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Effect of Changing Front Top Roller Pressure of Drafting Zone of a Ring Frame on the Quality of Cotton-Flax Blended Yarn

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Abstract

Pressure applied on the top roller of drafting zone is a vital factor on which the quality of ultimate yarn depends. Drafting zone is needed to reduce the mass per unit length of input material. Appropriate contact of top rollers with bottom rollers is necessary to ensure proper drafting. In this paper, the effects of different front top roller pressure of drafting zone on the quality of 20Ne cotton-flax blended yarns (C:L = 45:55) were studied. It was observed that a higher pressure value gives a lower co-efficient of mass variation, imperfections, hairiness and higher evenness, tenacity, elongation properties.

Keywords

Arm Pressure, Drafting Zone, Jingwei F-1520, Unevenness, Imperfection, Tenacity, Blended Yarn

1. Introduction

The arm pressure loads of roller drafting system in ring frame machine have a great influence on the yarn properties to produce a high quality yarn. Fiber friction, the roller setting and top arm pressure have a major impact on the nature of fiber movement during the drafting stages [1]. The ratio of the surface speed of succeeding rollers to that of the preceding rollers is defined as a draft. Here, the rollers run at higher speeds from the back- to the front-rollers and the fibre strand comparatively becomes thinner by drafting. In a ring spinning machine mostly 3-over-3 roller with a double apron drafting system is used to produce yarn from roving. The bottom rollers are made of steel and the top rollers are covered with synthetic rubber. The bottom rollers are positively driven and the top rollers are run by frictional surface contacts of the bottom rollers. The top rollers must be pressed with relatively high force over bottom rollers by spring load, air pressure or magnetically. The drafting force is needed to draft the fibre strand which gets from the loading of the pressure of top rollers by pressure arm [2].

Various research works have been carried out on the impacts of roller settings on various aspects during roller drafting [3] [4] [5]. The optimal changes on bottom roller setting, roller pressure and break draft at draw frame drafting system, showed that the yarn unevenness, coefficient of variation, end breakages rate, yarn hairiness, imperfections were reduced significantly and yarn strength was also improved [6]. Recently, Yuemin *et al.* [7] studied the effects of block gauge, pressure on the front rollers and break draft on a modified drafting system based on the ring spinning frame to produce 18.2 tex cotton yarn.

A number of research works also carried out on drafting force and its impact on the properties of yarn [8] [9] [10] [11] [12]. Qasim *et al.* [13] studied the online drafting force and its variability at draw frame drafting system and found that the minimum variability of drafting force ensures better fiber distribution along the sliver length resulting in a lower irregularity of sliver at certain break draft ratios.

In another, Qasim *et al.* [14] analyzed the draftometer data of dynamic drafting force and its variability with respect to the short fiber content of cotton carded sliver.

Mohammad *et al.* [15] proposed an experimental design to analyze the effects of the total draft, break draft, distance between the aprons (Clips) and production roller pressure to spin a 20 Tex blend yarn of PES (70%)/CV (30%) blend ratio. Results showed that the best quality of yarn was obtained under a total draft of 38, 1.2 break draft, 2.8 mm distance between of aprons and the maximum pressure of the production top roller (18 daN).

With the increase of top arm pressure the fiber friction area increases, which assists in better controlling the fiber flow in the drafting zone but in case of too high pressure, deteriorates the yarn quality. Previous studies showed that most of the works on top arm pressure are applied to cotton and synthetic yarns but till now little is known about the effects of top arm pressure on cotton-flax blended yarns.

In this project, we used a ring frame machine (jingwei F-1520) where spring loaded pressure arm was used. Particular amount of load is applied on each top rollers of drafting zone in every weighting system. Some pressure disc red, green and black are used to represent particular amount of pressure in kgs. The main object of this study was to investigate the yarn quality parameters by changing the front top roller pressure of drafting zone to optimize the yarn quality.

2. Materials and Methods

2.1. Materials

In this study Pima cotton, Chad cotton and Indian flax fibers were used to produce 20Ne cotton-flax blended yarn. The average flax fiber length was 40 mm and average fineness was 32 denier. The fiber properties of raw cottons were tested by USTER HVI (High Volume Instruments)-1000 Machine which are given in Table 1.

2.2. Methods

The cotton fibers and flax fiber were mixed on a Trutzschler blow room line with a mixing ratio of 25:20:55 for pima cotton, chad cotton and Indian flax fiber accordingly. Chute mat was produced at end of the blow room line. Then the card slivers (109 grains/yard) were produced through a carding machine (Trutzschler BC-05) and breaker draw frame (SBD-40) to produce first drawn sliver (90 grains/yard). First drawn slivers were then processed through a finisher draw frame and produced finisher drawn sliver (90 grains/yard). Then 0.73Ne roving were produced through speed frame (Toyota FL-16) and finally 20Ne cotton-flax blended yarns were produced in ring frame machine (Jingwei F-1520). To investigate the effects of different front top roller pressure, color of pressure disc were changed. Red, green and black colors of pressure disc represent 18, 14 and 10kg pressure on the front top roller respectively. To study the front top roller pressure, back and middle top roller pressure were kept constant (Table 2). Others parameters of ring frame were used to produce yarns are also given in Table 3.

We used 8 spindles where the total number of spindle of this ring frame was 1008. Produced yarns are collected from these eight spindles by changing front top roller pressures were 18, 14, 10 kgs respectively and tested on an USTER TESTER-5 machine for testing count, evenness, co-efficient of mass variation, imperfection, hairiness, CSP, tenacity and elongation. From each combination 8 readings were tested. The irregularity, hairiness and imperfections of all the yarns were tested on an Uster Tester-5 at 400 m/minute for 1 minute. Tenacity (RKM) were conducted through Mesdan lab strength tester with CRE principle with 500 mm sample length and clamp speed 500 mm/min. Count Strength Product (CSP) were also done with CRE principle through Elestretch (Mesdan lab).

Table 1. Fiber properties of Pima and Chad cotton.

Sl No.	SCI	Mst %	Mic	Mat	UHML mm	UI %	SFC %	Str g/tex	Elg %	Rd	+b	Colour grade	TrAr %	TrCnt Cnt/gm	Trash grade
USA Pima Cotton	200	4.6	4.12	0.86	35.38	86	5.3	43.2	7.2	72.7	10.9	33-1	0.12	17	1
Chad Cotton	151	6.9	4.62	0.87	30.48	83.7	7.2	34.6	6.4	74.9	11.2	23-1	0.34	14	3

Table 2. Combination of top rollers pressures of drafting zone.

Roller	Pressure for Red	Pressure for Green	Pressure for Black
Front	18	14	10
Middle	16	16	16
Back	14	14	14

3. Result

The detailed yarn quality parameters corresponding to given front top roller pressures in drafting zone of ring frame are given in **Tables 4-6** shows the different yarn characteristics and their correlation with the chosen variables. The values of top roller pressures for all the yarn characteristics were well correlated with all the chosen variables.

Correlation of yarn quality parameters with the changing of front top roller pressures of drafting zone of ring frame are graphically presented below.

4. Discussion

Figures 1-7 show that unevenness, co-efficient of mass variation, thin place, thick place, neps, imperfection, hairiness values decreases and **Figures 8-10** represents tensile properties of yarns *i.e.* CSP, elongation and tenacity (RKM) increases with increasing front top roller pressure. In almost all the cases highest

Table 3. Parameters of ring frame to produce 20Ne cotton-flax blended yarns.

Parameter	Value
Break draft	1.52
Front draft	18.78
Total draft	28.55
T.P.I	23.04
Twist multiplier	5.15
Traveler number	1/0
Spacer	4 mm
Roller gauge	44mm × 54mm
Spindle speed	9500

Table 4. Characteristics of yarns for applying 10 kg pressure on the front top roller of drafting zone.

No.	U%	CVm%	Thin −50%/km	Thick +50%/km	Neps +200%/km	IPI	H	CSP	Elongation %	RKM (CN/Tex)
1	23.53	30.17	2590	3803	6855	13,248	6.68	1720	5.40	13.44
2	23.61	30.51	2865	3993	7258	14,116	6.75	1725	5.22	12.36
3	23.91	30.72	2823	3990	6918	13,731	6.61	1700	5.16	12.29
4	22.88	29.66	2575	3525	6963	13,063	6.75	1698	5.10	12.15
5	24.08	31.29	3288	4078	7878	15,244	6.77	1735	5.04	11.91
6	24.06	30.99	2968	4000	7203	14,171	6.81	1738	4.92	11.84
7	23.34	30.03	2588	3873	6838	13,299	6.64	1745	4.92	11.64
8	23.56	30.44	2468	3723	6598	12,789	6.39	1739	4.80	11.57
Mean	23.62	30.48	2770.63	3873.13	7063.88	13,707.63	6.68	1725.00	5.07	12.15

Table 5. Characteristics of yarns for applying 14 kg pressure on the front top roller of drafting zone.

No.	U%	CVm%	Thin −50%/km	Thick +50%/km	Neps +200%/km	IPI	H	CSP	Elongation %	RKM (CN/Tex)
1	22.04	28.33	1835	3583	6873	12,291	6.67	1804	5.40	13.48
2	23.26	30.01	2648	3843	7408	13,899	6.84	1807	5.34	13.61
3	22.62	29.19	2110	3720	7008	12,838	6.7	1795	5.22	12.87
4	23.77	30.31	2795	3945	7193	13,933	6.86	1800	5.15	12.87
5	21.81	27.83	1675	3405	6588	11,668	6.55	1803	4.92	12.63
6	22.49	28.67	2130	3530	6928	12,588	6.8	1803	4.86	12.39
7	24.37	31.29	3253	4340	7778	15,371	6.88	1815	4.80	11.74
8	23.39	30.21	2715	3868	7245	13,828	6.88	1815	4.74	11.47
Mean	22.969	29.480	2395.125	3779.250	7127.625	13,302.000	6.773	1805.250	5.05	12.59

Table 6. Characteristics of yarns for applying 18 kg pressure on the front top roller of drafting zone.

No.	U%	CVm%	Thin −50%/km	Thick +50%/km	Neps +200%/km	IPI	H	CSP	Elongation %	RKM (CN/Tex)
1	21.7	28.22	1518	3353	6295	11,166	6.79	1988	6.78	15.25
2	22.03	28.44	1455	3460	6340	11,255	6.55	1989	6.78	14.70
3	22.79	29.64	2090	3730	6998	12,818	6.78	2001	6.48	14.50
4	22.54	29.44	2000	3628	6508	12,136	6.56	1985	6.42	14.30
5	22.33	29.08	1848	3670	6668	12,186	6.7	1990	6.36	14.30
6	22.08	28.84	1668	3335	6228	11,231	6.67	1988	6.24	14.26
7	22.65	29.59	2150	3608	7000	12,758	6.74	1981	6.12	14.12
8	22.85	29.75	2140	3680	6908	12,728	6.67	1982	6.06	13.51
Mean	22.371	29.125	1858.625	3558.000	6618.125	12,034.750	6.683	1988.000	6.40	14.36

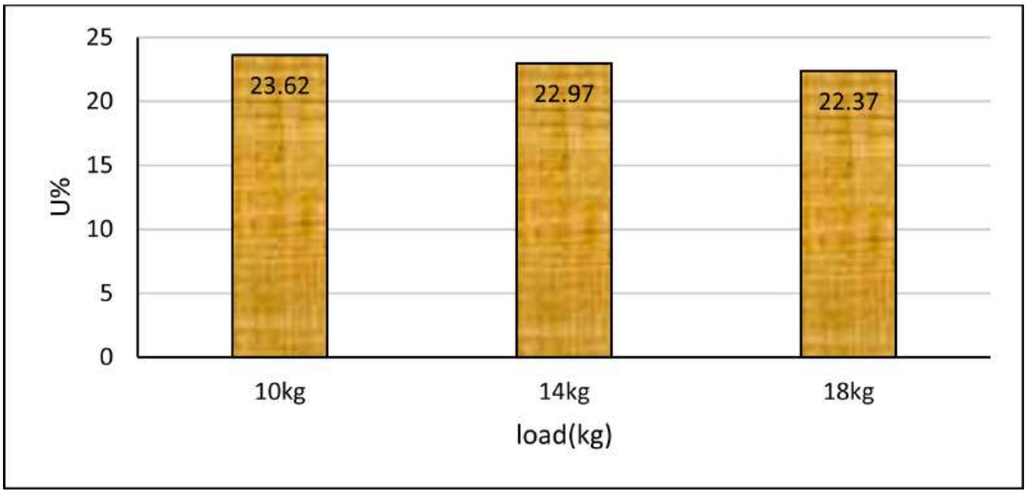

Figure 1. Effects of yarn unevenness on front top roller pressures of drafting zone.

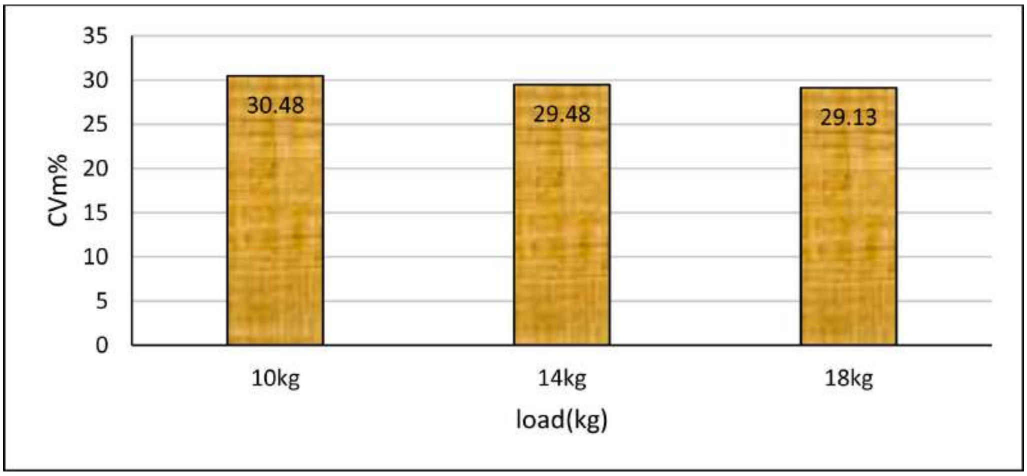

Figure 2. Effects of co-efficient of mass variations of yarns on front top roller pressures of drafting zone.

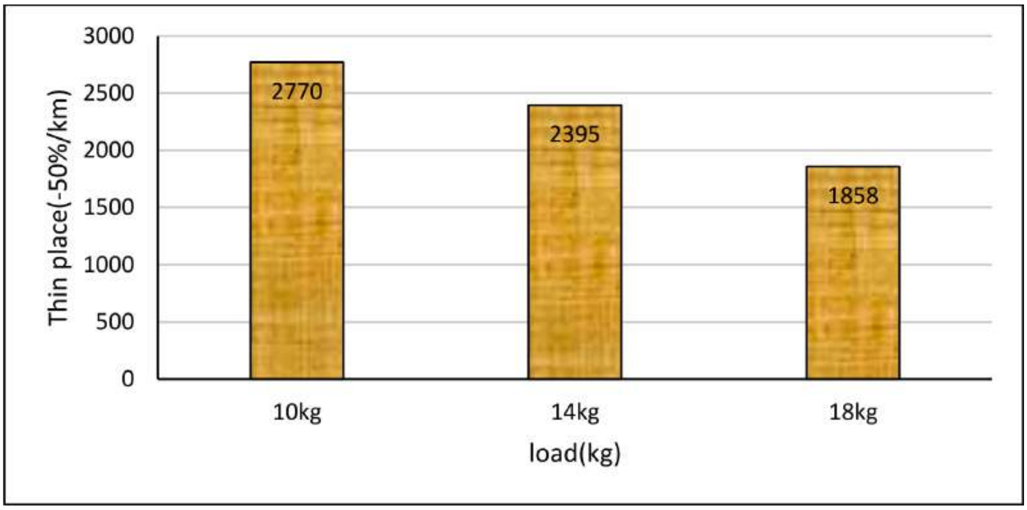

Figure 3. Effects of thin places of yarns on front top roller pressures of drafting zone.

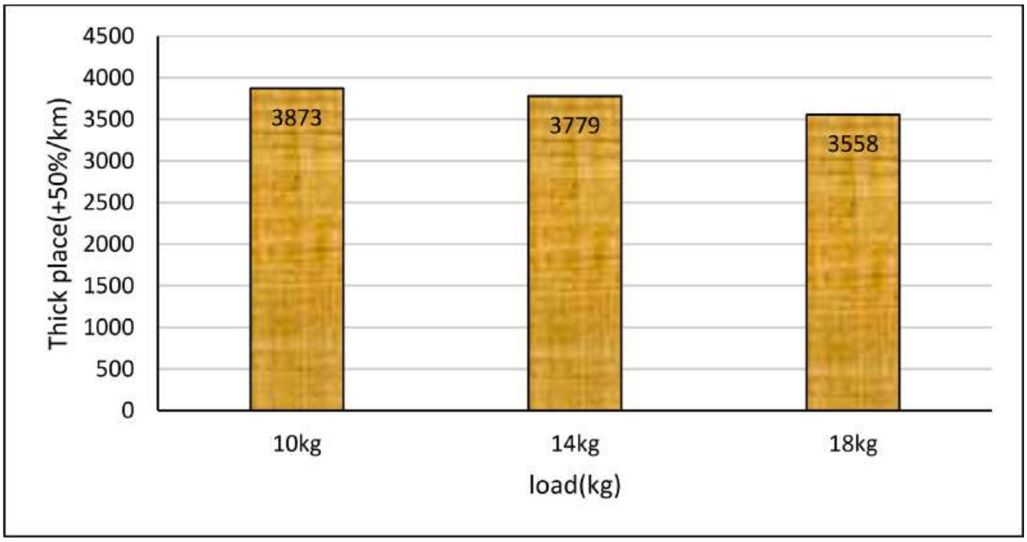

Figure 4. Effects of thick places of yarns on front top roller pressures of drafting zone.

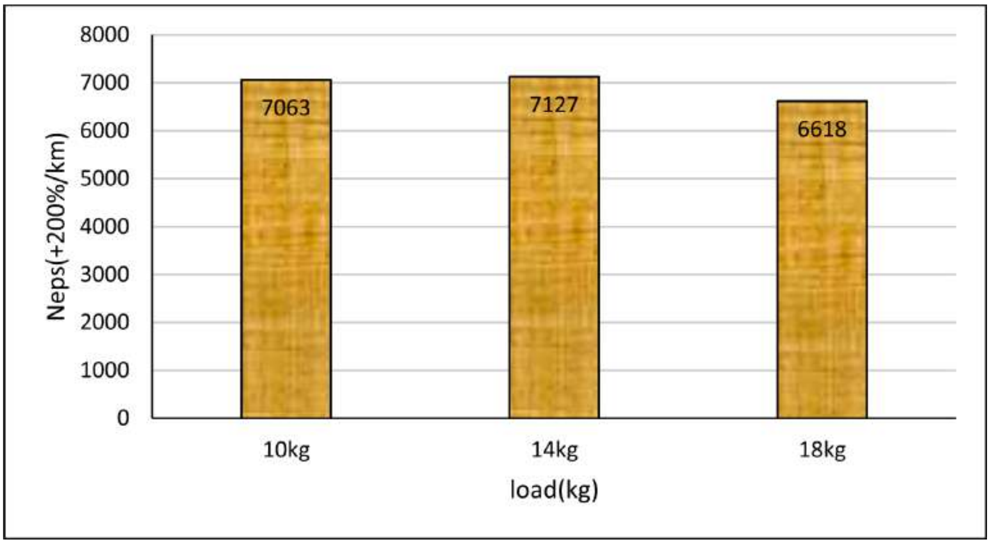

Figure 5. Effects of yarn neps on front top roller pressures of drafting zone.

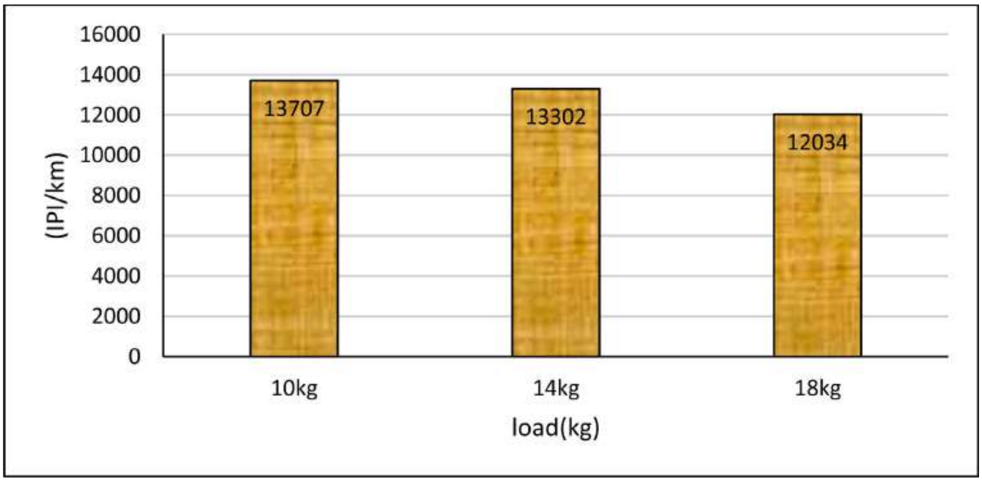

Figure 6. Effects of yarn imperfections on front top roller pressures of drafting zone.

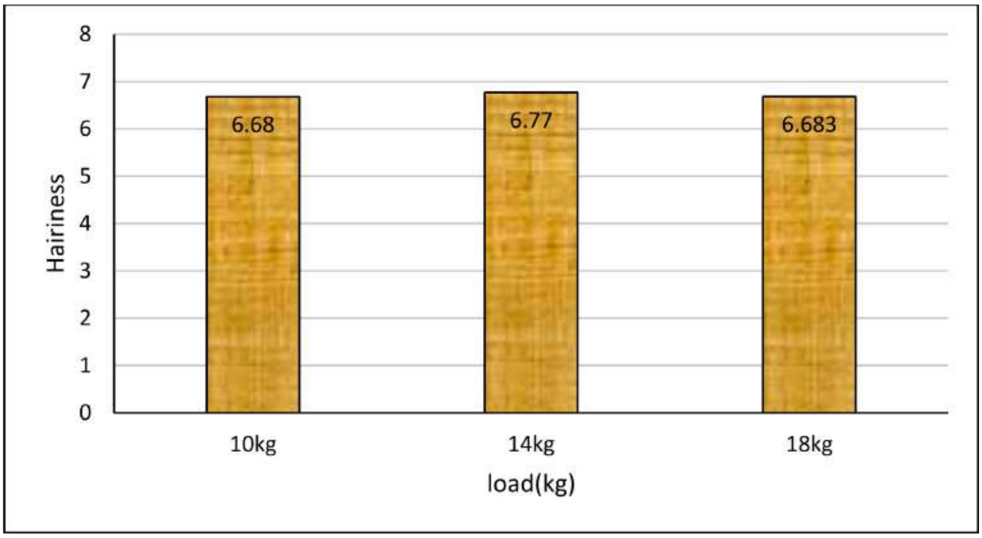

Figure 7. Effects of yarn hairiness on front top roller pressures of drafting zone.

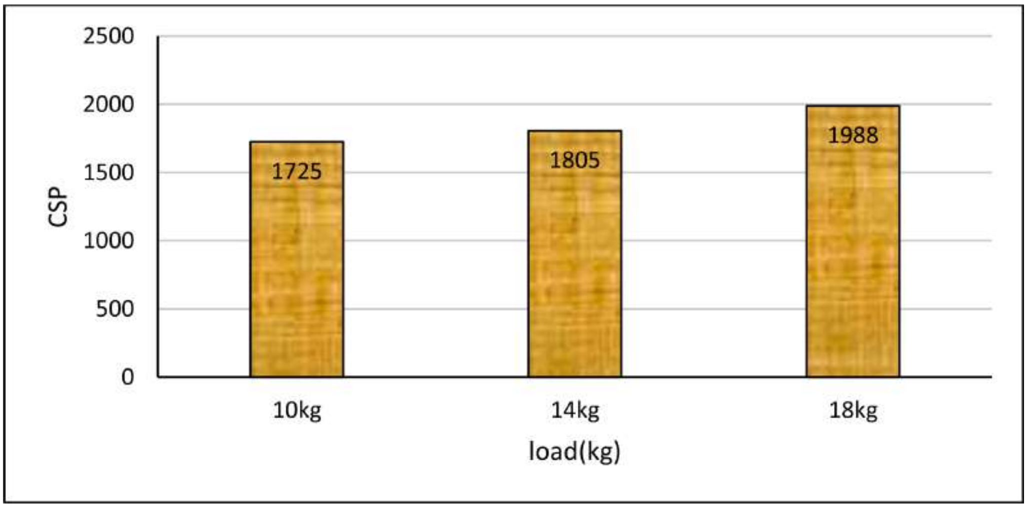

Figure 8. Effects of yarn CSP on front top roller pressures of drafting zone.

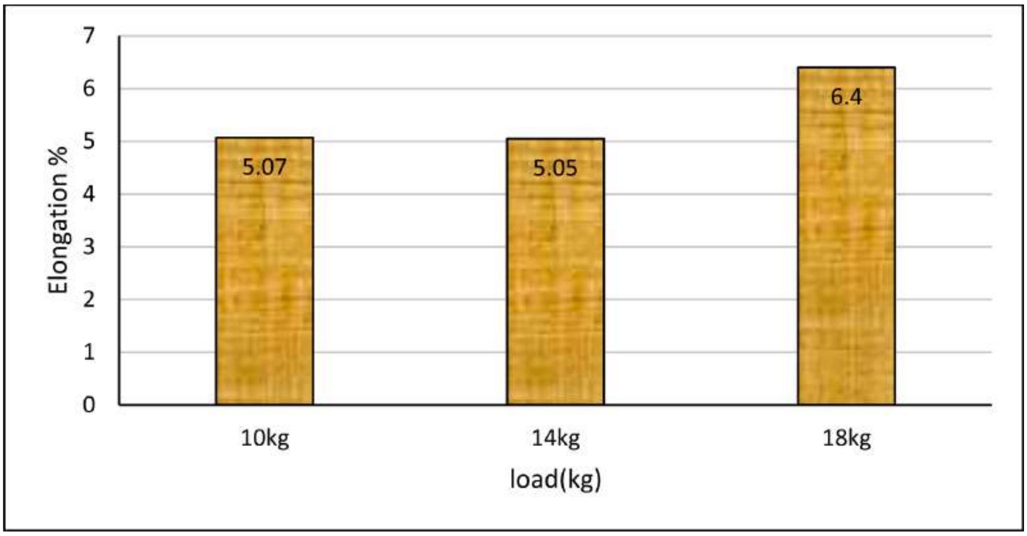

Figure 9. Effects of yarn elongation on front top roller pressures of drafting zone.

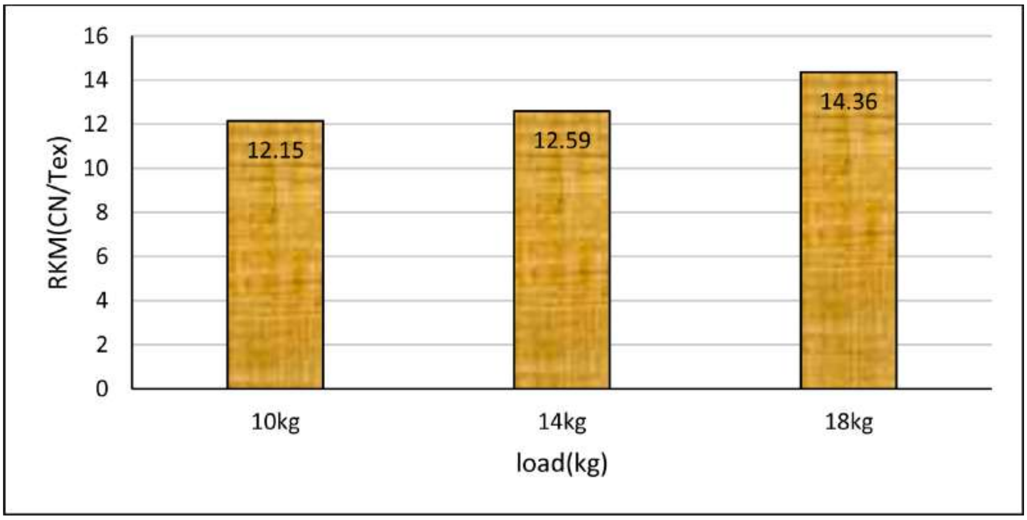

Figure 10. Effects of yarn tenacity on front top roller pressures of drafting zone.

pressure showed better results (higher evenness and strength).

5. Conclusion

The study shows the arm pressure loads of roller drafting system has a great influence on the yarn properties. It was found that the higher value of front top roller pressure gave higher evenness of yarns. Imperfection and hairiness also decrease with the increase of top roller pressure. Tensile properties *i.e.* yarn tenacity and elongation% also improved by applying 18 kg pressure to produce 20Ne cotton-flax blended yarns.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Ishtiaque, S.M., Das, A. and Niyogi, R. (2006) Optimization of Fiber Friction, Top Arm Pressure and Roller Setting at Various Drafting Stages. *Textile Research Journal*, **76**, 913-921. https://doi.org/10.1177/0040517506067331

[2] Rengasamy, R.S. (2010) Fundamental Principles of Ring Spinning of Yarns. In: Lawrence, C.A., Ed., *Advances in Yarn Spinning Technology*, Woodhead Publishing, Sawston, Cambridge, 42-78. https://doi.org/10.1533/9780857090218.1.42

[3] Ghosh, G.C. and Bhaduri, S.N. (1962) Dependence of Hook Removal at Drawing on Some Drafting Parameters. *Textile Research Journal*, **32**, 864-866. https://doi.org/10.1177/004051756203201013

[4] Cavaney, B. and Foster, G.A.R. (1955) 38—The Irregularity of Materials Drafted on Cotton Spinning Machinery and Its Dependence on Draft, Doubling and Roller Setting. *Journal of the Textile Institute Transactions*, **46**, T529-T550. https://doi.org/10.1080/19447027.1955.10750339

[5] Anderson, S.L. and Foster, G.A.R. (1955) 39—The Irregularity of Materials Drafted on Cotton Spinning Machinery and Its Dependence on Draft, Doubling and Roller Setting. *Journal of the Textile Institute Transactions*, **46**, T551-T564. https://doi.org/10.1080/19447027.1955.10750340

[6] Ramasamy, K.M., Duraisamy, R. and Mammo, H. (2019) Improving Yarn Quality by Modification on Drafting Zone Settings of Draw Frame. *International Journal of Engineering Trends and Technology*, **67**, 157-166. https://doi.org/10.14445/22315381/IJETT-V67I11P226

[7] Cui, Y., Song, H., Cheng, L., Deng, W. and Ji, Y. (2021) Experimental Study of a Modified Drafting System Based on the Ring Spinning Frame. *Textile Research Journal*, **91**, 1486-1496. https://doi.org/10.1177/0040517520984977

[8] Das, A., Ishtiaque, S.M. and Kumar, R. (2004) Study on Drafting Force of Roving: Part III—Effect of Process Parameters and Roving Irregularity on Drafting Force Variability. *Indian Journal of Fibre and Textile Research*, **29**, 308-312.

[9] Das, A., Ishtiaque, S.M. and Kumar, R. (2004) Study on Drafting Force of Roving: Part IV—Correlation between Drafting Force, Roving Strength and Yarn Quality. *Indian Journal of Fibre and Textile Research*, **29**, 313-317.

[10] Olsen, J.S. (1974) Measurement of Sliver Drafting Forces. *Textile Research Journal*, **44**, 852-855. https://doi.org/10.1177/004051757404401105

[11] Su, C.I., Lo, K.J. and Lee, J.Y. (1998) Drafting Force of Fine Denier Polyester Fibers. *Textile Research Journal*, **68**, 559-563. https://doi.org/10.1177/004051759806800803

[12] El-Sharkawy, A.F., Audivert, R. and De Castellar, M.D. (1974) The Relation between the Drafting Force, Draft, and Setting in the Roller-Drafting of Staple-Fibre Slivers. *Journal of the Textile Institute*, **65**, 325-327. https://doi.org/10.1080/00405007408630476

[13] Siddiqui, Q., Abro, Z. and Yu, C. (2015) Study of Drafting Force Variability and Sliver Irregularity at the Break Draft Zone of a Draw Frame. *Textile Research Journal*, **85**, 1465-1473. https://doi.org/10.1177/0040517514563724

[14] Siddiqui, Q., Naeem, M.A. and Ndlovu, L. (2020) A Preliminary Study on the Effect of Short Fiber Content on Drafting Force and Its Variability. *Journal of Natural Fibers*. https://doi.org/10.1080/15440478.2020.1727816

[15] Hatamvand, M., Mirjalili, S.A., Fattahi, S., Bashir, T. and Skrifvars, M. (2017) Optimum Drafting Conditions of Polyester and Viscose Blend Yarns. *Autex Research Journal*, **17**, 213-218. https://doi.org/10.1515/aut-2016-0016