BEHAVIOR OF YARN TENSION DURING THE CONTINUOUS UNWINDING FROM CONICAL PACKAGES

By

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ABSTRACT

The object of this work was to evaluate the yarn tension during continuous overhead unwinding from stationary conical Package, the yarn tension was measured under the effect of the following parameters:-

- Yarn withdrawal speed (340, 510 and 623 m/min).
- Package diameter (50 to 150 mm).
- Distance between package and yarn guide (10, 20 and 30 cm).
- Linear density of yarn (Ne 14, 20, 40 and 50).

The value of yarn tension and its flactuation can be reduced by varying the characteristic and its positioning of the stationary package during the continuous overhead unwinding.

INTRODUCTION

In several textile processes such as winding and warping, the yarn should be withdrown continuously and overhead from the stationary package. Due to withdrawal of the yarn from the package a yarn balloon is formed and result tension in the yarn. The value of yarn tension is affected by the following parameters:-

- Yarn withdrawal speed.
- Balloon dimensions and shape.
- Package characteristic (angle of winding, stroke and diameter).
- Linear density of yarn.

The variation in the value of yarn tension during unwinding from the package will affect the other textile processes such as winding, warping, weaving, knitting and dyeing.

In winding processes the tension variation affect the package density "hardness" which intern affect the uniformity of dyeing process in case of dyeing the yarn with package form /3/.

In warping process the variation in package diameter and its positioning on the creel will affect the value of yarn tension and result a different value of yarn tension between and along the warp threads which intern affect the irregularty of warp sheet during winding on the warp beam /1/.

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For non-conventional weaving (without using yarn storage) the weft thread will be inserted directly from the package, and due to the variation of the package diameter and its positioning leeds to a variation in weft tension which intern has its effect on fabric quality and machine efficiency /5/.

In case of knitting process the withdrawal yarn slips on the package surface because the withdrawing speed is law, by using a package with irregular density in knitting process, the soft layers slough off during withdrawing the yarn and this intern effect on the quality of the products and machine efficiency /6/.

In the present work, an experimental study was carried out to determine the effect of continuous winding speed, package characteristic, yarn count and package position on yarn tension. The study is limited to conical packages.

EXPERIMENTAL

Figure (1) shows the arrangement of the apparatus used, the signal from the electronic Rotschild tension-meter was fed to an amplifier to amplify the electric signal, then the electric signal was calibrated in force units (CN) and recorded on a pionter scale, this signal is also fed to HP data processer to evaluate the maximum value of yarn tension.

1- unwinding package.
2- yarn guides.
3- measuring head
4- box with grooved drum
5- yarn traverse.
6- driving cone.
7- winding package.
8- amplifier.
9- chart recorder.
10- HP-data processor
θ- angle of winding.
α- conicity angle.
H- stroke.
D̄- mean diameter.

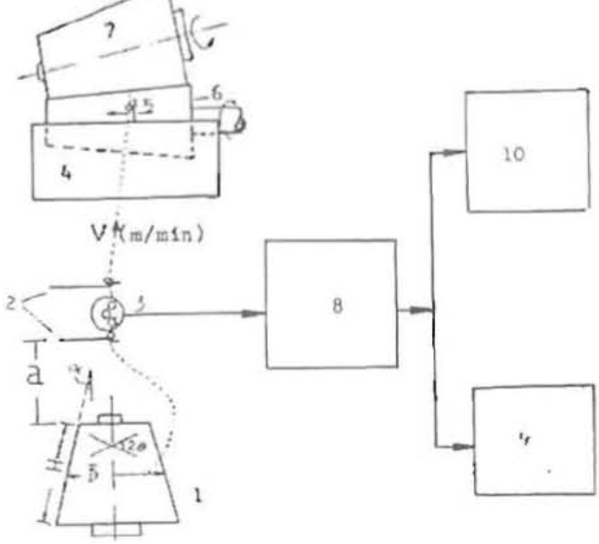

Fig.(1) Arrangement of measuring units.

The figures from 2 to 10 illustrate the relationship between yarn tension and the pre-described parameters.

COTTON Ne 14

V = 340-510-623 m/min H = 15 cm $\theta = 34^{0}$ $\alpha = 9^{0}\ 15'$

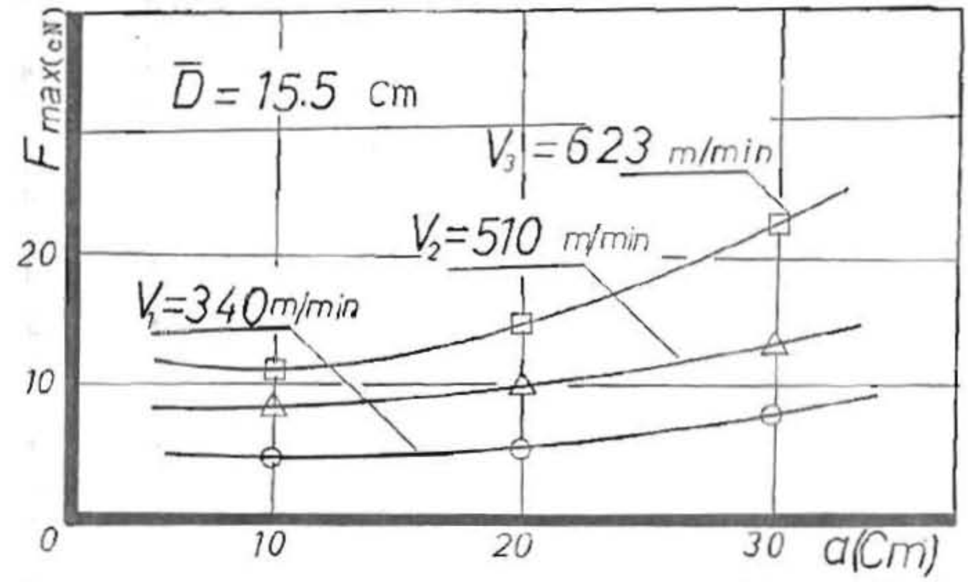

Fig.(2) Relationship between yarn tension and distance(a) for different yarn speeds. ($\bar{D}$ = 155 mm).

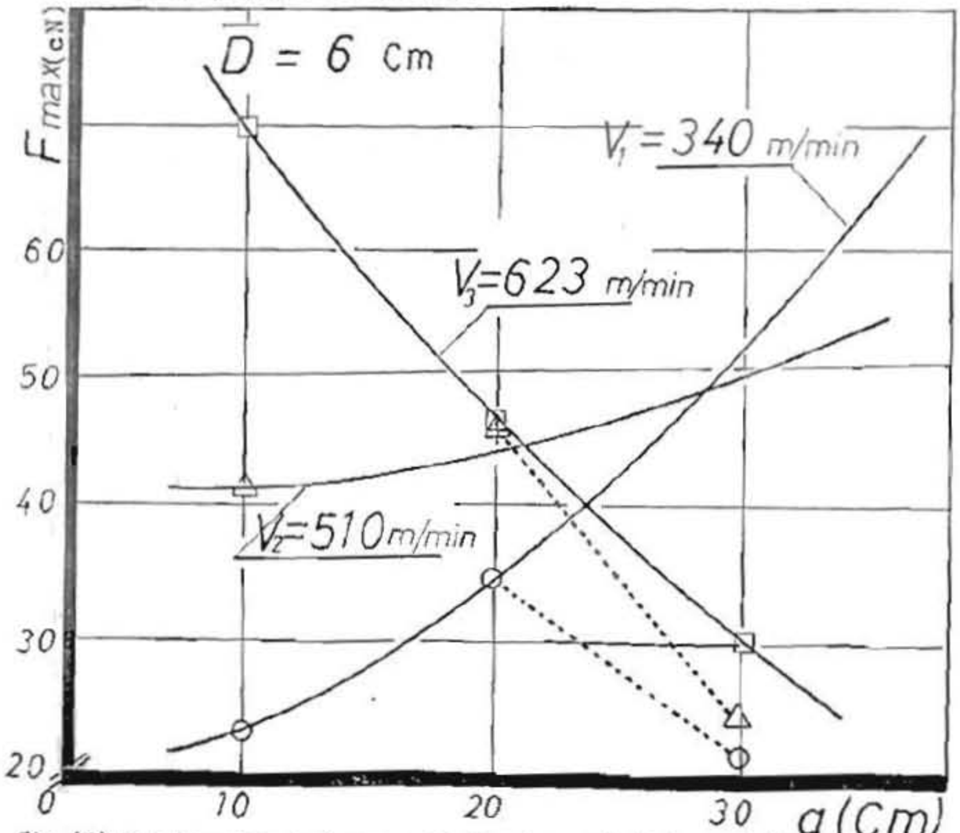

Fig.(3) Relationship between yarn tension and distance(a) for different yarn speeds ($\bar{D}$ = 60 mm).

OTTON Ne 20

340-510-623 m/min H = 15 cm θ = 34° α = 9° 15'

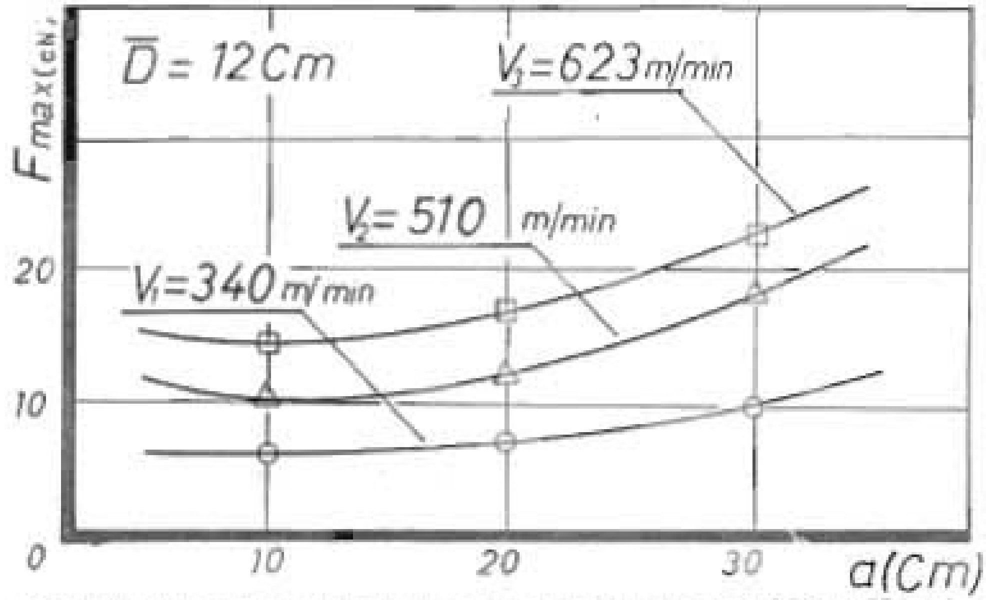

Fig.(4) Relationship between yarn tension and distance (a) for different yarn speeds ($\bar{D}$ = 120 mm).

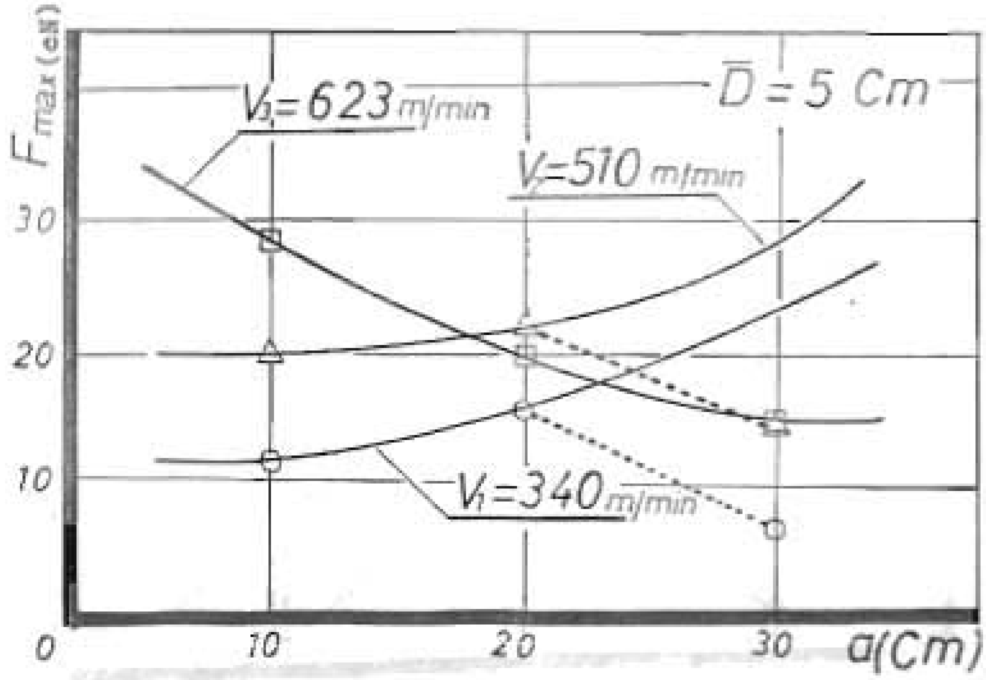

Fig.(5) Relationship between yarn tension and distance (a) for different yarn speeds ($\bar{D}$ = 50 mm).

COTTON Ne 40

V = 340-510-623 m/min H = 15 cm θ = 34° α = 9° 15'

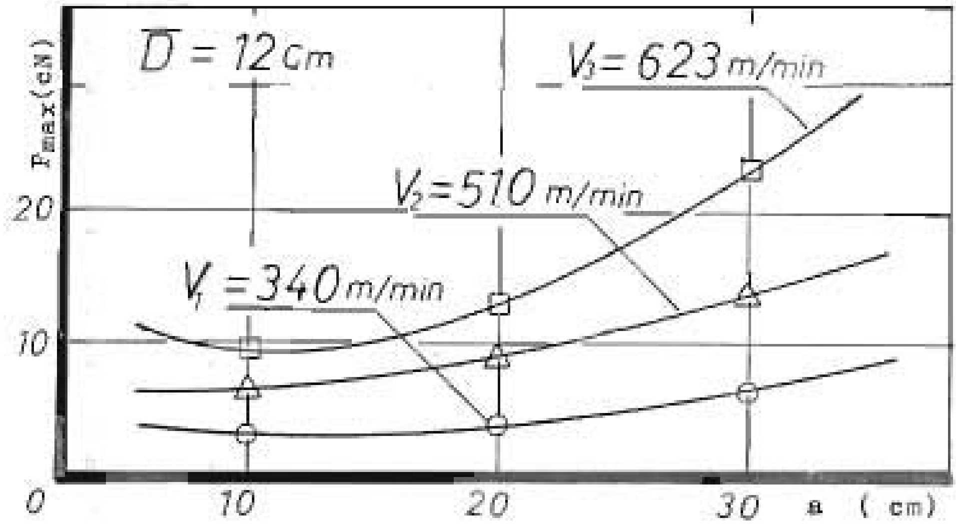

Fig.(6) Relationship between yarn tension and distance(a) for different yarn speeds (D̄ = 120 mm).

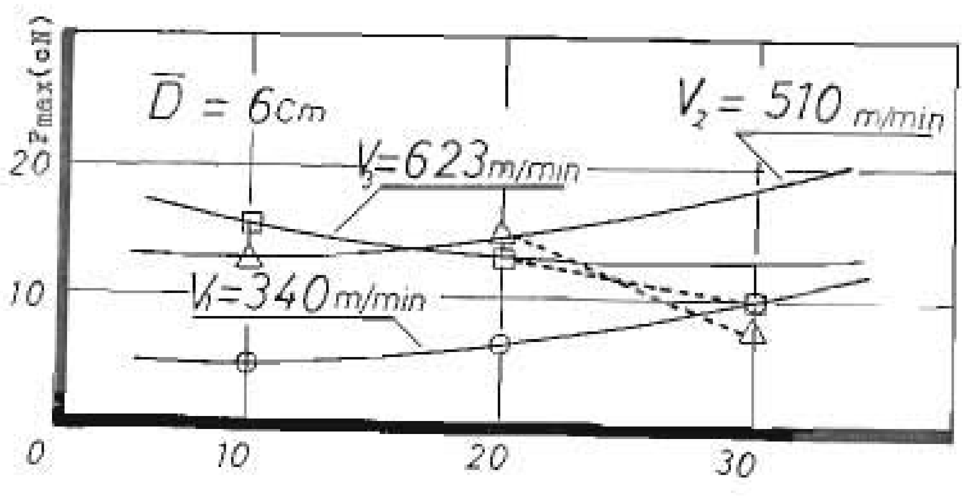

Fig.(7) Relationship between yarn tension and distance(a) for different yarn speeds (D̄ = 60 mm).

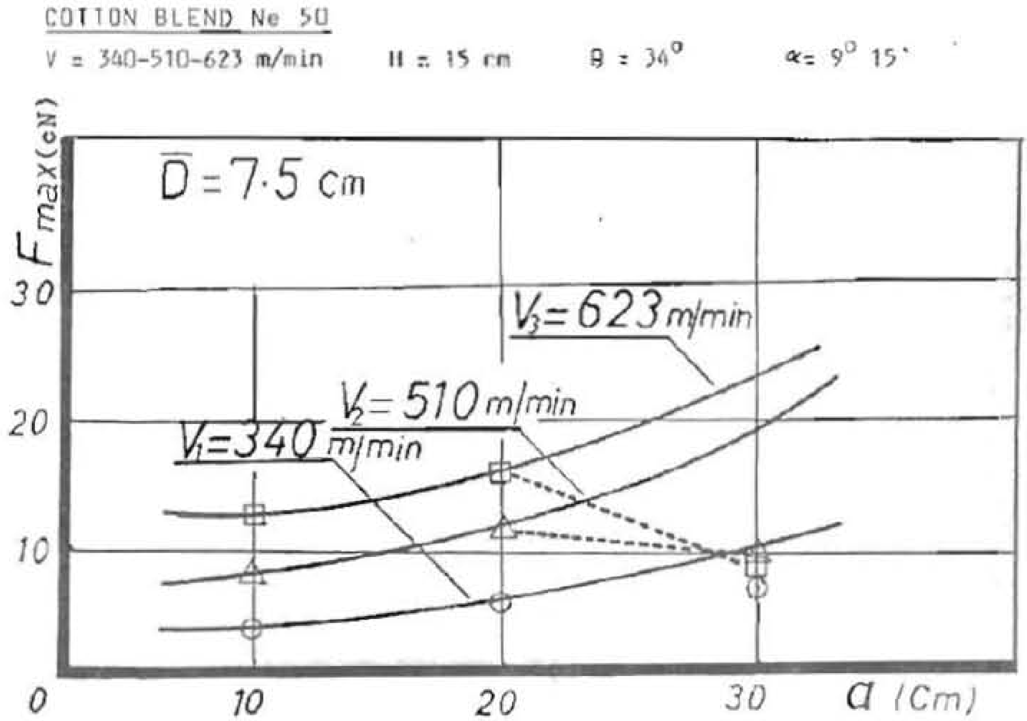

Fig.(8) Relationship between yarn tension and distance(a) for different yarn speeds ($\overline{D}$ = 75 mm).

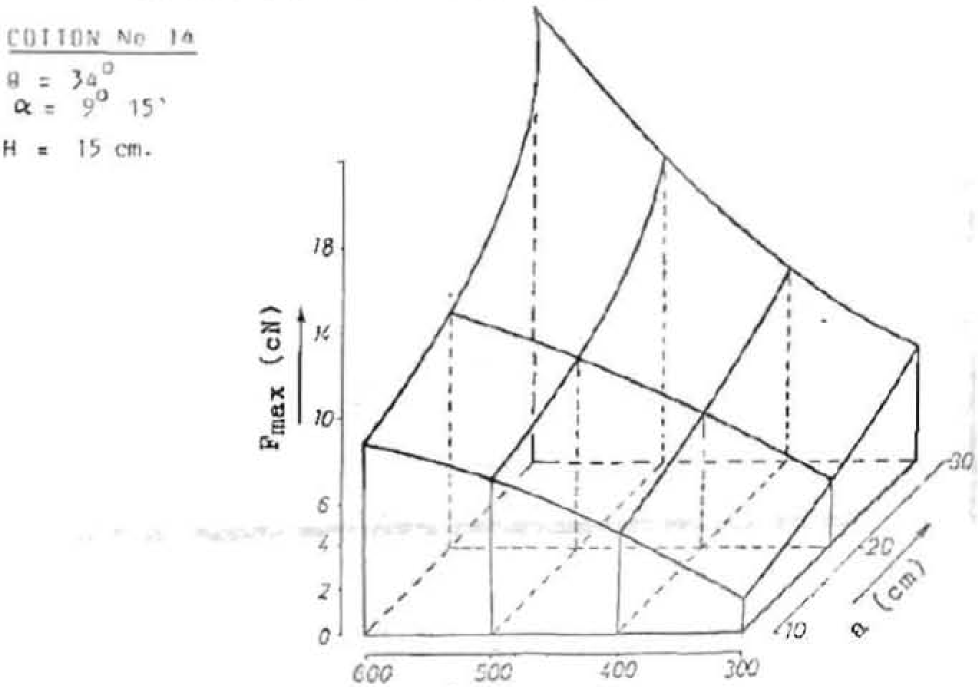

Fig.(9) Geometrical relationship between yarn tension and distance(a)for different yarn speeds ($\overline{D}$ = 125 mm).

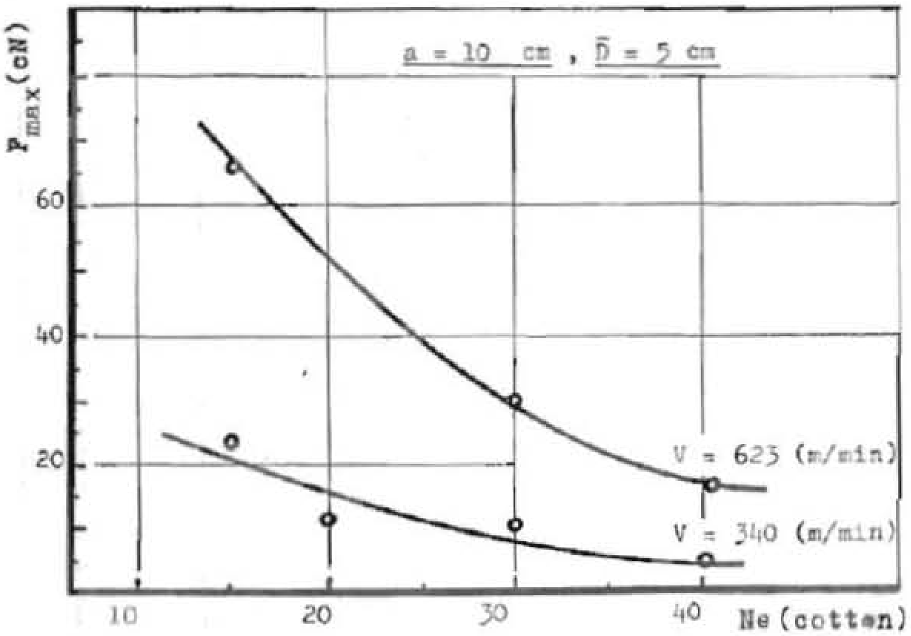

Fig.(10) Yarn tension as a function from yarn count for different speeds.

DISCUSSION

During unwinding the yarn from stationary package, a rotating balloon is formed and its shape is affected by many parameters such as yarn withdrawal speed, air resistance, centrifugal force, Coriolic force and yarn length in the balloon /4/.

The air resistance, which is proportional to the square of the absolute speed of balloon acts to divide the balloon to multi-shape when the value of air resistance overcome the stiffness of the tensioned yarn. The centrifugal force which is proportional to square angular velocity of balloon leeds to an increase in balloon radius, and this intern tends to increase yarn tension. The Coriolis force leeds to change in the balloon shape in spatial form. The length of yarn in the balloon increases with the increasing in the distance between yarn guide and unwinding point on package surface. The possibility of dividing the balloon into multi-shape becomes higher by increasing the yarn length in balloon.

Behavior of yarn tension during yarn withdrawal from full package (Figs. 2, 4, 6 and 9).

- The value of yarn tension for all distances between yarn guide and package (a = 10, 20 and 30 cm) increase with increasing the withdrawal yarn speed, because the angular velocity of balloon is proportional to the yarn withdrawing speed and intern the angular velocity is square proportional to the centrifugal force of the balloon, this force represents the main part of yarn tension.

- For all withdrawing speeds of yarn (V = 340, 510 and 623 m/min) the value of yarn tension increases with increasing the distance between package and yarn guide, this is because value of yarn tension is proportional to balloon dimensions and length of yarn in the balloon.
- Withdrawing the yarn from a full package the balloon shape still approximately stable, because the angular velocity of balloon is small and the air resistance which acts to divide the balloon is law.

Behavior of yarn tension during yarn withdrawl from package with small diameter (Figs. 3, 5, 7 and 8).

For packages with small diameter, the behavior of yarn tension under the effect of yarn speed and distance between package and yarn guide is different from packages with full diameters. In this case the behavior is related to the conditions of yarn unwinding.

As shown in Fig.(7) for yarn speed V = 340 m/min, the value of yarn tension increases with the increase in the distance(a) between package and yarn guide, and this is due to the low value of yarn speed. This behavior is the same at yarn speeds 340 and 510 m/min for all other yarn counts up to a distance of 20 cm, between yarn guide and package. For these two withdrawing speeds the value of yarn tension tended to decrease when the package is at a distance of 30 cm from yarn guide, this may be due to the balloon shape changed to multi-shape which leeds to a reduction in yarn tension.

By withdrawing the yarn at a speed of 623 m/min, the value of yarn tension decreases with the increase in the distance between package and yarn guide. The rate of reduction in yarn tension is higher for yarns with high linear density, as shown in Fig.(3).

As shown in Fig.(8) the reduction in yarn tension occures for the speed V = 623 m/min at a distance a = 30 cm, because the package diameter is relativly large. This intern will leed to low air resistance for balloon at small distauces (a = 10 and 20 cm) between package and yarn guide.

In generalm the reduction in yarn tension due to balloon collapse is undersirable, because this leeds to a high difference in the value of yarn tension which intern effect on the textile processes.

-Effect of linear density for yarn on yarn tension (Fig. 10).

The value of yarn tension decreases with decreasing the linear density of the yarn, because the forces acting on the balloon is a function from yarn mass.

The level of yarn tension and yarn count increases with increasing the yarn withdrawl speed, this is because the centrifugal force of balloon is proportional to yarn withdrawl speed.

CONCLUSION

The variation in yarn tension increases with the increase in the difference between the maximum and minimum diameter of the package.

The diameter of the package core should not be less than certain limit, because withdrawing the yarn from packages with small diameter increase the rate of yarn tension.

The regulation of yarn tension during warping process is considered one of the essential parameters, since any variation in tension between yarns due to variation in package characteristic and its positioning will have its effect on the quality of the warping process.

It is preferable to arrange the package from yarn guide at a distance ranging between 1H to 1,5 H, where H = package stroke.

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