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EFFECT OF TENSION IN ROTOR SPINNING ON THE QUALITY OF THE EGYPTIAN COTTON YARNS

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Abstract

In the present work, three rotor spun yarns with tex. 29.5 & 42.2 and 54.1 were processed on Rieter's Spin trainer rotor spinning frame. The rotor revs per min. Were changed from 15 K to 50 K. The measured draw off tension (at the outlet of the doffing tube) was varied from 0.10 CN/tex to 0.90 CN/tex.

It has been found that the draw off tension has appreciable effect on the twist efficiency, where it increases from 88 % to 97 % by the increase of spinning tension from 16 CN t 54 CN.

Also, the twist factor of the rotor spun yarn has an effect on the draw off tension. The increase of the twist factor by 8 %, increases the draw off tension by 12 %.

It has been that the yarn quality deteriorates at the high values of the draw off tension (higher than 0.3 CN/tex). The yarn strength decreases 10 %, while the uster value C.V % increases by 25 %. Also, the breaking extension increases by 20 % and the ends down increases five times.

The spinning at low draw off tension (0.10 CN/tex to 0.3 CN/tex) gives good results.

1. Introduction

The yarn tension in rotor spinning is generated by the various forces acting on the radial yarn part inside the rotor. These forces can be written as: centrifugal forces, friction forces, air drag forces and coriolis forces. Among these forces, the centrifugal forces, play the main role in determining the yarn draw off tension. The coriolis forces are negligible w.r.t. the centrifugal forces, and they can be neglected practically. The yarn moves in the close vicinity of the rotating wall of the rotor i.e in the boundary layer of the air carried by the wall, therefore the air drag forces can be ignored.

Several authors have studied the relations of yarn draw off tension such as: Curt (1), soliman (3) Schoneng [6], Stalder [9], Ripka [5] and Wulfhorst [10].

A little work has been published about the effect of draw off tension on the yarn quality: (1), (3) and (10), but for the Egyptian cottons, there were no puplished works.

2. EXPERIMENTAL PROCEDURE

Spinning Procedure

Three carded cotton yarns, from Giza-80, cotton with counts 59.1, 42.2 and 29.5 in tex. system were spun with twist factors: 3803.6, 4437.6 and 4754.5 turns per meter. Tex ½ respectively. To change the draw off tension, the rotor speed was changed from 15 K to 50 K r.p.m. in steps of 5K r.p.m. The values of the draw off tensions were recorded in table 1. The spinning process has been carried out on the Rieter's spin trainer rotor spinning frame. The twist factor has been increased

from 3803.6 turns per meter $tex^{\frac{1}{2}}$ to 5379 turns per meter. $tex^{\frac{1}{2}}$, to investigate the effect of the twist factor on the draw off tension. The ends down per 1000 rotors hour were counted, during the spinning process. All the produced cotton yarns have been spun from a fixed silver hank 0.13 (N_m = 0.22).

The tension measurements were carried out by the use of the tension meter (Rothschild), which is shown in Fig. (1)

3. Testing Procedure

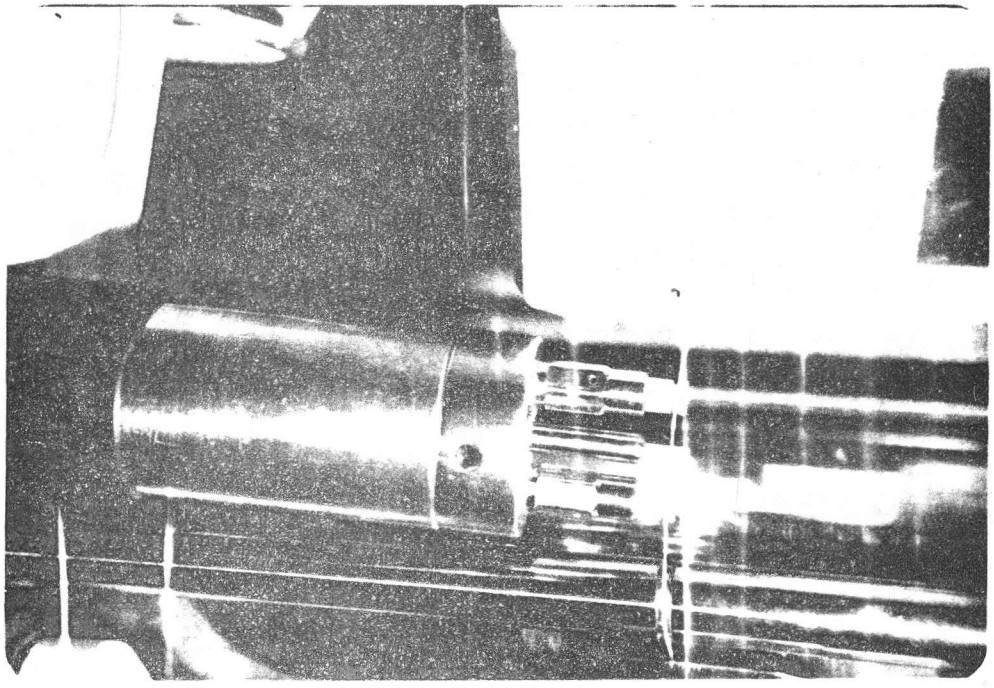
All the tests of the yarns have been carried out in a standard atmosphere of 65 $\pm$ 2 % R.H. and a temperature of 20 $\pm$ 2 C^{o}. The procedure of each experiment has been taken place according to the standards of the A.S.T.M.

The yarn strength and elongation were measured by the use of the Uster dynamometer (Dynomat). The yarn evenness and imperfections were measured on the Uster evenness tester model (UT 2 ET-B). The count of the yarn was checked by using a count balance. Also, the twist efficiency was measured by the use of the twist and untwist method, in spite of it's inaccuracy for rotor yarns.

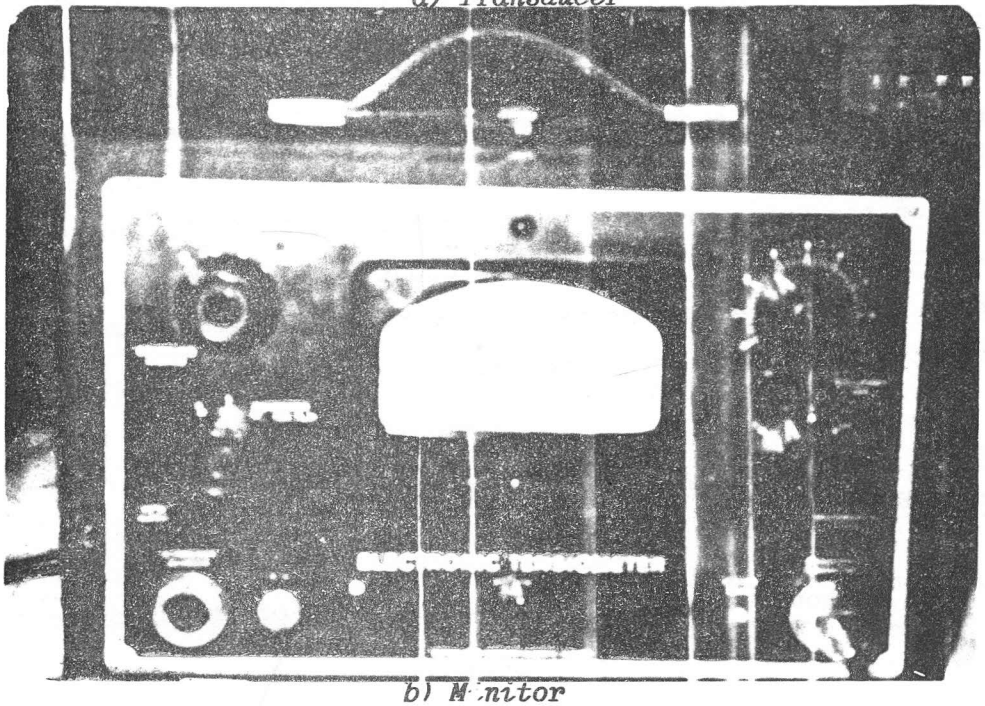
Results and Discussion

Tenacity & Extension

Fig. (2) & (3) show the relation between the draw off tension and both



a) Transducer



b) Monitor

Fig. 1. Rothschild Tension Meter

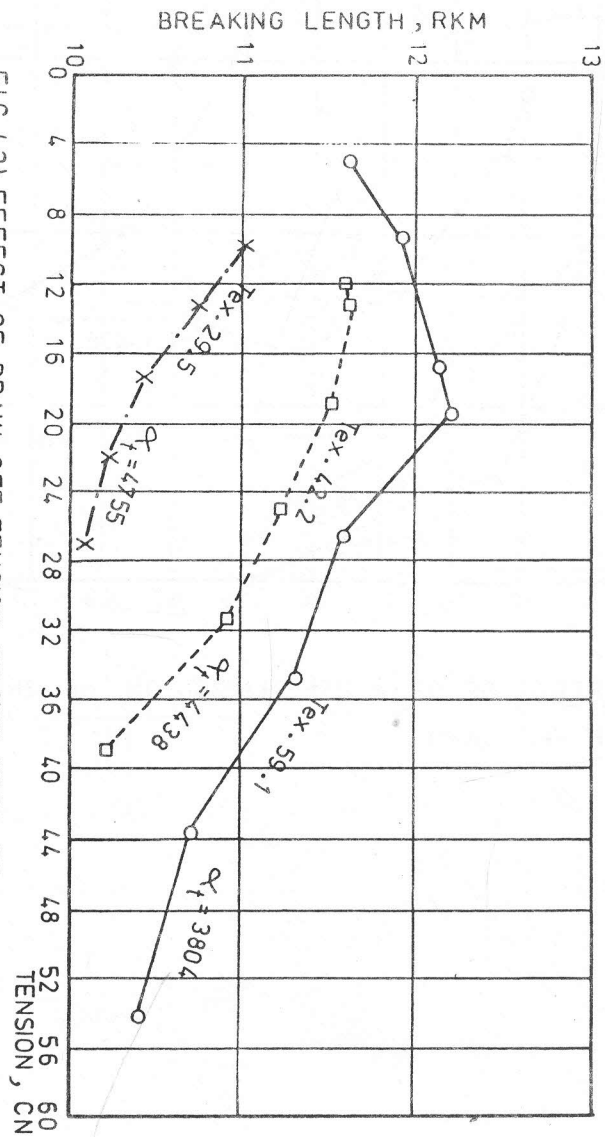


FIG.(2) EFFECT OF DRAW OFF TENSION ON THE YARN TENACITY

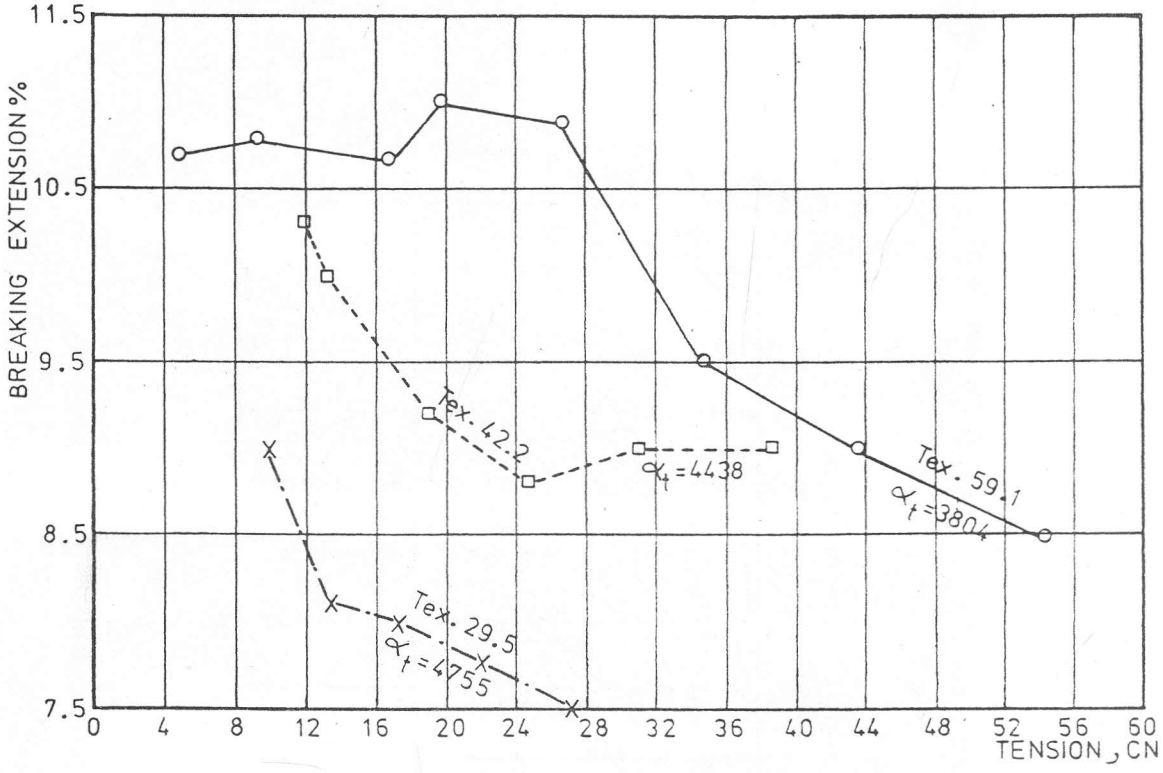


FIG.(3) EFFECT OF DRAW OFF TENSION ON THE BREAKING EXTENSION OF THE YARN

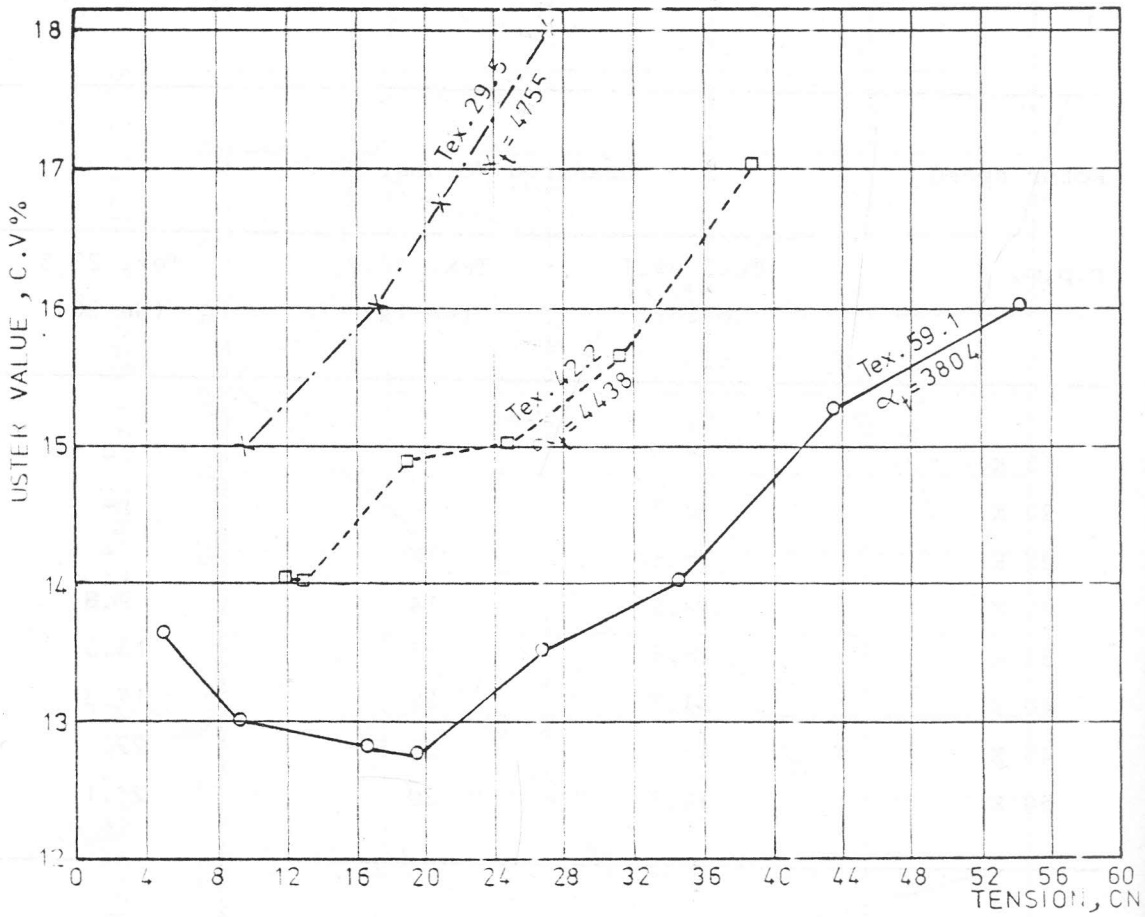


FIG.(4) EFFECT OF DRAW OFF TENSION ON THE YARN IRRUGULARITY

Table 1. Measured Mean values of Draw off Tensions at Different Rotors Speeds

Rotor speed	Measured Values, CN		
r.p.m.	Tex. 59.1 (Ne 10)	Tex. 42.2 (Ne 14)	Tex. 29.5 (Ne 20)
15 K	5	-	-
20 K	8.7	-	-
25 K	16.8	12	-
30 K	19.5	14	9.8
35 K	26.6	19	13.3
40 K	34.7	25	17.3
45 K	43.7	31.5	22
50 K	54.3	39	27.1

of the tanacities and breaking extensions of the rotor spun yarns. The decrease of both of the tenacity and breaking extension due to the increase of the draw off tension can be related to the decrease of the binding zone at the fiber's ribbon at the collecting durface.

Mass Variation and C.V % OF Strength:

Figs. (4) and (5) show the relation between the draw off tension and

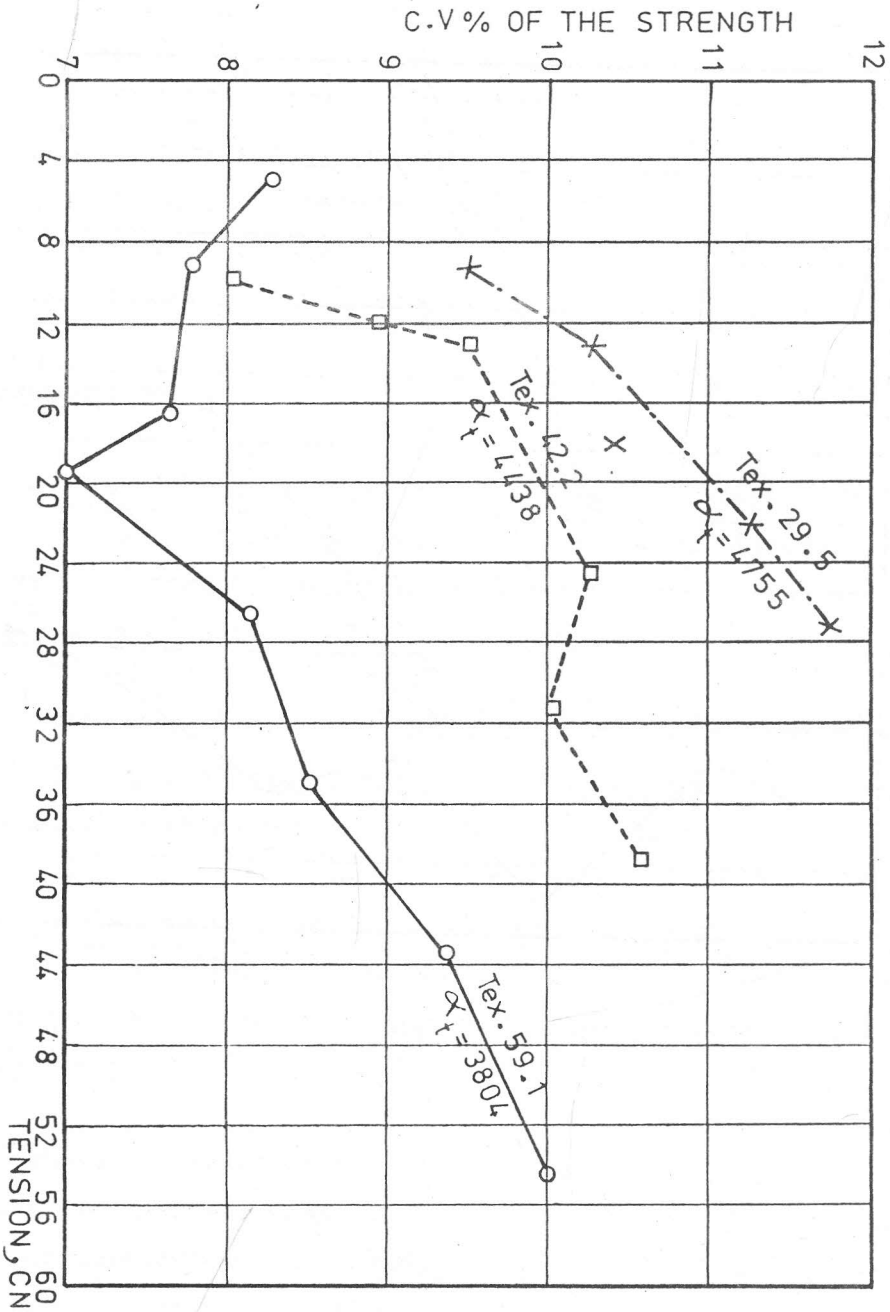


FIG.(5) EFFECT OF DRAW OFF TENSION ON TH C.V% STRENGTH OF THE YARN

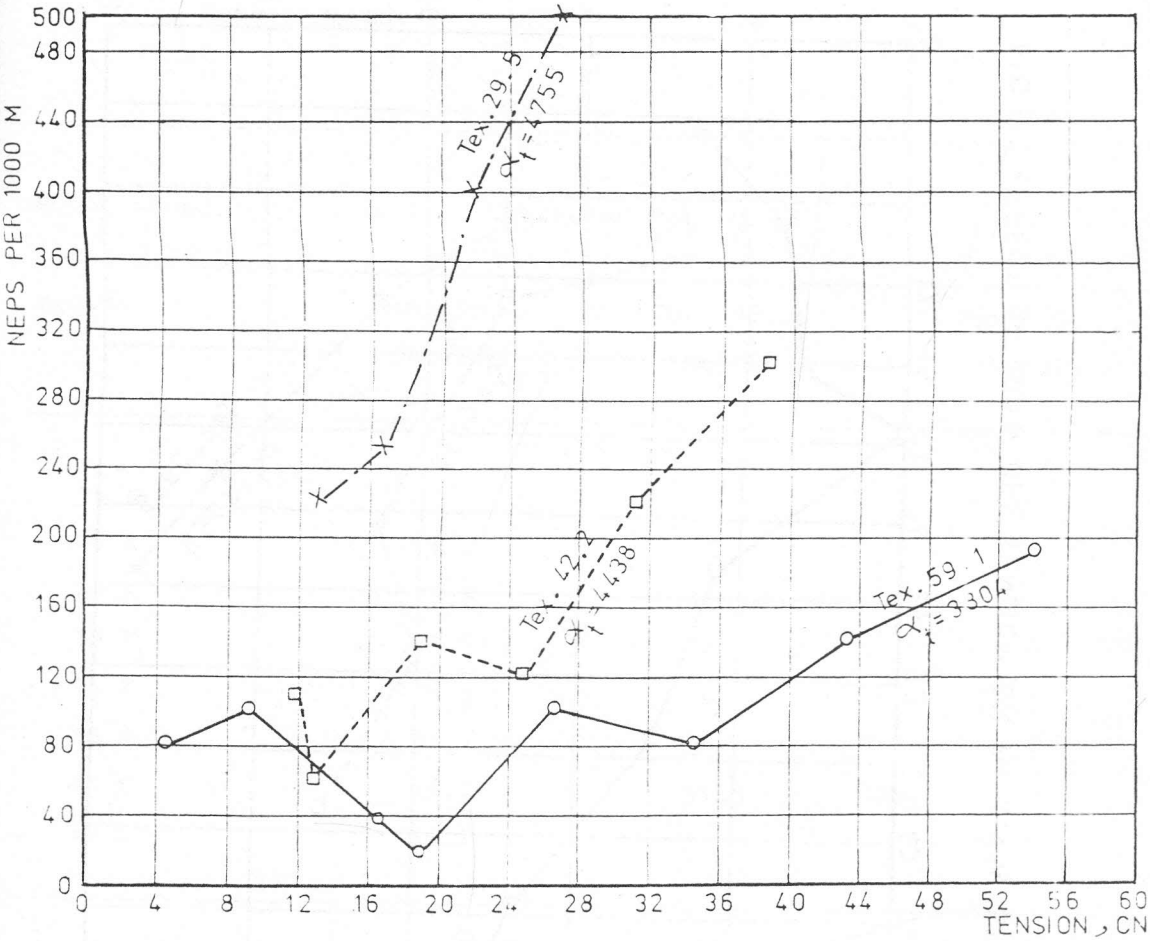


FIG.(6) EFFECT OF DRAW OFF TENSION ON NEPS PER 1000 M

both of the uster values C.V. % and the C.V. % of the strength of the rotor spun yarns.

These figure indicate that the mass variation and the variability in the strength of the yarn increases due to the increase of the draw off tension. This may be related to the increase of cyclic variation of the draw off tension at it's high levels.

Yarn Imperfections

Figs. (6-8) show the effect of the draw off tension on the yarn imperfections per 1000 meters (neps, then and thick places). It can be seen from the figures that the increase of the draw off tension increases the imperfections of the totor spun yarn.

This may be related to the increase of friction between the doffing tube and the rotor yarn at the high values of the draw off tension. Also, the high twisting torque at the point of yarn formation may head to the grow up of the yarn imperfections. Also, the increase of tension may be causes many of wrappers. In addition, the use of a fixed sliver hank for all counts may be affects.

Twist Efficiency

Fig. (9) shows the relation between the twist efficiency and the draw off tension. It is clear that by the increase of the draw off tension, the twist efficiency decreases and then increases. This may be related to the easiness of the twist propogation to the fibres on collecting surface at the low spinning tension. At high levels of the draw off tensions, the frictional torque increases which resists the twist

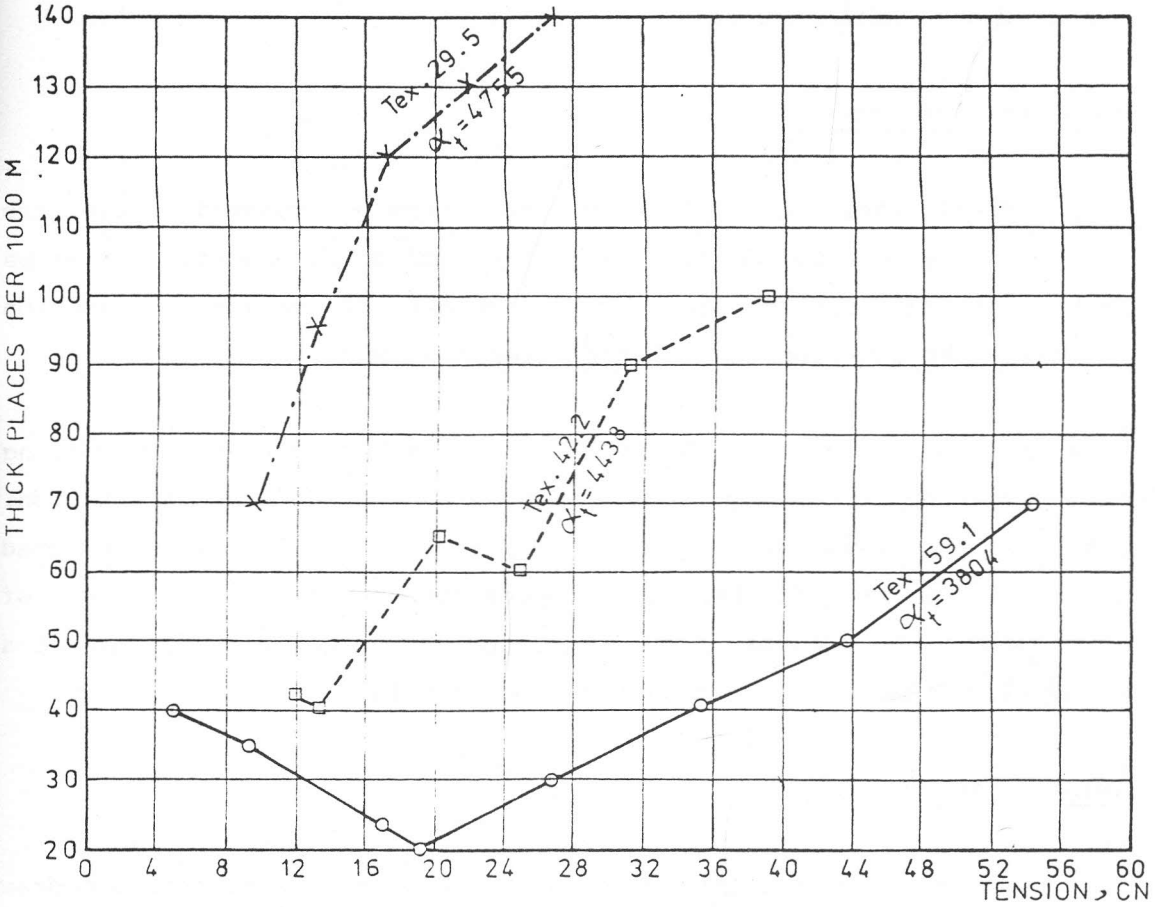


FIG.(7) EFFECT OF DRAW OFF TENSION ON THICK PLACES PER 1000 M

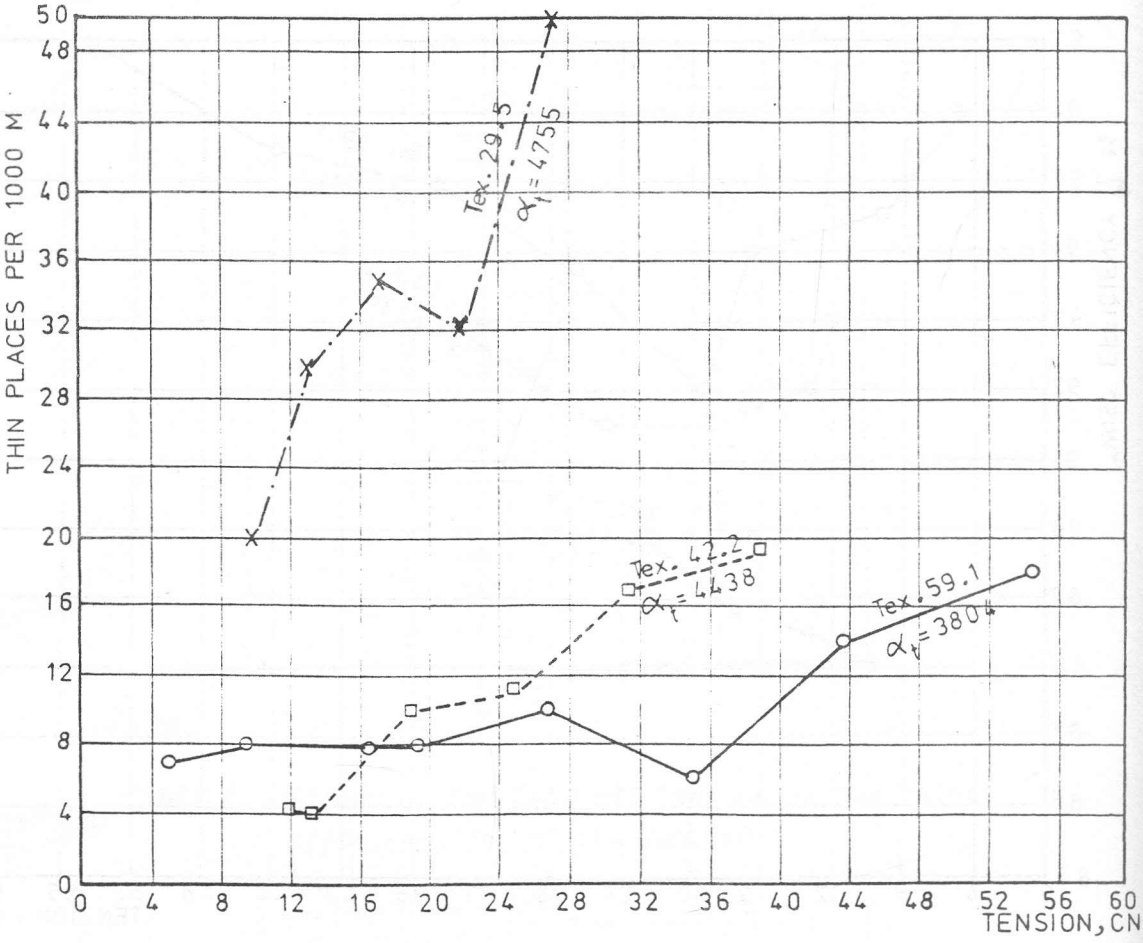


FIG.(8) EFFECT OF DRAW OFF TENSION ON THIN PLACES PER 1000 M

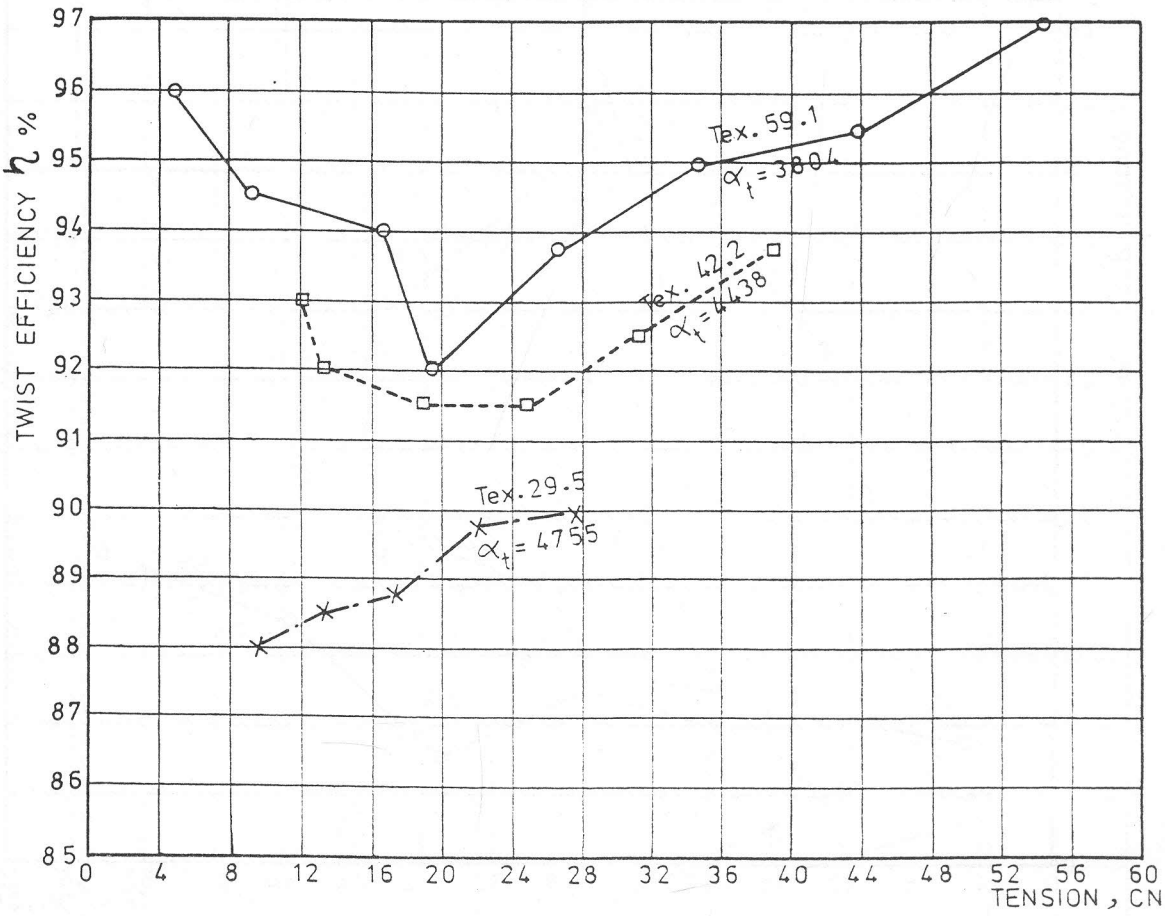


FIG.(9) RELATION BETWEEN THE TWIST EFFICIENCY AND DRAW OFF TENSION

Table 3. Effect of the Twist Factor on The Tension's Increase

Yarn Nos.	Twist Factor (Tex. System)	The Increase of the draw off Tension, N.C., w.r.t. the initial value
59.1	3801.5	0
	3868.5	8
	3891	11
	3924.6	21
	4125.4	28
	4186.8	29
12.2	4119.4	0
	4521.8	3
	4616.7	4
	4717.2	6
	4795.1	9
	5212.1	12
29.5	4773.1	0
	4881.7	2
	4896.1	4
	5136	7
	5253.2	8
	5307.2	9

Table 2. Effect of The Draw off Tension on The Twist efficiency for a yarn Tex. 59.1

Rotor Speed R.P.M.	Tension CN	Twist Efficiency η %
15 K	5	96
20 K	8.7	91.6
25 K	16.8	94
30 K	19.5	92
35 K	26.6	93.8
40 K	34.7	95
45 K	43.7	95.4
50 K	54.3	97

insertion to the fibres on the collecting surface.

It can be also noted that the coarser yarns give better twist efficiency. An example of the numerical values, records the experimental results of a yarn Tex. 59.1

Twist Factor

The relation between the twist factor and the spinning tension is illustrated in Fig. (10). From that figure, it can be shown that the increase of the twist factor increases the spinning tension. This may be related to the large radial tension which is required at the peel off point to speed up the twisting rate i.e. the twisting torque. The values of the tension's increase are recorded in table 3.

ENDS DOWN PER 1000 R.H.

Fig. (11) shows the effect of the draw off tensions on the rate of ends down per 1000 R.H. The increase of ends due to the increase of tension is a result of the combined effect of yarn tension and yarn strength parameters "average and standard deviation" [4].

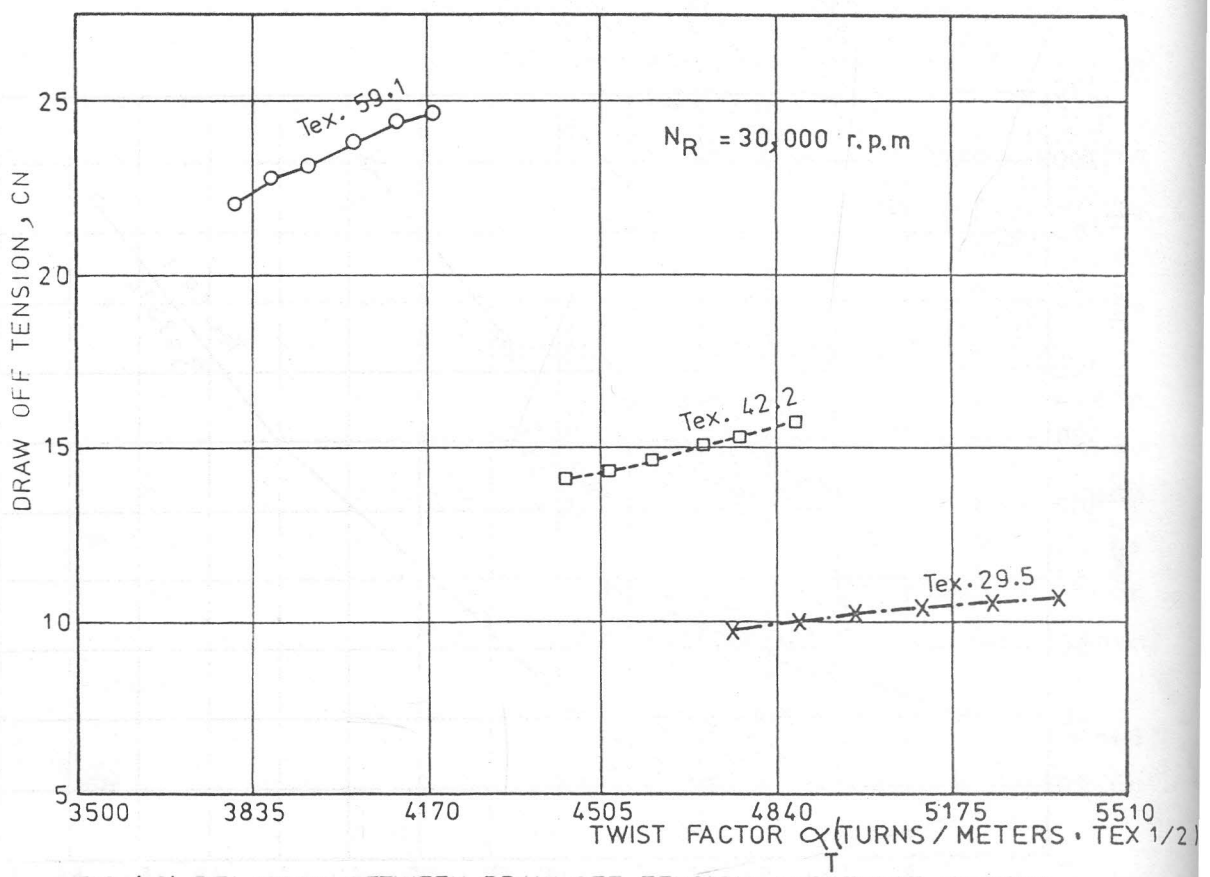


FIG. (10) RELATION BETWEEN DRAW OFF TENSION AND TWIST FACTOR

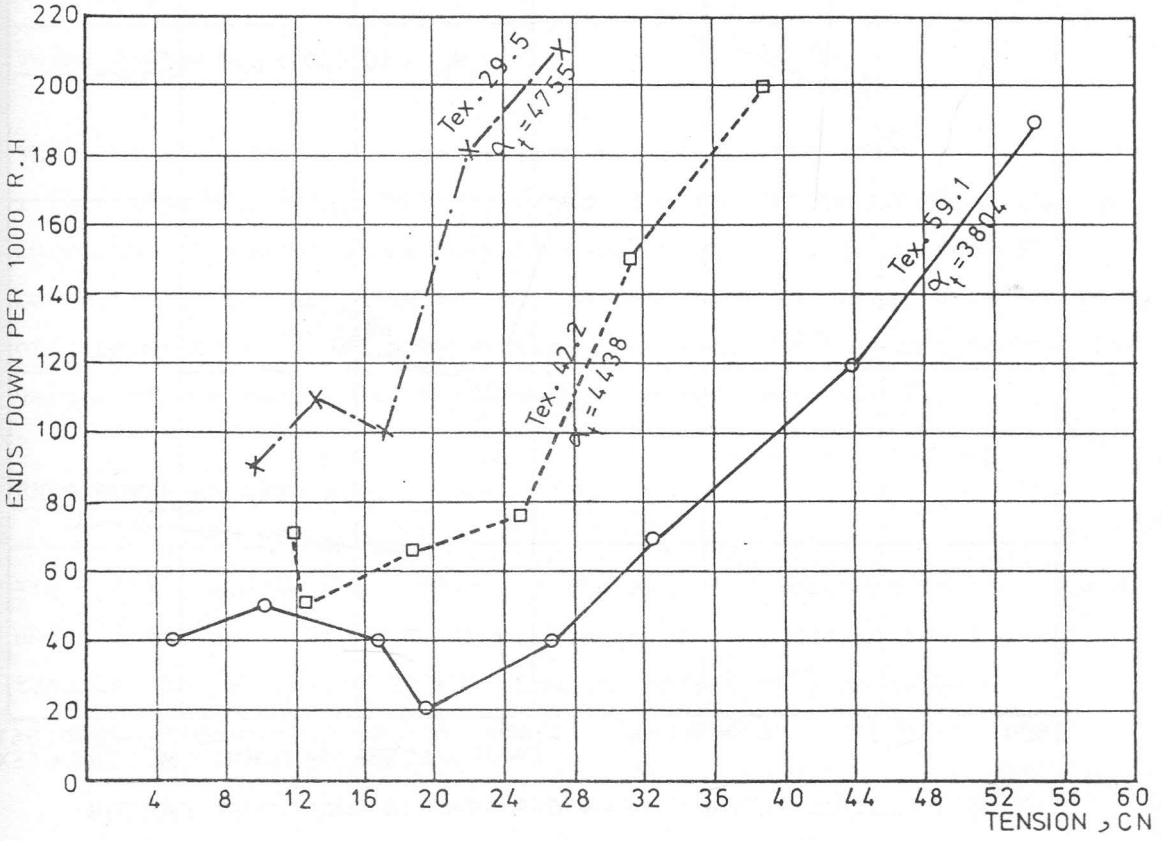


FIG.(11) EFFECT OF DRAW OFF TENSION ON ENDS DOWN PER 1000 R.H

Conclusions

From the previous results and dissussions the following conclusions can be drawn out:

1. the yarn quality improves, generally, when the draw off tension changes from 0.10 CN/tex to 0.30 CN/tex.
2. When the draw off tension increases from 0.30 CN/tex to 0.90 CN/tex, the quality levels of the rotor spun yarns, in general, detoriorate.
3. The ends down per 1000 rotor hour, increases from 20 to 190 by the increase of the draw off tension from 0.3 CN/tex to 0.90 CN/tex.
4. Generally, the good yarn quality of the rotor spun yarns has been obtained at the value of the draw of tension equals to 0.30 CN/tex, which corresponds to 30 K R.p.m. of the rotor. It should be noted however that this is only valid for similar generations of machines as that used for experimentation Variations in rotor design, doffing tube design...etc. enables spinning at much higher speeds.
5. The acceptable yarn quality for Egyptian Cotton can be obtained when the draw off tension ranges from 2 % to 3 % of the breaking length of the yarn under present spinning conditions.
6. the increase of the draw off tension affects the measured twist as compared with the nominal twist.
7. The increase of the twist factor by 7-13 %, for all the spunyarn counts increases the draw off tension by 12-14 %.
8. The choice of the spinning twist factor, for a certain count, must be determined carefully.

References

[1] Curt Bandis, Rotor Spinning at Rotor Speed Over 60,000 r.p.m. pp. 323, Rotor Spinning Technical and Economic As-ects. E. Dyson, 1975.

[2] Derichs J., Theoritical and practical Limits of Rotor Spinning in the production of Fine Yarns, Dokumenation No. 16, Schlafhorst, 1986.

[3] Krause H.W. & Soliman H.A., The Significance of Yarn Tension In Open-Eng Spinning, J.T.I., Vol. 67, No. 5, May 1976.

[4] Mansour S.A., Rotor Spinning, PhD thesis, leeds, 1974.

[5] Ripka, Theory of the OE Spinning System, Open-end Spinning, pp. 190, V. Rohlena 1974.

[6] Schoneng B., Textil Praxis, 1980, 35, 1190.

[7] Schubert & Salzer, Open-End Spinning, Spincomat, Special Communication.

[8] Simpson Jand Paturean J, Tex. Res. Journal, 1979, 49, 468.

[9] Stalder H., Will Rotor-Spinning Supplement or Replace The Conveutional Precess The 5th th Annual Conference of the Textile Institute, 1976.

[10] Wulfhorst B. et-al, Modern Rotor Spinning Technology with Particular Attention Paid to the Preparation of the Sliver, Schubert & Salzer-Rieter, Seminer at Consold. Fund, Alex., 1987.