

FALSE-TWISTER EFFECT IN THE PRODUCTION OF WRAP SPUN YARNS

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Abstract

In the paper the influence of the false-twister application on the formation process and the properties of plain wrap spun yarns is studied. 9 types of yarns produced on a hollow spindle machine Prenomit with three types of wrapper threads (PET – texturized, PA-texturized and PA – non-texturized) are investigated. Three cases: 1.- with the false-twister bypassed; 2 - with a single wrapping of the yarn around the false-twister; 3 - with double wrapping of the false twister – are analysed. The experimental results obtained show the significance of twist distributor application as one of the important production factors.

Keywords: false-twister, yarn formation, plain wrap-spun yarns, yarns properties, wrapper thread

INTRODUCTION

Plain wrap-spun yarns are produced on hollow spindle spinning machines. The basic difference between the technologies and the machines used is in the construction of the twisting unit. Two constructions can be found – with and without a false-twister at the exit of the hollow spindle [2].

This element is used to determine two twist zones in the spinning process as well as to regulate yarn's structure. Usually, it is applied when fancy yarns are produced. When the machine is used for production of plain yarns the false-twister can be bypassed by the yarn or to be wrapped by it. In the production units where there is no false-twister the hollow spindle is closer to the drafting cylinders to maintain better control.

As the quality of plain yarns produced in the two possible yarns is regarded to be similar, there are not many studies dedicated to the investigation of its influence on yarn's quality indicators. Information is also missing about the combined influence of the twist distributor and other factors in the process – for example the type of wrapper thread used.

It is also not very well studied how using or bypassing the false twist hook influences the process of yarn formation and there are some contradictions in different publications [6,7]. In a previous work [5] the different theories

and the non-studied aspects of the problem are outlined and generalized.

The present study is ambitious to clarify some of the contradictory details and to contribute to the better knowledge of the wrap spinning method as a whole.

EXPERIMENTAL DATA

For the objectives of the experiment 9 types of yarns altogether are produced on a hollow spindle spinning machine Yantra PKVE 1-12 using technology Prenomit ON-1. For the yarn core a roving of Wool/Acrylic 50/50% with linear density of $T_{t_{rov}} = 1536\text{tex}$ is used. The fibers have length of $L_f = 129,2\text{mm}$, linear density $T_{t_f} = 3,05\text{dtex}$ and tenacity $R_f = 43.51\text{cN/tex}$.

Three types of wrap threads are used:

- PET 100% - texturized (PET-T), polyfilament thread (36 monofilaments), $T_t = 16,7\text{tex}$
- PA 100% - non-texturized (PA-NT), polyfilament thread (32 monofilaments), $T_t = 18\text{tex}$
- PA 100% - texturized (PA-T), polyfilament thread (36 monofilaments), $T_t = 18\text{tex}$

With each of the wrap threads 3 cases are realized that differ in the application of the false-twister:

- Case 1 (marked as 1) – yarns produced with the false-twister bypassed.
- Case 2 (marked as 2) – yarns produced by with a single wrapping around the false-twister.
- Case 3 (marked as 3) – yarns produced with double wrapping of the false-twister.

Normally, when false-twister is used for plain yarns, it is wrapped only once by the yarn. In this experiment with double wrapping, the extreme influence of the false twist hook is sought on purpose.

For all the cases the machine parameters – hollow spindle rotational frequency (n_{sp}), delivery speed (V_d) and draft value (i) are kept constant.

The spinning parameters are shown in Table 1.

Table 1. Spinning parameters

Wrap thread	Cases	n_{sp} , 1/min	V_d , m/min	i
PET-T	1	15000	40	29,5
	2			
	3			
PA-T.	1			
	2			
	3			
PA-NT	1			
	2			
	3			

After the yarns are produced, their linear density T_t , wrap twist T_c , breaking strength (tenacity) R , elongation El and twist liveliness TL are measured.

The results are statistically processed aiming to assess the influence of the false-twister application on the yarns' properties.

RESULTS AND DISCUSSIONS

During the production of the yarns some particularities in the spinning process are noticed.

First of all, it is ascertained that depending on using or bypassing the false-twister the yarn is formed in different zones.

When the false-twister is bypassed the two yarn components – wrapper and core - are twisted in a point somewhere close to the

entrance of the hollow spindle and at its exit the yarn is already formed (Fig. 1). This observation verifies the statements published in [7].

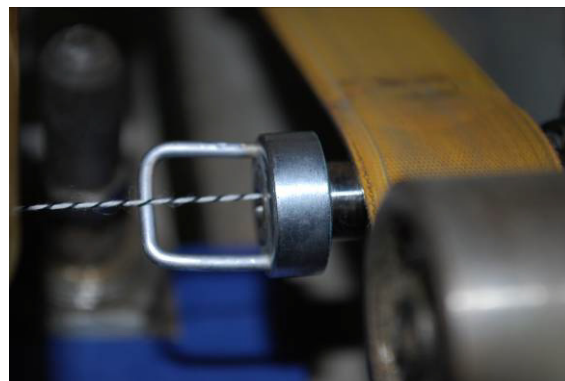


Fig. 1. Case 1 – Yarn formation when the false-twister is bypassed

When the yarn wraps the false-twister at the exit of the spindle the two components are not twisted together and are practically parallel. They get twisted at the contact point with the false twist hook (Fig. 2). This conclusion however disproves the suggestion of the authors of [7] according to which the two components get low initial wrap twist before going out of the spindle. A conclusion can be made that in these cases the yarn is finally formed in the zone after the false-twister.

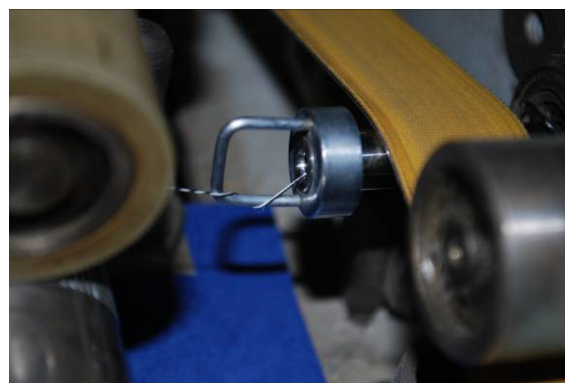


Fig. 2. Case 2 – Yarn formation when the false-twister is wrapped once

Another difference found is that when the false-twister is bypassed, a spinning triangle is formed at the exit of the drafting system, similar to the one typical for the ring spinning method (Fig. 3). This spinning triangle is one of the main reasons for ends-down during production.

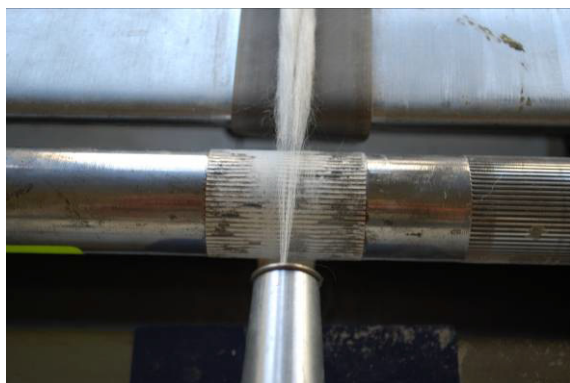


Fig. 3. Case 1 - Spinning triangle at the exit of the drafting system

If the false-twister is used this triangle is missing (Fig. 4), and the twist spreads to the front rollers nip. As a result fewer stops due to ends-down of the core are registered.

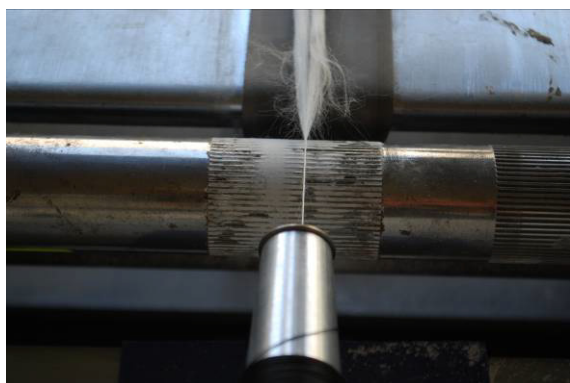


Fig. 4. Case 2 – Spinning triangle at the front rollers nip

A conclusion can be made that in relation to the way the false-twister is used, the second phase in the morphology of the spinning process [1] is realized differently. Actually, when the false-twister is used, fibers are better consolidated by the twist, as the torsion turns reach the drafting zone. As cohesion forces are critical for the mechanical properties of yarns, changes in yarns properties can be expected.

Table 2 represents the results for the yarns characteristics - linear density T_t and wrap twist T_c .

As it can be seen, the yarns have more or less similar linear density due to the little difference in the wrap threads linear density.

Table 2. Yarns linear density and wrap twist

	T_t, tex			T_c, 1/m		
	1	2	3	1	2	3
PET-T	69,2	71,2	71,1	496	514	539
PA-T	70,0	69,3	69,2	508	533	542
PA-NT	63,9	66,6	67,3	511	519	537

Yarns twist on the other hand is slightly higher in the cases with false-twister used and is highest in the ones with double wrapping. According to literature [4, 7] one of the sources for this twist increase is that when false twist is introduced into the hollow spindle it makes the core contract. After the core is detwisted at the contact point with the false-twister, it recovers from this contraction thus releasing an excessive length. This excessive length preconditions the tortuous shape of the yarn. In the cases with the false-twister bypassed such a contraction-recovery process does not take place and the yarn does not have a tortuous structure. It is logical to suggest that the contract-recovery process leads to internal tension and strain in the yarn, which makes it contract and relax once again after it is wound onto the bobbin. This way, more material per unit length is accumulated, thus explaining also the differences in the linear density of the yarns. However, the suggestion of the authors of [7] that when the false-twister is used, the core and the wrapper obtain a low initial twist in the hollow spindle, is not proved, as it was mentioned above. So, it cannot be verified that an initial twist between the two components is superimposed to the nominal twist thus forming greater final twist.

Another result, which can be expected from the increased strain in the yarn, when the false-twister is used, is that the wrapper will exert more radial stress over the core, thus changing its behavior.

The results for the yarn's tenacity are presented on Fig. 7.

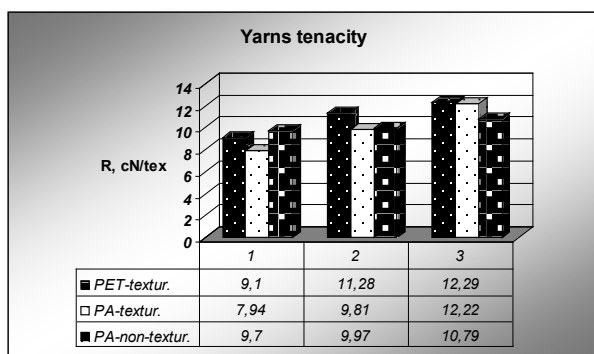


Fig. 7. Tenacity of the yarns investigated

The chart shows a clear tendency of increase in the tenacity with using the false-twister. The highest values are in the cases when the yarn wraps twice the false-twister. The differences are statistically significant ($r=0,05$).

It has also to be mentioned that the influence of the application of the false-twister is stronger for the yarns made with texturized wrapper threads and not so strong for the ones made with the non-texturized wrapper. In case 1 the yarns made with PA-NT wrapper thread have significantly greater tenacity than the yarns made with PA-T wrapper of the same linear density as well as than the yarns made with PET-T thread. In the other two cases the situation is the opposite.

The differences between the texturized and the non-texturized threads can explain also the results for the yarns elongation shown on Fig. 8.

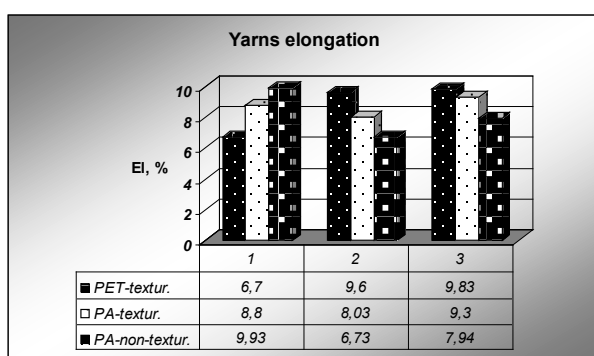


Fig. 8. Yarns breaking elongation

The first observation that can be made is that the yarns made with texturized wrappers have greater elongation in cases 2 and 3 than in cases 1. On the contrary, the yarns with PA-NT do not tend to elongate more if they are produced with the false-twister applied. Here the greater radial stress over the core fibers

does not let them slip and they break quicker. On the other hand, the non-texturized thread can not elongate as the texturized ones do at the expense of straightening of their crimps. For the yarns made with texturized wrappers, it can be suggested that when the yarn is strained, at first the wrapper crimps are straightened and after that core fiber slippage occurs. This leads to increased capability of the yarn to bear greater load.

The results for the twist liveliness (Fig. 9) show a negative influence of the false-twister.

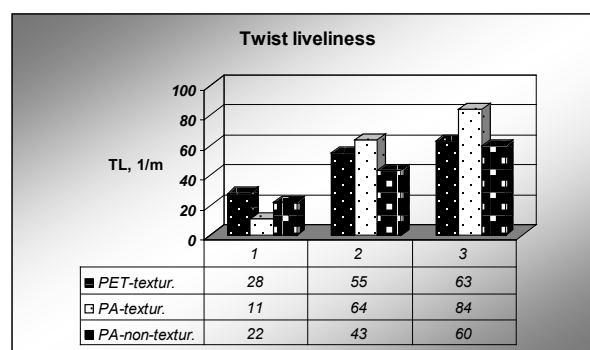


Fig. 9. Twist liveliness of the investigated yarns

In all the cases from 1 to 3 the twist liveliness increases, even in cases 3 the values exceed the normally acceptable for plain wrap yarns. The result can be easily explained with the increased internal stress in the yarns produced with the false-twister used as it was discussed above. However this negative trend cannot be a reason to avoid the its usage as the internal stress in the yarns can be overcome with suitable finishing treatments (for example, thermal fixing).

CONCLUSION

In the paper the influence of the false-twister application on the formation process and the properties of plain wrap-spun yarns is studied.

The observation of the spinning process shows that depending of the way the false-twister is used the yarn is formed in different zones. The application of the false-twister also helps eliminating the spinning triangle thus lessening the ends-down during spinning.

It is found that using the false-twister leads to increase in yarns tenacity. As a whole its

influence on yarns properties has to be analyzed together with the influence of the wrapper threads characteristics and the possible yarns' breaking mechanisms.

There is a negative influence of the application of the false-twister on the yarn twist liveliness, but this disadvantage can be possibly overcome with suitable finishing treatments.

The results obtained and their analyses prove that the way the false-twister is used in the production of plain wrap yarns is important. It has to be taken as one of the possibilities to affect yarns properties and structure without changing the machine parameters.

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