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STUDIES ON EFFECT OF RING FRAME DRAFTING PARAMETERS ON YARN FAULTS USING FACTORIAL DESIGN TECCNIQUE

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Abstract: *Drafting process being the most important operation in ring frame which influences the major quality parameters of yarn, spinners were becoming increasingly concerned to optimize the parameters of drafting process in ring frame. Faults in yarn which are considered to be major causes of rejection and down grading of fabric and reduced productivity in all the downstream processes are largely influenced by ring frame drafting variables e.g. back zone roller setting, break draft and spacer size. In the present work, the effect of afore said ring frame drafting parameters on different categories of yarn faults are studied in detail using factorial design technique (Box –Behnken design of experiment.)*

***Keywords: Back** zone setting, Break draft, spacer size, drafting faults, thick faults, slub, thin fault design of experiment*

I. INTRODUCTION

The seldom occurring faults in yarn are the major factor responsible for rejection and down grading of yarn and fabrics and low productivity in the downstream processes due to higher end breakage. Furthermore, new generation high speed looms and knitting machines place more stringent demands on the fault level in the yarn. Thus, spinners are becoming increasingly concerned to reduce the fault level in the yarn. Accordingly, many experimental and theoretical researches on drafting in ring frame have been carried out with an aim to control the drafting process to improve quality of yarn. Most of the research works carried out hitherto considered the effect of ring frame drafting variables on generation of yarn fault in isolation [1, 2, 3, and 4]. There is notable absence of literatures on the combined effect of ring frame drafting parameters on generation of different types of seldom occurring faults. Hence, the present study is undertaken to analyze in detail the effect of important drafting variables e.g. back zone setting, break draft and spacer size on different categories of faults employing Box- Behnken design of experiment.

II. MATERIAL AND METHOD

2.1 Material

The specifications of polyester and viscose fibres used in the study are given in the Table1

Table 1
Specification of polyester, and viscose

Fibre characteristic	Polyester	Viscose
Length (mm)	44	44
Fineness (denier)	1.4	1.5

2.1 Preparation of sample:

Standard process and machine parameters as adopted by the industry is followed for preparation of polyester- viscose (70:30) blended roving of hank 1.0 Ne. Twenty roving bobbins are collected from the same doff of a roving frame and creeled on the same set of spindles of ring frame to rule out any variation in the experimental results due to machine conditions. It is ensured that all the parameters (other than the variable ones) are identical in all the spindles. In total 15 numbers of samplesof 30^{s} Ne having twist multiplier of value 3 were prepared on LR-6 medium cradle ring frame for all the combinations by using three-variable factorial design as suggested by Box and Behnken (Table 2). The actual levels of variables were taken within the range commonly adopted by industries and mentioned in Table 3. For each combination total 40 bobbins (2 complete doff) were prepared.

Table 2
Experimental Plan (Box and Behnken) for Preparation Ring Yarn (Coded Values)

Combination No	Break draft	Back zone setting	Spacer size
1	-1	-1	0

2	-1	+1	0
3	+1	-1	0
4	+1	+1	0
5	-1	0	-1
6	-1	0	+1
7	+1	0	-1
8	+1	0	+1
9	0	-1	-1
10	0	-1	+1
11	0	+1	-1
12	0	+1	+1
13	0	0	0
14	0	0	0
15	0	0	0

Table 3
Actual Values of The Process Parameters of Yarn Spinning Corresponding to Coded Levels

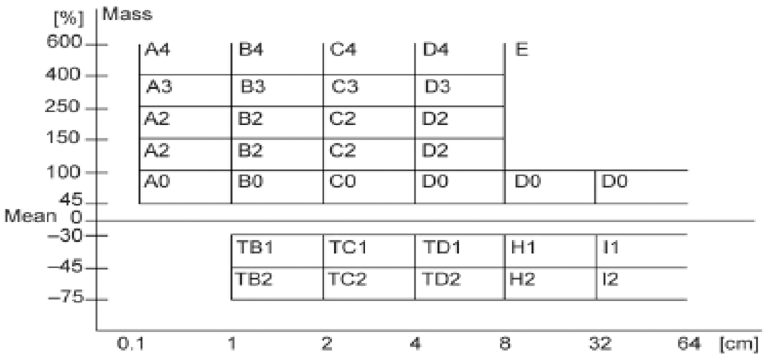
Coded levels	Actual Values		
	Break draft	**Back zone setting(mm)**	**Spacer size(mm)**
-1	1.17	70	3.0
0	1.24	75	3.5
+1	1.30	80	4.0

2.1 Measurement of yarn faults: Measurement of seldom occurring yarn faults, which occur at infrequent intervals, was done in which classify the yarn faults in following categories:
Slub - 25 classes by 5 level limits of 0 to 4 and 5 length limits of A to E.
Thick Place: 15 classes by 3 level limits of TK1, TK2, and TK3 and 5 length limits of L1 to L5.
Thin Place-:15 classes by 3 level limits of TN1, TN2, and TN3 and 5 length limits of L1 to L5.
Drafting faults: C_3, D_3 and C_4, D_4

The CFT –II classifies the yarn faults in 40 classes as shown below in Table-4 [5] :

Table 4

Characteristics	Description
Fault classification	



Testing condition:
Winding Speed – 500 m/min
Total Length of tested material approximately 150 km for each sample

III. RESULT AND DISCUSSION

The experimental results for different characteristics of the yarn samples prepared for different combinations of break draft, back zone setting and spacer size is given in the yarn the Table5. Mathematical models (in form of regression equations) were developed to predict various physical properties of yarn using SYSTAT 12 statistical package are given in Table 6. The corresponding significant tests of model equations were carried out on the basis of adjusted coefficient of determination ($R^2_{adjusted}$), and standard error. Higher the value of $R^2_{adjusted}$, stronger is the correlation between dependent and independent variables and the regression equation derived is considered to be more significant.

Table 5 Test Results for Seldom Faults Yarn Samples

Combination No.	Objectionable Drafting Faults/ 100 km	Total slub / 100 km	Total Thin faults/ 100 km	Total Thick faults / 100 km
Y_1	21	1213	1855	1118
Y_2	30	1291	1907	1153
Y_3	27	1178	1870	1152
Y_4	32	1224	1928	1171
Y_5	25	1313	1983	1124
Y_6	41	1198	1917	1217
Y_7	29	1255	1859	1295
Y_8	53	1326	1925	1181
Y_9	32	1187	1876	1153
Y_{10}	46	1151	1973	1219
Y_{11}	29	1275	1881	1281
Y_{12}	50	1318	1920	1335
Y_{13}	22	1279	1977	1304
Y_{14}	16	1187	1886	1287
Y_{15}	13	1213	1928	1181

Table 6. Response Surface Equation for Various Yarn Faults

Properties	Response surface equation	R^2_{adj}	S.E.
drafting fault	$3782.82-2466.19*x_1-36.54*x_2-552.35*x_3-3.45*x_1*x_2+59.88*x_1*x_3+.70*x_2*x_3+1037.09*x_1*x_1+0.26*x_2*x_2+63.50*x_3*x_3$	0.89	3.85
slub total	$11036.68-15259.70*x_1+127.66*x_2-3126.55*x_3-0.68*x_1*x_2+1441.59*x_1*x_3+7.9*x_2*x_3+4738.25*x_1*x_1-0.8*x_2*x_2+105.83\ x_3^2$	0.34	46.0
total thick	$-40655.81+49785.95*x_1+218.15*x_2+1392.11*x_3-.67*x_1*x_2-1546.01*x_1*x_3-1.2*x_2*x_3-17617.52*x_1*x_1-1.32*x_2*x_2+90.83*x_3*x_3$	0.26	68.01
total thin	$-6313.98+5979.69*x_1+168.42*x_2-1017.81*x_3-0.05*x_1*x_2+1052.51*x_1*x_3-5.8*x_2*x_3-3972.83*x_1*x_1-0.98*x_2*x_2+26.33*x_3*x_3$	0.32	49.27

3.1 Objectionable drafting Faults

Results of Drafting Faults (/100km) for the experimental samples are given in Table 5. High value of $R^2_{adjusted}$ (0.894) (Table 6) shows that the regression model derived for the drafting fault is significant and correlates well with the independent variables. This is also evident from Fig1. It can be seen from the fig 2 and fig 3 response surface plot that drafting faults is significantly affected by spacer size. Besides the size of the spacer, break draft also affects incidence of drafting fault. The effect of back zone setting is marginal and significant only at higher level.

Effect of Break Draft

It can be inferred from Fig 1 that the effect of beak drafts is more prominent at higher level (beyond 1.24). At higher break draft level, stick-slip effect is more prominent. This is because the fibres are subjected to static and dynamic friction in quick succession and the movement of the fibres becomes more erratic [6] . This leads to substantial increase in drafting fault after drafting in front zone (specially belonging to D_3 and D_4 categories).

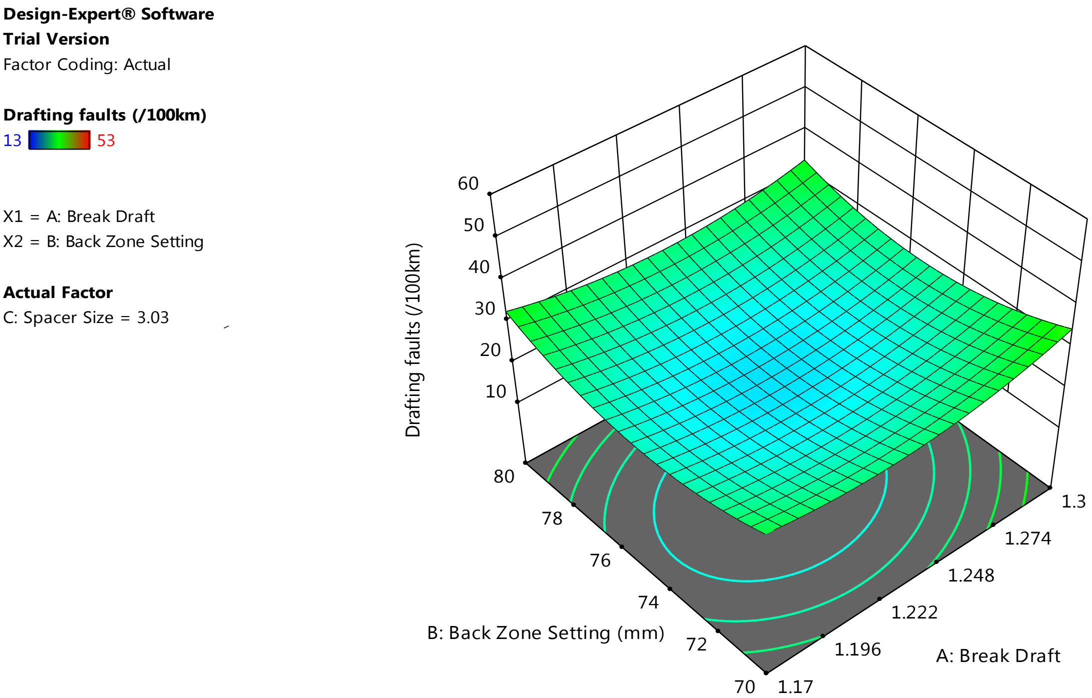


Fig 1 –Effect of Break Draft and Back Zone Setting on Drafting Faults(/100km)

Effect of Back Zone Setting:
Response surface plot fig 2 shows that the effect of back zone setting and spacer size on drafting faults. The incidence of higher drafting fault with wider back zone setting may be ascribed to the relatively higher level of floating fibres.
With the widening of the gap between the friction field created by the back roller and middle roller, movement of the floating fibre will be uncontrolled in this zone creating mass variation [6]. These are extended in length by the amount of draft in the main drafting zone and counted as infrequent drafting fault.

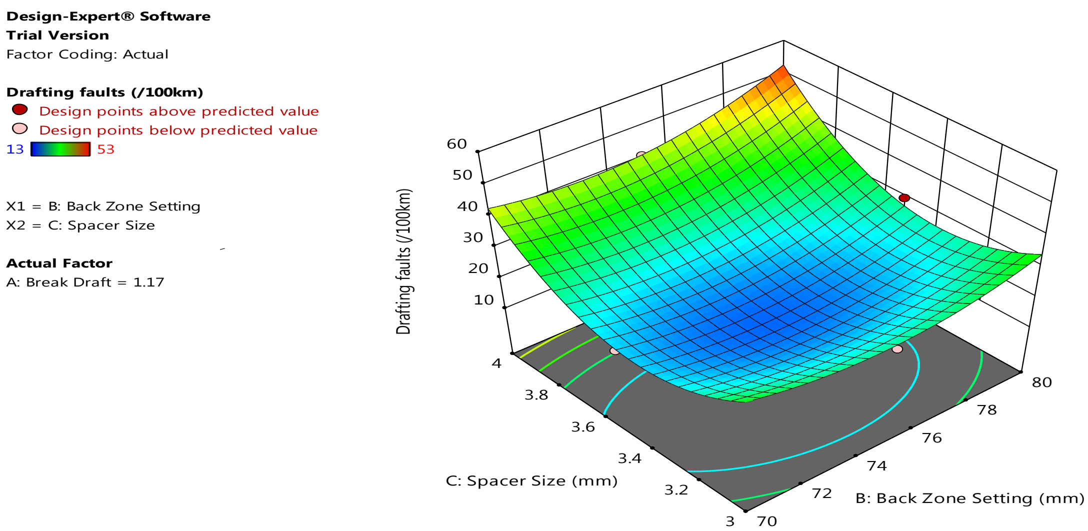


Fig 2 – Effect of Back Zone Setting and Spacer Size on Drafting Faults(/100km)

Effect of Spacer Size:
Response surface plot Fig 3 shows that number of drafting faults decrease initially up to an optimum spacer size and then increases sharply with increase in size. This may be attributed to the fact that for narrower the apron nip opening, same number of fibres will pass through narrower gap causing increased cohesion among the fibres. Thus, fibres are subjected to greater strain and are more resistant to drafting. Thus, drafting fault reduces initially up to a certain optimum size [7] . Beyond this, control over the fibres by the aprons is reduced and the movement of the fibres will become more irregular leading to higher drafting faults.

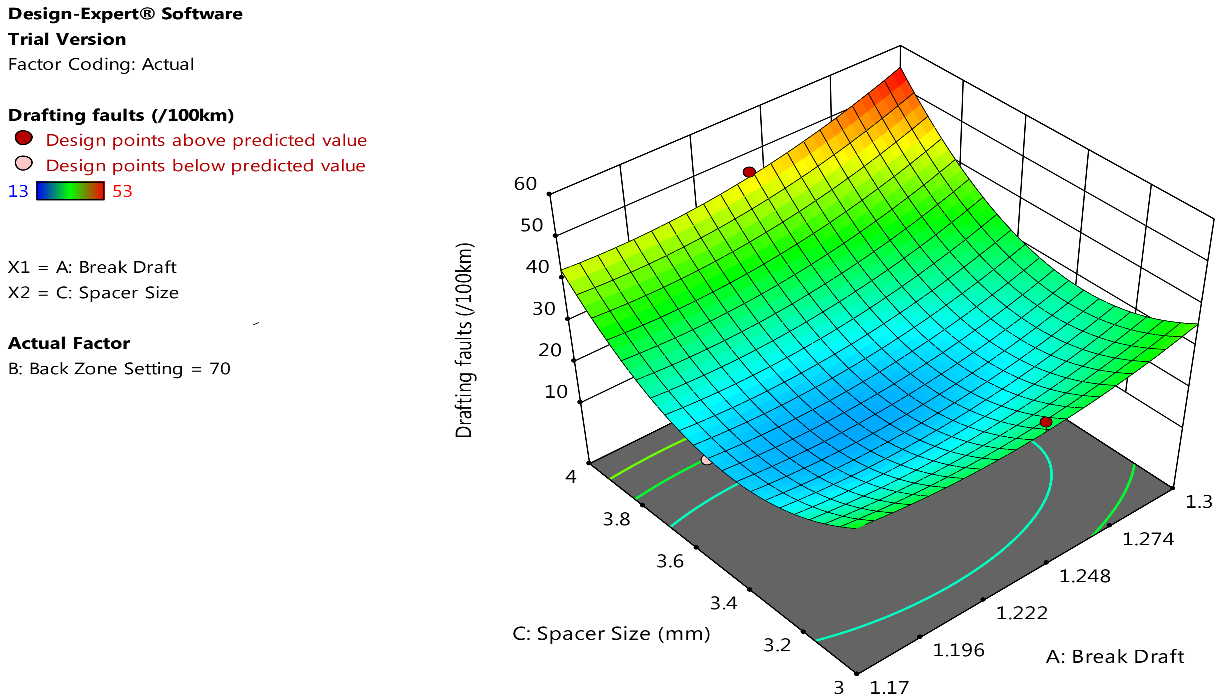


Fig 3 – Effect of Break Draft and Spacer Size on Drafting Faults(/100km)

3.2 Total Slub

The low value of $R^2_{adjusted}$ (0.345) and Fig 4 confirms that the regression model for total slub is fairly weak. This is because of the fact that total slub measured by the Keisokki classifault tester [5] include all categories of short thick faults originating both from poor opening at preparatory stage and faulty drafting at ring frame, the former being much higher in number, overshadowed the effect of drafting.

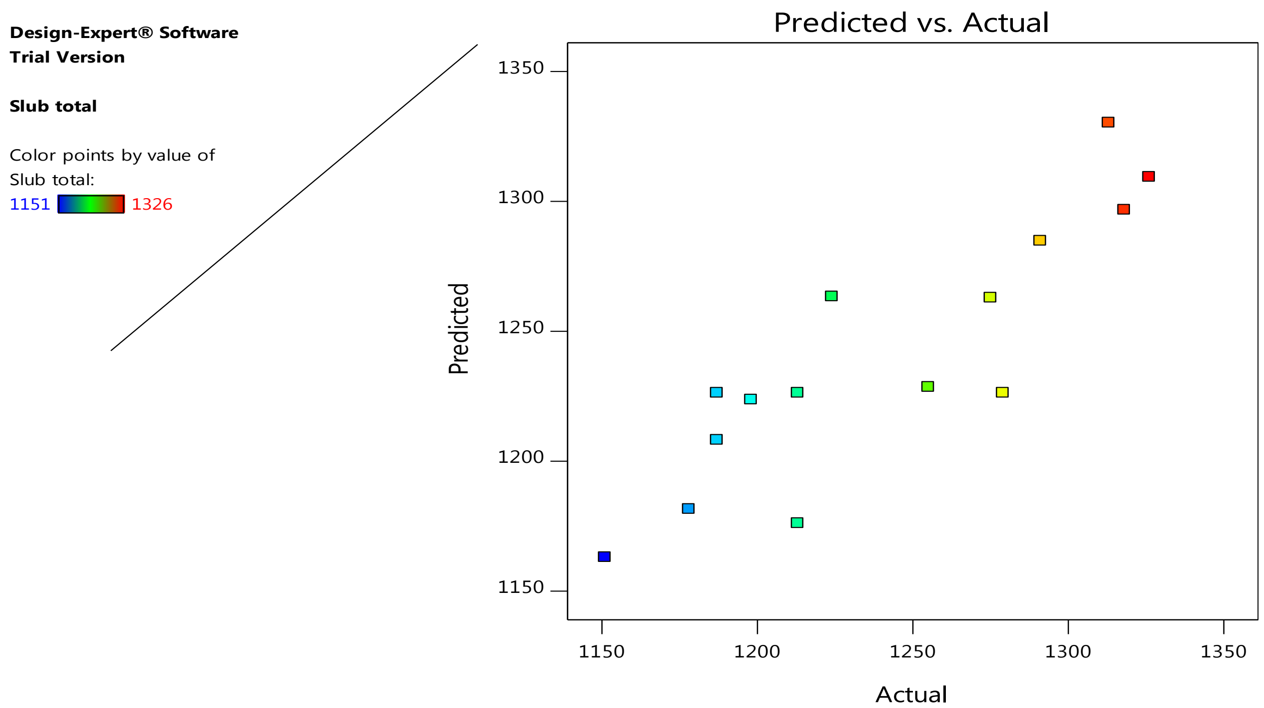


Fig 4 - Correlation Between Predicted Vs Actual Value of Total Slub Faults

3.3 Total Thick Fault:

Results of the Total Thick Faults (/100km) for the experimental samples are given in Table 5. The low value of $R^2_{adjusted}$ (0.063) confirms that the regression model for total thick faults is fairly weak. It is also evident from the Fig 5 that the experimental data fit poorly to the straight line from the analysis of the ANOVA. It is clear that there is no significant effect of any of the spinning process variables on the number of long thick in the yarn.

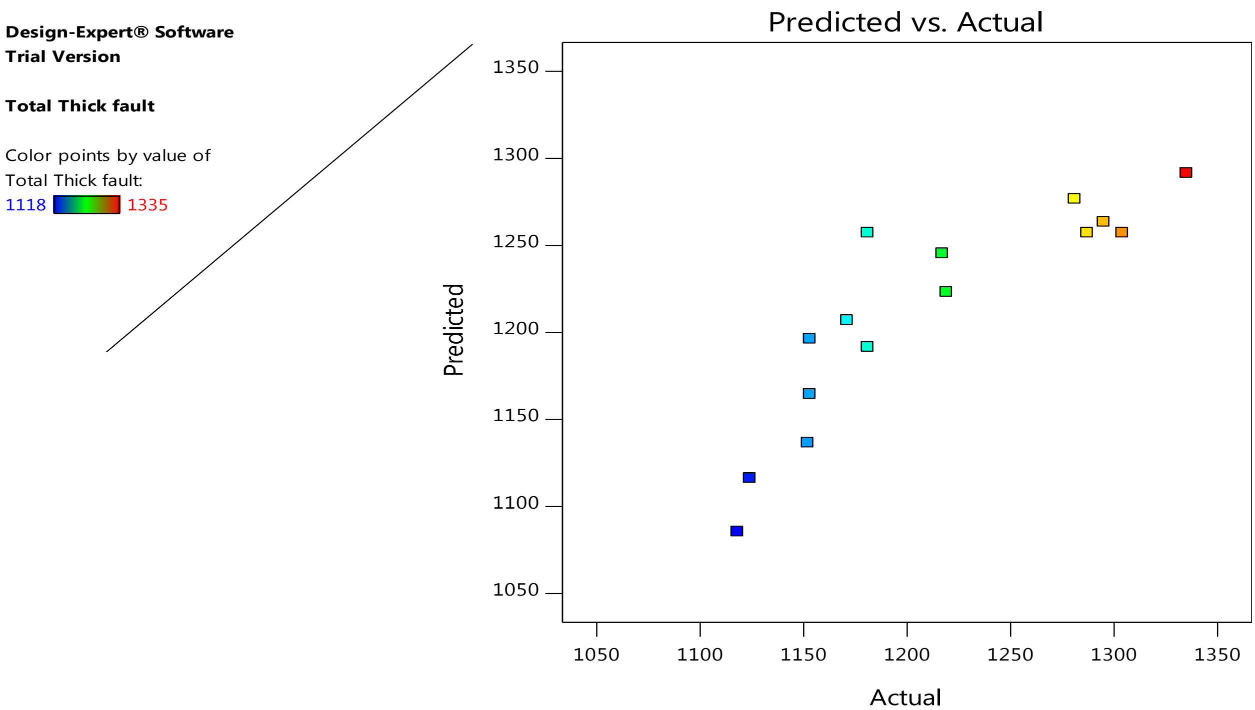


Fig 5 - Correlation Between Predicted Vs Actual Value of Total Thick Faults

3.4 Total Thin Fault:

Results of the Total Thin Faults(/100km) for the experimental samples are given in Table 5 The low value of $R^2_{adjusted}$ (0.100) and Fig 6 confirms that the regression model for total thin fault is fairly weak. This is because of the fact that total thin faults originate due to stretching and none of the drafting parameters considered for this study can influence the generation thin faults.

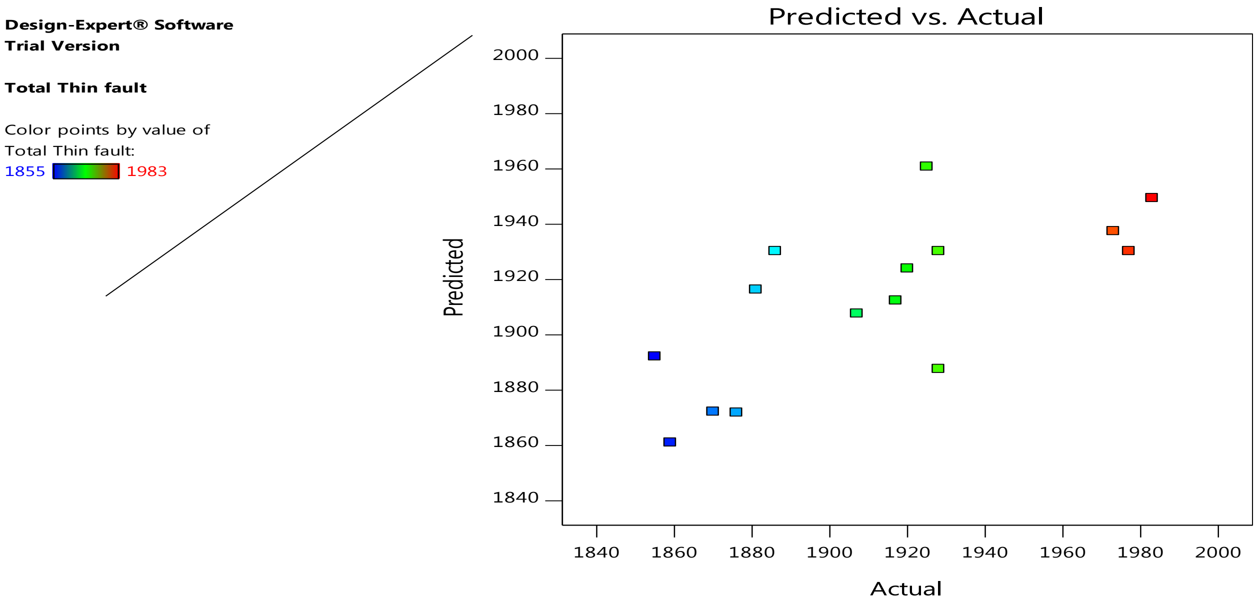


Fig 6 - Correlation Between Predicted Vs Actual Value of Total Thin Faults.

III. CONCLUSION

1. It can be concluded that number of objectionable drafting faults (C3, C4, D3 and D4) is significantly affected by spacer size. Besides the size of the spacer, break draft also affects incidence of drafting fault. The effect of back zone setting is marginal and significant only at higher level.
2. Total number of slub in the yarn is not significantly any of the parameters considered in the study. This may be due the fact that total slub measured by the Keisokki classifault tester include all categories of short thick faults originating both from poor opening at preparatory stage and faulty drafting at ring frame, the former being much higher in number, overshadowed the effect of drafting
3. Total thick and total thin faults are not affected by any of the spinning process variables

VI. REFERENCES

1. V. Ramachandran, Journals of the Textile Association (Bombay), sept-oct, 1996, No. 3, Page No. 153
2. R. N. Yadav, Man-Made Textile India, 36, No. 5, May 1993, Page No. 185-188.
3. K Kumaraswamy and I Sheriff, Journals of Textile Association, Vol.40, November 1979, No.6, page 213.
4. Vishwanath C.S, Jumdar C. R, Indian Textile Journal, 102, No.1, October 1991, 90-93.
5. Classifault
6. W. Klein, The Rieter Manual of Spinning, Vol. 1 – The Technology of short-staple Spinning
7. Dr. N. Balasubramanian, Curbing yarn faults, The Indian Textile Journal, May (1997), page. 12-23.