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Influence of Drafting System Variables at Speed Frame on Yarn Tenacity and Breaking Elongation Using Taguchi Method

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Article

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ABSTRACT

This study evaluates the impact of drafting systems and variables on yarn quality, emphasising tenacity and elongation. The study tries to determine the best drafting system setup and how spacer size and roller load affect yarn qualities. The investigation used PK 1500 3/3, 1600 4/4, and 1500 4/4 drafting systems. The front top roller load and spacer size varied for yarn samples. We examined and analysed yarn tenacity and elongation to evaluate their impacts. Statistics were used to evaluate the results and find relationships between drafting system setups and yarn quality. The PK 1500 3/3 drafting system produced the best average yarn tenacity, followed by PK 1600 4/4 and PK 1500 4/4. Spacer size had a smaller effect on tenacity than front top roller load, increasing and then decreasing with load. The 3/3 system was most affected by the front top roller load. The drafting system and overhang affected yarn elongation more than the front roller load, back roller load, and spacer size. The PK 1500 3/3 process produced the highest-breaking-elongation yarn. Lower R^2 results suggest ring frame specifications have a greater impact on yarn quality than roving quality. The research helps optimise drafting system settings and emphasises ring frame process parameters. The foundation for future research on textile manufacturing yarn quality factors is laid by this research.

KEYWORDS

drafting system, yarn, elongation, Taguchi, tenacity

INTRODUCTION

The spinning of fibres into yarn is the first process in the formation of textile structures. The introduction of new fibres like recycled polyester poses a challenge for quality yarn spinning. The yarn quality parameters are mostly decided by unevenness, hairiness and mechanical parameters like tenacity, breaking elongation etc. It is evident from the studies that the yarn quality which affects the end product is dependent upon factors like individual machine settings in the spinning line, fibre parameters etc. [1–3]. Mamun et al. studied the properties of ring and compact yarns spun from two different carded sliver linear densities and found a positive effect on the yarn quality for both types of spinning systems [4].

Drafting is the most vital and essential process in spinning, and it has a very significant effect on the yarn quality. Drafting components have also a significant impact on yarn quality and production costs in ring spinning, particularly, spinning top roller covers i.e., cots and drafting aprons [5–9]. These are the main apparatuses of the drafting operations and positively, it has more influence on the quality of the yarn produced.

Apart from textile products, sewing threads play an important role in the overall appearance and mechanical performance of the stitched garment. Islam et al. studied, how stitch density affects plain-woven cotton fabrics [8]. Their findings showed a positive connection between yarn linear density and seam strength, regardless of the stitch type used. Ishtiaque et al. studied the impact of preparatory fibre orientation parameters in a high-speed draw frame on the cotton sliver and the parameters of card draft, coil diameter of card and delivery speed of breaker draw frame have a significant effect on the sliver delivered from the breaker draw frame [10]. So, it is evident that the settings of the machines utilized to produce yarn have a considerable effect on the yarn quality. The speed frame process is one of the intermediary procedures that follows the draw frame process in the spinning line. The speed frame introduces twists and reduces the mass per unit length of the feed material. Consequently, the integrity of the roving is preserved. A drawn sliver cannot be inserted directly into the ring frame because of draft restriction. It is, therefore, necessary to reduce in two stages to produce textiles of high quality. The performance of the spinner is significantly impacted by improper roving preparations. Production parameters for roving's have a substantial effect on both spinning quality and output. It has been observed that the drafting settings of speed frame machines have a significant impact on the quality of the ring yarn. Even though contemporary ring frame technology is adequate for processing coarser hank material at a higher draft speed without compromising quality, this ultimately contributes to an increase in speed frame productivity [11]. Producing roving of superior quality at a rapid rate while maintaining flexible processing conditions is an ideal outcome. This can be accomplished by optimising the process in terms of efficiency. Since speed frame substantially affects yarn quality, research into the impact of various speed frame process parameters on yarn quality has taken on considerable significance, and any effort to optimise the speed frame process parameter set at this stage is worthwhile. Apart from winding and twisting, drafting is the most significant process that affects the primary quality parameters of roving, followed by yarn.

Although numerous studies have focused on improving yarn quality by altering fibre parameters, twists, and individual spinning machines in the spinning line, there is a lack of research on enhancing yarn quality through the optimization of speed frame drafting parameters. Hence, this study aims to optimize the speed frame drafting system parameters using the Taguchi method to enhance yarn quality in the traditional ring spinning system [12–16]. The drafting parameters considered for improving yarn quality include the front top roller load, rear top roller load, spacer size, and overhang.

MATERIALS AND METHODS

Preparation of Samples

As shown in Table 1, the samples were prepared from Sankar-6 cotton using an L9 mixed orthogonal array (OA L9) which can be used to conduct experiments involving typically 4 factors set at 3 levels. Taguchi's experimental design (OA L9) was developed utilising the statistical software Minitab® 17 [17]. The design's specifics and responses are presented in Table 2. Initially, the process parameters of the roving frame (which is equipped with a PK-1500 3/3 drafting system), including front top roller load, rear top roller load, spacer size, and overhang, are optimised utilising the Taguchi method in the orthogonal array L9. Ten finisher drawframe cans are taken from the same finisher drawframe machine and criss-crossed onto the same set of spindles to eliminate any potential influence of machine conditions on the experimental outcomes. Except for the variables, every parameter is verified to be identical within the spindle. A total of nine samples are spun, each containing a unique combination of variables. A total of ten bobbins are prepared for each combination. Additionally, the identical procedure is replicated for the PK-1500 4/4 and PK-1600 4/4 drafting systems. The drafting system settings for different drafting systems at speed frame are shown in Table 3. Following this, 27 (9 x 3) distinct samples of the roving frame, each prepared using one of three drafting systems, are individually creeled onto the same set of spindles on the ring frame to produce core spun yarns. This is done to determine the impact of the various drafting systems of the speed frame on cotton Lycra yarn. The 30^s Ne core yarns are prepared on a ring frame by passing Lycra filament yarn through the front roller nip of a ring frame and roving through the drafting zone of the ring frame. The spindle speed and other spinning process parameters were kept unchanged throughout all the yarn manufacturing processes (Spindle speed-14000 rpm; Break draft-1.21; Main draft-35.4; Spacer-2.25 mm).

To generate the textile samples and examine the impact of each controllable factor on multiple responses, Taguchi's experimental design was implemented. Several studies have determined that the dimensions of the spacer, the load exerted by the top and rear rollers in the drafting zone, and the overhang significantly impact the properties of the yarn [12]. Hence, this study considers the following controllable variables: front top roller load, rear top roller load, overhang, and spacer size. The responses to this investigation are the yarn tenacity and breaking elongation, as shown in Table 4 for the various levels of these factors. To assess yarn tenacity and breaking elongation, a 500 mm length of yarn was examined at a yarn speed of 5000 mm/min for each reading and 100 observations were recorded for each yarn sample using Uster Tensorapid 4 tester. It works on the constant rate of elongation (CRE) principle where the yarn is automatically laid into the clamps and a load is exerted till the yarn breaks [18].

Table 1. L9 orthogonal array

RUN	Overhang	Front top roller load	Back top roller load	Spacer size
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

Table 2. Actual values of the process parameters of the drafting system of speed frame corresponding to coded levels

Actual values				
PK 1500 3/3				
Coded levels	Front top roller load (kgf)	Back top roller load (kgf)	Overhang (mm)	Spacer size (mm)
1	20	15	2	4.7
2	25	20	4	5.1
3	30	25	6	8.9
PK 1500 4/4				
Coded levels	Front top roller load (kgf)	Back top roller load (kgf)	Overhang (mm)	Spacer size (mm)
1	20	15	2	4.7
2	25	20	4	5.1
3	30	25	6	8.9
PK 1600 4/4				
Coded levels	Front top roller load (kgf)	Back top roller load (kgf)	Overhang (kgf)	Spacer size (mm)
1	20	10	2	4.7
2	25	15	4	5.1
3	30	20	6	8.9

Table 3. Drafting system setting in Speed frame

	PK-1500 3/3	PK-1500 4/4	PK-1600 4/4
Main Draft zone, mm	40	45	45
Break Draft zone, mm	50	55	55
Top Roller diameter, mm	28/25/28	28/25/28/28	28/25/28/28
Bottom Roller diameter, mm	30/27/30	30/28/30/30	30/28/30/30
Total draft	10.1	10.1	10.1
Break draft	1.17	1.15	1.15
Main draft	8.60	8.78	8.78

Table 4. Experiment layout using L9 orthogonal array for individual drafting system and with their responses

Experiment No	Drafting System	Overhang (mm)	Front Roller Load (kgf)	Back Roller Load (kgf)	Spacer Size (mm)	Tenacity (g/tex)	Elongation at break (%)
P 1	PK-1500 3/3	6	20(BLACK)	25(RED)	5.1	16.91	5.92
P 2		6	25(GREEN)	15(BLACK)	8.9	16.67	5.98
P 3		6	30(RED)	20(GREEN)	4.7	16.45	5.88
P 4		4	20(BLACK)	20(GREEN)	8.9	16.42	5.32
P 5		4	25(GREEN)	25(RED)	4.7	16.73	5.72
P 6		4	30(RED)	15(BLACK)	5.1	16.47	5.13
P 7		2	20(BLACK)	15(BLACK)	4.7	16.85	5.68
P 8		2	25(GREEN)	20(GREEN)	5.1	16.70	5.03
P 9		2	30(RED)	25(RED)	8.9	16.42	5.79
S 1	PK-1500 4/4	6	20(BLACK)	25(RED)	5.1	16.08	5.43
S 2		6	25(GREEN)	15(BLACK)	8.9	16.11	5.38
S 3		6	30(RED)	20(GREEN)	4.7	16.36	5.23
S 4		4	20(BLACK)	20(GREEN)	8.9	16.57	5.74
S 5		4	25(GREEN)	25(RED)	4.7	16.39	5.08
S 6		4	30(RED)	15(BLACK)	5.1	16.13	5.53
S 7		2	20(BLACK)	15(BLACK)	4.7	16.51	5.08
S 8		2	25(GREEN)	20(GREEN)	5.1	16.08	4.19
S 9		2	30(RED)	25(RED)	8.9	16.36	5.32
R 1	PK-1600 4/4	6	20(BLACK)	20(RED)	5.1	15.95	5.51
R 2		6	25(GREEN)	10(BLACK)	8.9	16.37	5.69
R 3		6	30(RED)	15(GREEN)	4.7	16.19	5.46
R 4		4	20(BLACK)	15(GREEN)	8.9	16.84	5.50
R 5		4	25(GREEN)	20(RED)	4.7	16.95	5.51
R 6		4	30(RED)	10(BLACK)	5.1	16.10	5.27
R 7		2	20(BLACK)	10(BLACK)	4.7	16.33	5.29
R 8		2	25(GREEN)	15(GREEN)	5.1	15.71	5.32
R 9		2	30(RED)	20(RED)	8.9	16.26	5.59

Taguchi Method

The Taguchi method is a technique used to minimise the variability in a process by designing robust experiments. The main goal of this method is to create a product of excellent quality while keeping the manufacturing costs low. The Taguchi method was developed by Dr. Genichi Taguchi of Japan. He believed that variation is important to consider. Taguchi developed a method to design experiments that can be used to study how various parameters impact the average and variability of a process performance characteristic, which is a measure of how effectively the process is operating. The Taguchi method employs orthogonal arrays to reduce variance and optimize process parameters. In the Taguchi method, the signal-to-noise (S/N) ratio is used as a performance characteristic to measure process robustness and to evaluate deviation from desired values [19-20]. The S/N ratio, a logarithmic function, is computed by assessing the proportion of signal (mean) to the noise (standard deviation) [20]. There exist three types of S/N ratios, namely, higher-the-better, nominal-the-best and smaller-the-better as shown in Equations (1)–(3):

Higher-the-better (HTB): This is suitable for objectives with maximization of output, or the goal is to maximize the response. The data characteristics are positive in this case. The S/N ratio for larger the better characteristics can be expressed as:

$$\left(\frac{S}{N}\right)_{HTB} = -10 \times log_{10}\left(\frac{1}{n}\sum_{i=1}^{n}\frac{1}{y_i^2}\right) \tag{1}$$

Nominal-the-better (NTB): This case arises when a specified value is most desired, meaning that neither a smaller nor a larger value is desirable. The data characteristics may be positive, zero or negative. The S/N ratio for nominal the better characteristics can be expressed as:

$$\left(\frac{S}{N}\right)_{NTB} = 10 \times log_{10}\left(\frac{\overline{y}^2}{s^2}\right) \tag{2}$$

Smaller-the-better (STB): This is suitable for objectives with minimization of output, or the goal is to minimize the response. The data characteristics are non-negative with a target value of zero. The S/N ratio for smaller the better characteristics can be expressed as:

$$\left(\frac{S}{N}\right)_{STB} = -10 \times log_{10}\left(\frac{1}{n}\sum_{i=1}^{n}y_i^2\right) \tag{3}$$

Where n is the number of experiments, y_i represents the response value of the i^{th} experiment in the OA, y^2 indicates the mean, and s^2 is the variance of the observed data.

The actual values of the maximum S/N ratio were also evaluated directly from the curves of the S/N ratio with change in process variable by using the equation:

$$S/N_{max}=S/N+(S/NA_{max}-S/N)+(S/NB_{max}-S/N)+(S/NC_{max}-S/N)+(S/ND_{max}-S/N) \quad (4)$$

where S/N_{max} is the maximum actual value from the graph; S/N is the overall average value of the S/N ratio; $S/NA_{max\ is}$, the maximum value of the S/N ratio in the plot of overhang, S/NB_{max}, the maximum value of S/N ratio in the plot of front roller load, S/NC_{max} maximum value of S/N ratio in the plot of back roller load and S/ND_{max} maximum value an S/N ratio in the plot of spacer size.

Note that the S/N ratios of the various parameters should be maximized to get the optimum set of process variables, i.e., for reading the plot, the highest values of the S/N ratio are looked up for determining the optimum value of process variables in all the cases.

RESULTS AND DISCUSSION

Table 4 shows the average mean values of tenacity and breaking elongation of yarns prepared from roving of PK 1500 3/3, PK 1500 4/4 and PK 1600 4/4 by keeping nine sets of process variables. The actual values of S/N ratios within the 95% confidence limits, S/N low (S/NL) and S/N High (S/NH) of the various drafting parameters are given in the respective Tables. Since in all the cases, the highest calculated values of the S/N ratio lie within the 95% confidence limits of actual response by graphical method there was no need for a confirmatory test.

The influence of four experimental factors viz overhang, front roller load, back roller load and including drafting system factor on the yarn characteristics are assessed for significance using ANOVA at a 95% level of significance and the results are shown in Table 5.

Effect of Process Variables on Yarn Tenacity

The ANOVA results for various variables of the speed frame drafting system on yarn tenacity are given in Table 5. Based on the findings, it is evident that the drafting system of the speed frame has a statistically significant impact on the tenacity of the yarn. However, the yarn tenacity is not significantly affected by the front roller load, back roller load, overhang, or spacer size of the speed frame drafting system. Additionally, the coefficient of determination (R^2) value of 0.571 indicates that the speed frame variable of the drafting system has minimal effect on the tenacity of the yarn.

The S/N ratio, mean value, and predicted value of yarn tenacity are shown in Table 6. It is evident from the data that the yarn spun using the PK 1500 3/3 drafting system of the speed frame exhibits the highest average values of yarn tenacity followed by the yarn spun using the PK 1600 4/4 and PK 1500 4/4 systems. This is due to the narrow roller setting (40 mm/50 mm) in the PK 1500 3/3 speed frame drafting system, which reduces floating fibres, in contrast to the wider roller setting (45 mm/55 mm) in the other two 4/4 speed frame drafting systems. Furthermore, the increased frictional field induces controlled motion of the floating fibres, which enhances their tenacity. However, broader roll settings cause a significant reduction in the frictional field, which in turn causes irregular fibre movement and ultimately a decline in yarn tenacity [21].

The percentage effect and rank of various variables of three-speed frame drafting systems on yarn tenacity are presented in Table 7. The low R^2 values for PK1500 4/4 and PK1600 4/4 indicate that yarn tenacity is not significantly correlated with overhang, front-top roller load, back-top roller load, or spacer size. The front top roller load (40.66) exerts the greatest influence on the yarn tenacity of PK 1500 3/3, while the spacer size (22.34) follows suit. The S/N ratio diagram of tenacity for various process variables of the speed frame drafting system is depicted in Figure 1. Tenacity for PK 1500 3/3 initially increases as the front top roller load is increased, then decreases as the front top roller load is further increased. This is because the optimal circumstance is established when the rear friction field penetrates deeply into the drafting zone to direct the fibres over a considerable distance, while the front field remains brief yet precisely defined, ensuring that exclusively the nipped fibres are drawn out of the fibre strand. Strong compression and a correspondingly strong friction field result from high front top roller load; consequently, the back and front load fields may overlap in the main drafting zone, impeding the proper and smooth motion of the fibres [22]. Additionally, the primary impact of the front top roller load is observed exclusively in the 3/3 drafting system, which could be attributed to the lack of a condensing zone in PK 1500 3/3. When the roller load is low, the undrafted material tends to come out of the drafting zone because there is less influence from the fibre friction field. Similarly, when the top roller load is very high, the fibres in the drafting field can move in an uncontrolled manner as the drafting force increases. The ultimate yarn structure experiences an uneven distribution of fibres, resulting in a decrease in yarn strength [9]. For PK 1500 3/3, the tenacity rises as the spacer size increases. This is because the fibre assemblage is attenuated more smoothly due to the decreased cohesiveness, resulting in an integrated yarn structure [23]. An increase in spacer size results in a greater gap between the drafted fibre assembly and the top and bottom aprons. Increasing space during the attenuation of the fibre assembly decreases the cohesive forces between fibres, resulting in a more uniform attenuation process and fibre straightening that enhances the yarn's tenacity [21]. The optimum values of variables for yarn tenacity in various speed frame drafting systems, along with their corresponding predicted means using MINITAB, are presented in Table 8.

Table 5. ANOVA test results

	P value	
	Tenacity	Breaking elongation
Drafting System	0.022^s	0.029^s
Overhang, mm	0.336	0.048^s
Front roller load, kgf	0.316	0.381
Back roller load, kgf	0.794	0.199
Spacer size, mm	0.074	0.066
R^2	0.571	0.640
s-significant at 95% confidence limit		

Table 6. S/N ratios and mean values of tenacity and elongation of yarn

	PK 1500 3/3	PK 1500 4/4	PK 1600 4/4
Tenacity (gm/tex)			
S/N ratio calculated	24.56	24.39	24.60
S/N ratio actual	24.57	24.39	24.60
S/N L	24.50	24.32	24.46
S/N H	24.63	24.46	24.73
Average	16.62	16.28	16.30
Predicted	16.91	16.58	16.79
Breaking elongation (%)			
S/N ratio calculated	14.51	15.71	15.29
S/N ratio actual	14.51	15.72	15.28
S/N L	14.277	15.209	15.13
S/N H	14.743	16.231	15.43
Average	5.60	5.22	5.46
Predicted	6.52	6.01	6.25

Table 7. Changes in the S/N ratio of tenacity and elongation as explained by ANOVA and ranked by the Taguchi method

	PK 1500 3/3		PK 1500 4/4		PK 1600 4/4	
	Tenacity	Elongation	Tenacity	Elongation	Tenacity	Elongation
Overhang (mm)						
Taguchi rank	4	3	3	1	2	2
% V Effect	0.21	3.93	9.11	22.6	0.59	21.90
Front top roller load (kgf)						
Taguchi rank	1	4	2	2	3	4
% V Effect	40.66	0.72	5.74	0.31	4.35	0.04
Back top roller load (kgf)						
Taguchi rank	3	2	4	4	4	3
% V Effect	0.28	6.49	0.36	0.28	1.74	13.42
Spacer size (kgf)						
Taguchi rank	2	1	1	3	1	1
% V Effect	22.34	14.65	2.78	18.93	9.36	47.37
R^2	63.49	25.79	18.08	45.78	16.03	84.48

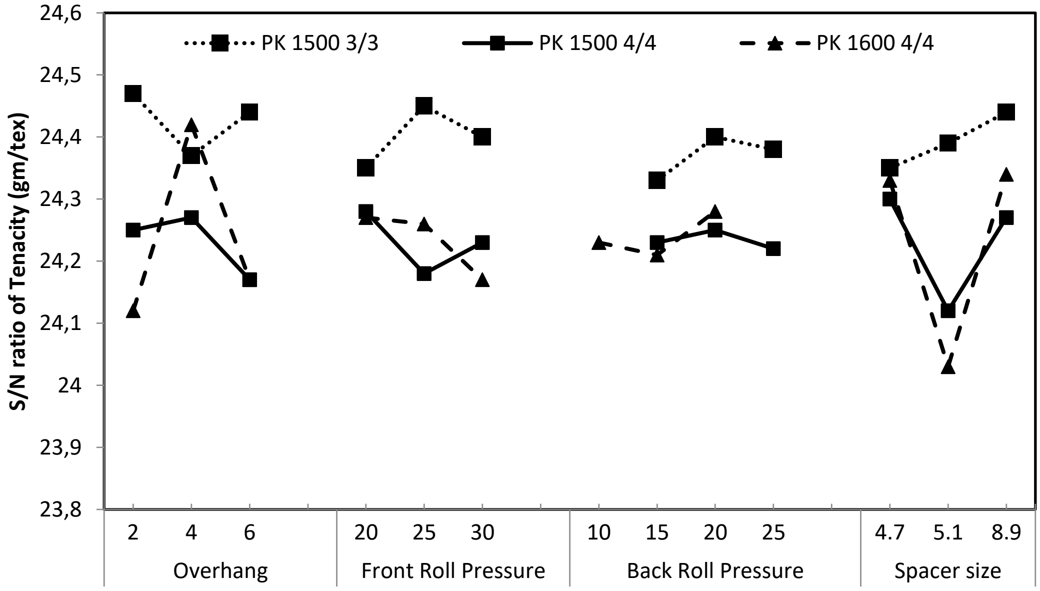

Figure 1. S/N ratio plot of tenacity with change in process variables

Table 8. Optimum values of process variables of different drafting systems

Drafting System		Yarn property	Overhang (mm)	Front roller load (Kgf)	Back roller load (Kgf)	Spacer size (mm)	Predicted mean	S/N ratio
PK 1500	3/3	Tenacity (gm/tex)	6	20	25	5.1	16.91	24.57
		Elongation %	4	30	20	8.9	05.32	14.51
PK 1500	4/4	Tenacity (gm/tex)	4	20	25	4.7	16.59	24.39
		Elongation %	4	20	15	8.9	06.02	15.70
PK 1600	4/4	Tenacity (gm/tex)	4	20	20	8.9	16.98	24.60
		Elongation %	6	25	20	8.9	05.81	15.29

Effect of Process Variable on Breaking Elongation

Table 4 presents the ANOVA results for different variables of the speed frame drafting system on yarn breaking elongation. The results indicate that the drafting system and overhang of the speed frame have a notable impact on yarn elongation. However, other variables of the speed frame drafting system, such as front roller load, back roller load, and spacer size, do not have a significant effect on yarn breaking elongation. In addition, the R^2 value of 0.640 indicates that the drafting system variable at the speed frame has a minimal impact on yarn-breaking elongation.

Table 5 displays the signal-to-noise ratio, average value, and projected value for yarn-breaking elongation. The data indicates that the highest average values of yarn breaking elongation are found in the yarn spun from the PK 1500 3/3 drafting system of speed frame, followed by PK 1600 4/4 and PK 1500 4/4. The reason for this is the narrower roller setting (40 mm/50 mm) in the PK 1500 3/3 speed frame drafting system, in contrast to the broader roller settings (45 mm/55 mm) in the other two 4/4 speed frame drafting systems. This narrower setting lowers the presence of floating fibres, resulting in a more optimal arrangement of fibres.

Table 6 displays the percentage impact and ranking of several variables in the three-speed frame drafting system on yarn-breaking elongation. The low R^2 values for PK1500 3/3 and PK 1500 4/4 indicate a weak correlation between yarn breaking elongation and front top roller load, back top roller load, overhang, and spacer size. Spacer size has the greatest impact on yarn elongation for PK 1600 4/4 (47.37), with overhang coming in second (21.90). Figure 2 displays the signal-to-noise ratio plot of elongation for various process variables in the speed frame drafting system. For PK 1600 4/4, the breaking elongation initially increases as the spacer size increases, but then decreases. This is because when the space between the aprons is small, the fibres are unable to move easily. Conversely, if the space is large, there is insufficient control to guide the fibres towards the delivery roller. As a result, the fibres become disordered in the yarn structure, leading to a decrease in yarn-breaking elongation [16]. The optimal values of the variables for the various drafting systems of the speed frame for yarn-breaking elongation are displayed in Table 7 along with their anticipated means, which were determined using MINITAB.

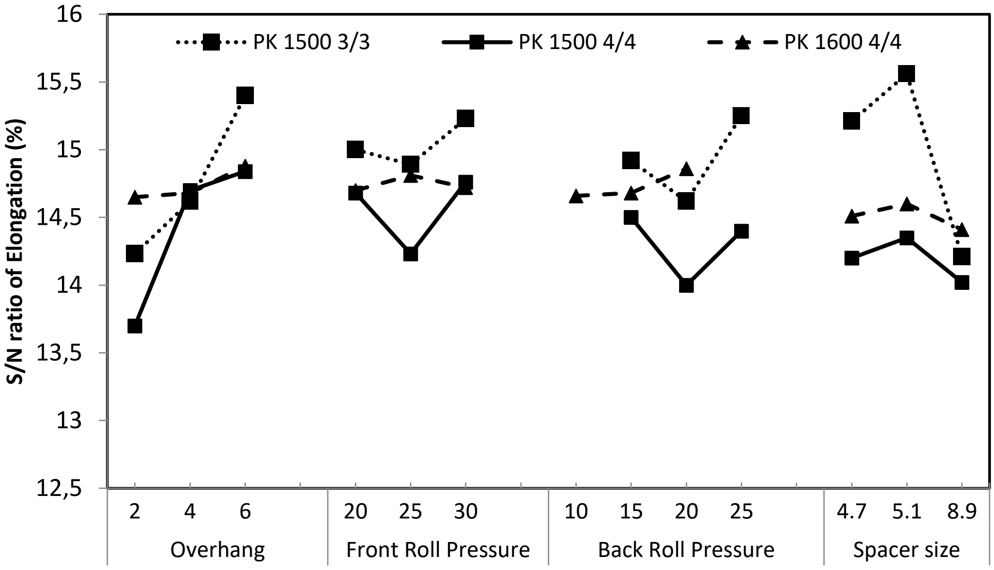

Figure 2. S/N ratio plot of Elongation with change in process variables

CONCLUSION

The study found that yarn spun using the PK 1500 3/3 drafting system had the highest average yarn strength, performing better than the PK 1600 4/4 and PK 1500 4/4 systems. The size of the spacer had a smaller effect on the strength of the yarn compared to the load on the front top roller. Initially, increasing the roller load increased the strength of the yarn, but then it decreased afterwards. The impact of this effect was particularly significant in the 3/3 drafting system. The elongation of yarn was greatly affected by the drafting system and overhang, but the front and back roller loads, as well as the spacer size, had very little impact. The PK 1500 3/3 system also produced yarn that had the highest breaking elongation. It was followed by the PK 1600 4/4 and PK 1500 4/4 systems.

The results indicate that by adjusting the parameters of the drafting system, specifically in the PK 1500 3/3 setup, it is possible to improve the quality of the yarn. It is important to choose the right drafting systems and settings to enhance the mechanical properties. However, the fact that the R^2 values are lower for different drafting systems and their variables suggests that yarn quality is influenced less by roving quality and more by the parameters of the ring frame process. The study emphasises the importance of considering drafting system variables in yarn production for students. It also encourages further investigation into ring frame parameters. The limitations of this study are that it only focuses on a particular set of drafting systems and variables. This suggests that further research is needed to include a wider range of systems and conditions. In the future, it would be beneficial for researchers to study more factors that can impact the quality of yarn. This could include looking at things like process parameters, environmental conditions, and the properties of the fibres used. By doing so, we can gain a more complete understanding of all the different factors that can influence the production of yarn.

Author Contributions

Conceptualization– Goyal A, Dhiman S; methodology – Goyal A, Dhiman S; formal analysis – Goyal A, Dhiman S, Pattanayak AK, Patnaik A; investigation – Dhiman S; writing-original draft preparation – Goyal A, Dhiman S; writing-review and editing – Goyal A, Pattanayak AK, Patnaik A; visualization – Dhiman S; supervision –Goyal A. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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