SS2 - Effect on repeat test
Avg Axial Load, kg
0.300
0.250
0.200
0.150
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Test Number
With Laundering
Without Laundering

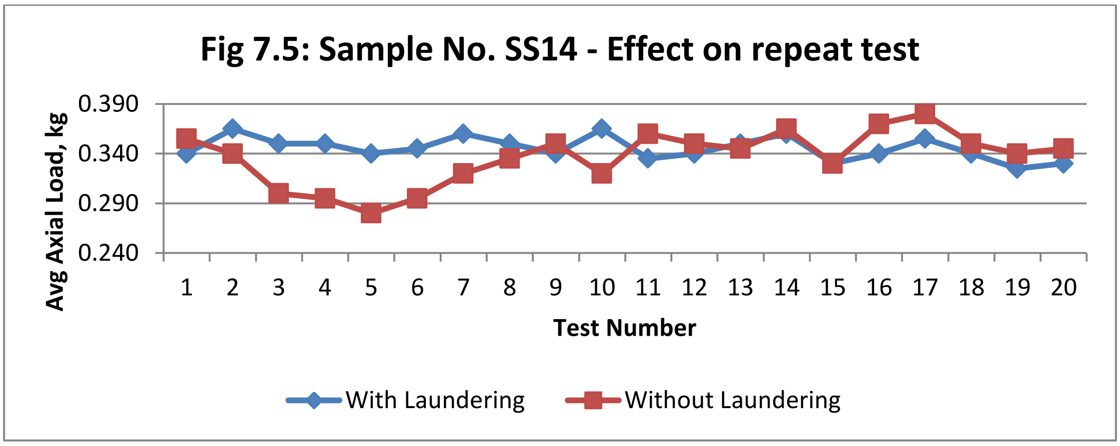


Fig 7.5: Sample No. SS14 - Effect on repeat test
Avg Axial Load, kg
0.390
0.340
0.290
0.240
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Test Number
With Laundering
Without Laundering

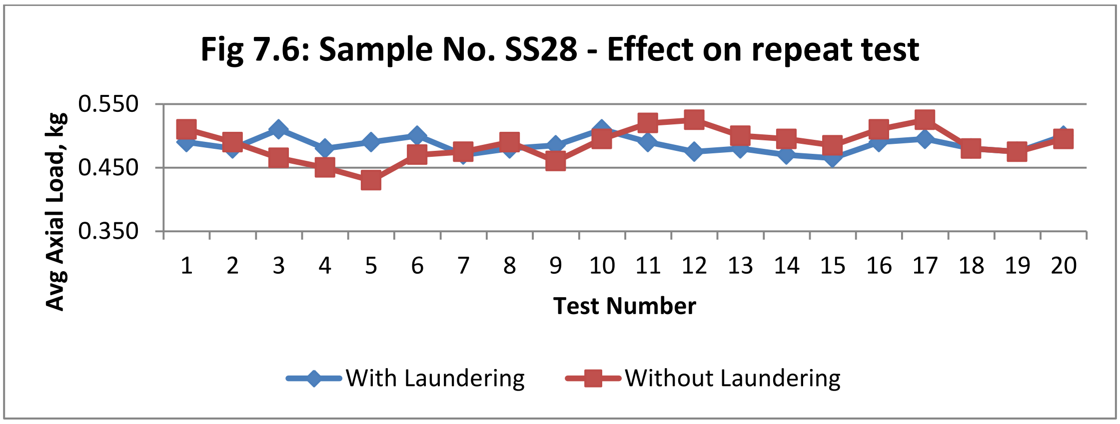


Fig 7.6: Sample No. SS28 - Effect on repeat test
Avg Axial Load, kg
0.550
0.450
0.350
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Test Number
With Laundering
Without Laundering

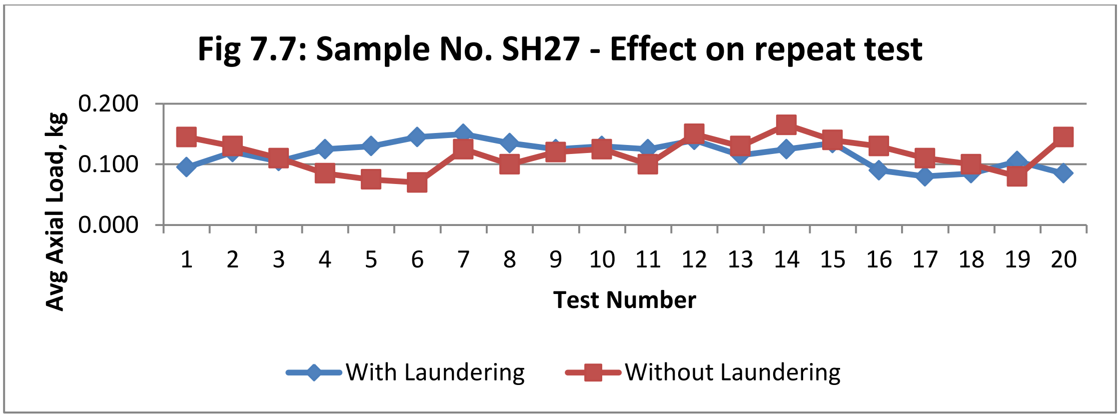


Fig 7.7: Sample No. SH27 - Effect on repeat test
Avg Axial Load, kg
0.200
0.100
0.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Test Number
With Laundering
Without Laundering

7.3 Conclusion

From the above mentioned experiment it can be concluded that nozzle extraction testing parameters like nozzle diameters, speed of testing, materials used in nozzles, etc are very much in conjunction with the age old established theory of physics and textile engineering.

As far as the later part of the experiment with repeat test, node formations and the changing of nodes in subsequent test are very important. In subsequent test, if the pattern of node formation change, the resistance to draw the sample through increases. If the pattern of node formation doesn’t change, it offers less resistance while drawing through the nozzle, as the specific fold line already there and not recovered 180° crease recovery. Therefore, resilience of the fabric plays important role in this aspect and so as the performance of the fabric while in use.