THE FEASIBILITY OF MODERNIZING RING FRAMES
PART I. TECHNOLOGICAL STUDY

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ABSTRACT

Due to escalating prices of textile machineries, the feasibility of modernizing ring spinning frame should be considered. In this work, a study of yarn quality of two machines after modernizing presented. The first machine only the drafting system is changed. For the second machine the drafting system geometry, ring and spindles are changed. It is found that by changing drafting system spinning geometry, rings and spindle, an increase of 30% of the production is possible maintaining an acceptable level of ends down and yarn quality "better than 25% world standard according to uster statistics. Changing the drafting system alone is not enough. The decisive factor, for modernization should be the spinning cost of yarn.

INTRODUCTION

In the last decade the process of textile machines are escalating the change of the textile industry from a labour intensive industry to a capital intensive one (1) introduced some modern trends such as automation computerization and on line production control.

In modern developed countries investments are in short and in an industry of a limited profit margin such as textile an alternative approach other than completely new investments should be investigated . One of these alternatives is modernization of an old ring spinning frame. There are some other justifications of using moderni..ed machines rather than a completely new machines.

El-Messiery [2] have proved that increasing spindle speeds beyond certain limit may lead to an increase in total yarn cost per kg-due to a variety of reasons power cost may be the most influencing factor.

Relatively cheaper labour rates of pay many be another limitation of investment-in automated machines.

Mashaly [3] have proved that automatic doffing for example costs much more than manual doffing during the life span of the spinning machine.

A third consideration is that some studies [4] have proved that the cost of one end per breakage in spinning may mount to 0.16 LE. An increase in ends down rate extremely high speed machines should therefore be considered carefully.

Some yarn properties-are new known to be adversely affected by increased spindle speed [5] such as yarn hairiness a phenomena of growing interest in both yarn production and usage.

If modernization of conventional old frame proved to produce an acceptable quality yarn with a competitive cost per kg as compared to yarns produced at new spinning frames, the modernization will be feasible.

In this research, the yarn quality of two differently modernized ring spinning frames is considered.

The first machine is a conventional ring frame for which the drafting system is equipped with a new SKF drafting system-PK 225. The spindle and ring remain unchanged.

The second spindle and ring designs. When modernizing ring spinning frames, it is suggested that the geometry of twisting mechanism should be taken into considerations as it affects yarn tension and consequently end breakage rates. Reduced bobbin lift-reduced spindle and bobbin diameters compared to ring diameter proved to be of important effect.

It was found that the ratio of ring diameter D to bobbin diameter d of about 1.9 gives best results, while bad results occur when D/d exceed 2.4 A value of winding angle of 25° gives the best results [4]

EXPERIMENTAL WORK

Spinning procedure

The basic independent variable considered is the balloon tension which is affected by many variables, spindle speed, yarn count, ring diameter, travelled weight and spinning geometry.

The yarn balloon tension is calculated for each case using capella equations [6].

$$\alpha^2 + \frac{2P\sqrt{m}\ .\mathrm{Sin}^2 PH}{\gamma(2PH - \mathrm{Sin}2PH)} . \alpha - \frac{r^2}{H^2} = 0$$

$$\rho^2 m = \frac{r^2 - \alpha^2 H^2}{\sin^2 PH} + \alpha^2 \pi^2 / 4P^2$$

where,

α- angle between X-axis and the projection of the straight line (ballon) >

m- mass of the length unit of the yarn

H- balloon height

yx,z- cartesian axes

$$p = \frac{\sqrt{m}\ .\omega^2}{T_x}$$

r- radius of the smallest balloon circle

ρ- radius of the largest balloon circle.

As the yarn count, travelled weight are kept const. only spindle speed and spinning geometry yielded the balloon tension variation.

Yarn count produced is 36 with nominal twist factor 4, made Giza 75 cotton-spindle speeds are varied in arrange from 7000 rpm to 11350 rpm.

The two modifications considered are the change of drafting system alone and changing both draft system, spindles, rings and spinning geometry.

TESTING PROCEDURE

The yarn properties considered are; yarn tenacity, c.v. % strength, yarn elongation, uster evenness test and mean twist & c.v. %.

Yarn hairiness is evaluated using F-Index tester reviewed else where (4).

For quality reference uster statistics are considered (7).

The testing procedure has been carried out according to the ASTM standards.

RESULTS AND DISCUSSIONS

Variation of Yarn Tenacity With Ballon Tension

Table 1 gives a summary of the experimental results. Figure (1) illustrates the relation between yarn tenacity in CN/tex and balloon tension in CN.

There is a general trend of increasing tenacity with increased balloon tension within the range of experiments. However thr increase in yarn tenacity is not appreciable. This is justifiable on the ground that, higher tension during spinning creates differential tension promoting fibre migration. In addition-fibres subjected to higher tensions are liable to be oriented in the direction of yarn axis (7). This trend is found in modifications but it is m[ore] pronounced with sussen modification.

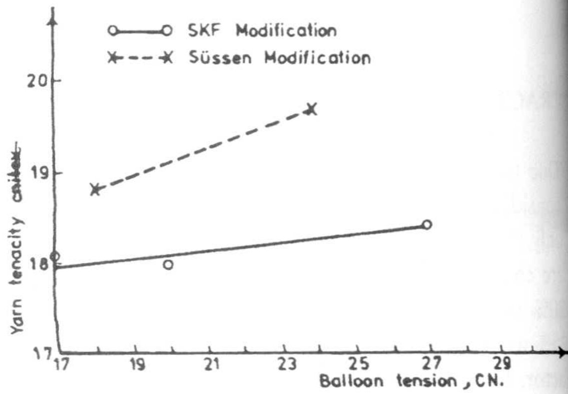

Figure 1. Yarn tenacity vs. balloon tension.

variation of Yarn Extension at Break With Ballo[on] Tension

Figure (2) shows the relation between balloon tensi[on] and yarn breaking extension.

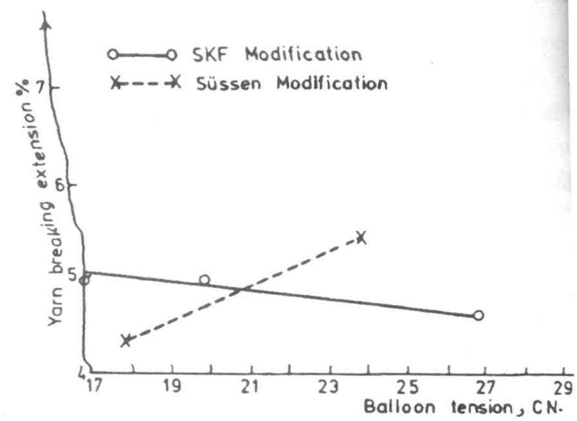

Figure 2. Yarn breaking extension vs. balloon t[ension].

It is interesting to notice that while changing th[e] system alone the extension at break reduced b[y] an increase of tension of about 60%. However both drafting system and balloon geometry an[d] results in an breaking extension of about 2[...] change of balloon tension of 33 %. AS the extension at break for Egyptian cotton [y...] comparatively low, this should be of significant i[...]

It may be reasonable to assume increase in ya[rn...] without changing the balloon geometry results in [...] yarn tension variation and this is reflected [...] extension at break.

Effect of Balloon Tension on Yarn uster irregularity

Figure (3) shows the relation between yarn evenness (c.v. % uster) and balloon tension in C. The general trend is that better regularity is expected while spinning under higher tension. One more higher tension results in better fibre disposition along the yarn axis improving yarn irregularity.

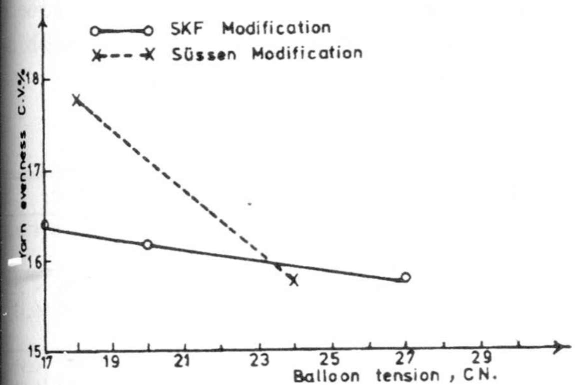

Figure 3. Yarn evenness vs. balloon tension.

Effect of Balloon Tension On Yarn C.V. % of Tenacity

Figure (4) gives the relation between the balloon tension and yarn c.v% of tenacity. There us a trend of increased c.v% of tenacity with higher balloon tension. This is in contradiction with the yarn mass variation. However there is the possibility of the effect of hairiness, twist variation & dynamic of the system on the yarn c.v. % strength which may result in weaker points allonge the yarn surface due t irregular protruding fiber ends, and twist variation rather than mass distribution. However a further details. Study may be necessary.

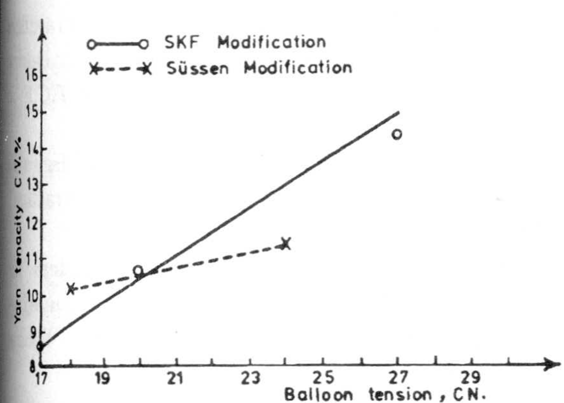

Figure 4. Yarn tenacity C.V.% vs balloon tension.

Relation Between Balloon Tension and Yarn Imperfections

Figure (5)-Figure (7) show the relation between the balloon tension and yarn imperfections (neps, thick places and thin places per 1000 meters). There is a trend of improvement of yarn imperfection with higher spinning tension. This is the same trend found for the yarn irregularity.

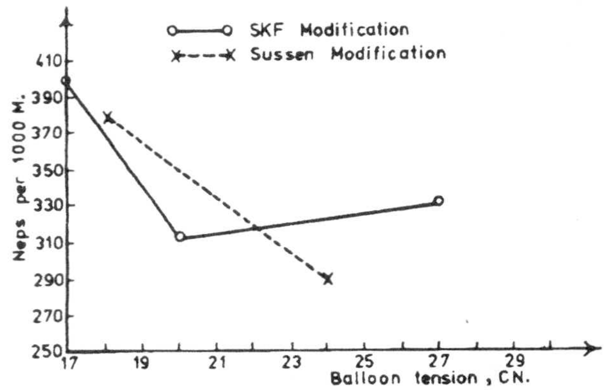

Figure 5. Neps vs. balloon tensio.

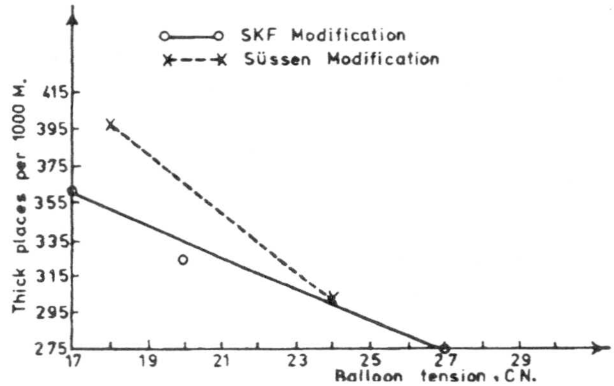

Figure 6. Thick places vs. balloon tension.

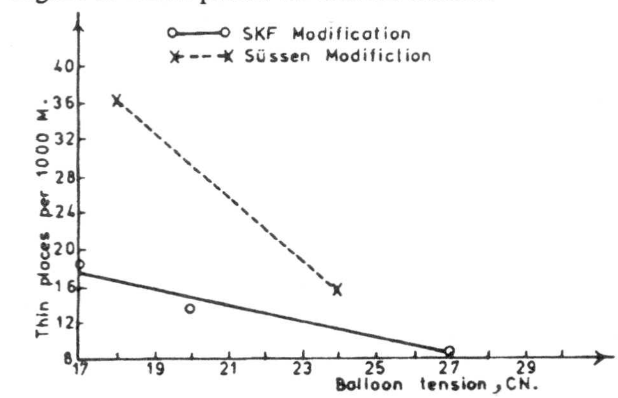

Figure 7. Thin places vs. balloon tension.

Effect of Balloon Tension On Yarn Hairiness (F-Index)

Figure (8) shows the relation between the balloon tension and the F-Index. From the figure it is clear that the yarn hairiness increase with the increase of the yarn balloon tension within the range of experiments tried. The effect is more pronounced in acse when the geometry is not changed.

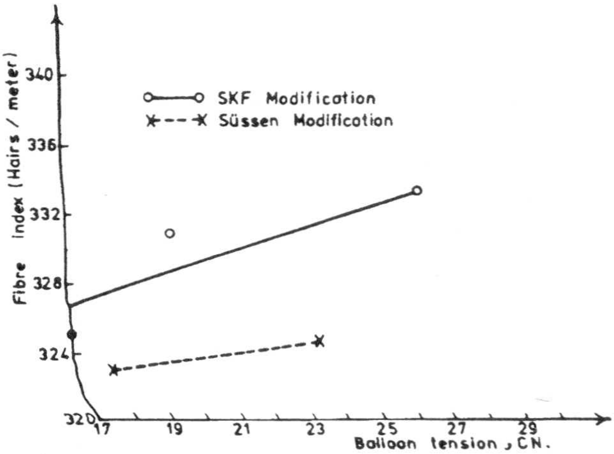

Figure 8. Fibre index vs. balloon tension.

From previous work (5), it is found that the spindle speed is most significant regarding the hairiness-plotting of spindle speed-varn hairiness relation many be more feasible as tension is varied with traveller weight & geometry. Figure (9) illustrates that the effect of spindle speed is even more pronounced with SUssen modification which gives better yarn hariness.

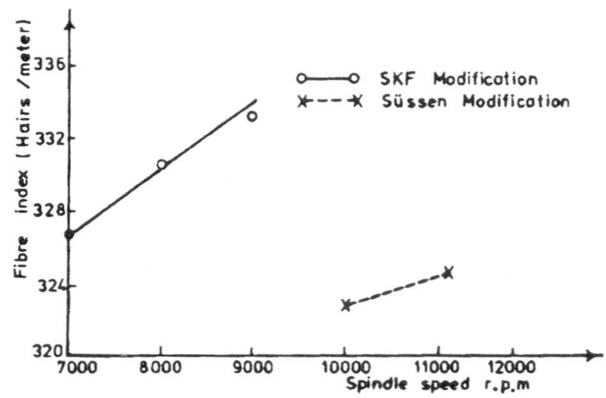

Figure 9. Fibre index vs. spindle speed.

CONCLUSION

From the previous results and discussions, the following conclusions may be drawn:

1. Changing of spindles, traveller, rings in addition to the drafting system proved to be necessary for achieving an acceptable yarn quality-changing the drafting s[...] alone is not enough.
2. Through change of both drafting system and spi[...] geometry, it is possible to increase the speed o[...] spindle by about 30% maintaining an acceptable [...] of ends down rate keeping the yarn quality better [...] 25 % of the world standard uster statistics.

It becomes obvious that the decisive factor should b[...] spinning cost analysis of yarn production-which will b[...] aim of part II of this paper.

Table 1. Yarn Quality.

Modification	Spindle Speed rpm	count		Tenacity	
		Actual	C.V.%	RKM	C.V.%
Sussen	10,000 11,350	35.50 35.52	2.77 1.67	18.8 19.93	10.[illegible] 11[illegible]
SKF	7000 8000 9000	36.16 35.10 35.10	1.70 2.91 2.91	18.03 17.99 18.20	8[illegible] [illegible] [illegible]

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[8] Uster Statistics 1989, Uster New Bulle[...] October 1989.

Table 1. Continued.

Twist		Uster Test				F-Index Test	
'I	C.V.%	C.V.%	Thin	Thick	Neps	Mean value of hairs/meter	Standard deviation
4	4.16	16.80	36.1	397	381	321.5	17.85
7	3.16	15.83	15.5	304	291	324.2	15.00
9	2.96	16.40	18.3	362	401	325.3	14.60
9	4.49	16.25	13.2	328	315	329.5	14.65
0	4.42	15.80	8.3	275	331	332.7	14.50

Table 1. Continued.

Twist		Uster Test				F-Index Test	
TPI	C.V.%	C.V.%	Thin	Thick	Neps	Mean value of hairs/meter	Standard deviation
24.4	4.16	16.80	36.1	397	381	321.5	17.85
24.7	3.16	15.83	15.5	304	291	324.2	15.00
23.9	2.96	16.40	18.3	362	401	325.3	14.60
23.9	4.49	16.25	13.2	328	315	329.5	14.65
25.0	4.42	15.80	8.3	275	331	332.7	14.50