ISSN 2229-5518

The Observation of the Core Dref Yarn Production Methods and the Friction Property of the Yarn According to the Spinning Drum Speed

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Abstract— Developments in textile technology have led to an increase in production speeds in spinning. However, it is known that an increase in production only in terms of quantity will not lead to an increase in the market share of the products. The yarns produced must be of quality and quality that can meet the differences in the expectations of people from textile products in parallel with the changing lifestyle. For this reason, in recent years, with the changing lifestyle, more comfortable, more functional and longer-lasting textile products have been preferred. In order to meet these demands, core yarn types produced by combining materials with different properties have started to be used increasingly.

Core yarns are produced for many different purposes, most importantly, it increases the strength of the yarn produced from staple fibers with low strength. For this purpose, high-strength endless filaments are used to the core of the yarn and thus both the yarn strength increases and the properties such as the appearance, attitude and water absorbency provided by the fibers in the mantle to the fabric are not lost. In this study the production methods of core yarn with dref yarn spinning system is observed and the production methods analyzed with details. In this study, the core dref yarn production methods were observed and the effect of spinning drum speed on dref yarn friction coefficient is observed. According to test results, the increase of the spinning drum speed decreases the friction coefficient of the Dref yarns and the effect is more significant with the coarse yarn linear densities than fine yarns.

Index Terms— the core yarn production, dref 2000 spinning, dref 3000 spinning, technical textiles, coarse yarn, yarn strength, dref yarn friction coefficient

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1 Introduction

The principle of friction spinning was developed in 1973 in Austria by Dr. Ernst Fehrer. The spinning system based on OE-spinning and using basic mechanic-aerodynamic rules. Problems such as rotor rotations, diameter, weight and centrifugal force have been solved thanks to this new twisting method. The friction spinning system provides the opportunity to work with natural and regenerated fibers in a wide staple fiber length, as well as working at high production speeds. It is also possible to produce core yarn with material in filament or strip form fed into the spinning system. The first mass production of the Dref 2 friction spinning machine has been started in 1976, the introduction of the Dref 3 system in 1979, the introduction of the Dref 2000 friction spinning machine in 1999, and the introduction of the Dref 3000 system in 2004.

The friction spinning process is included in the OE spinning system. The material fed into the machine is in the form of sliver (draw frame or card sliver). The fed fibers are opened by the opening roller, split into individual fibers and form the yarn. The individual fibers are brought together thanks to the high air suction power of the perforated spinning rollers. At the junction of the spinning rollers, thanks to the rotation of one or two perforated rollers in the same direction, the fibers come together, gain twist and form the yarn structure. Then, the yarn passes the special conveying device and is wound in cross wound bobbin form.

The fineness of the yarn obtained is determined by proportioning the mass of fiber fed per unit time to the spinning speed. The machine automatically adjusts the feeding speeds according to the number of the belt fed to the machine, the number of the filament or tape used in the core. Mathematical expression of feed rate is given below;

The amount of twist given to the yarn is the ratio of the number of turns the spinning rollers make around themselves to the production speed. However, the amount of twist given to the yarn is generally lower than the predicted value. This is due to the slippage between the yarn and the spinning cylinder surface.

Fig. 1. Dref 2000 spinning machine production center show-

room, Linz (Austria)

The usage areas of the products produced on the friction spinning machine are given in the graphic below. Accordingly, the highest usage areas are blankets and cleaning cloths. It is also a spinning system frequently used in the reuse of filter material and used fibers.

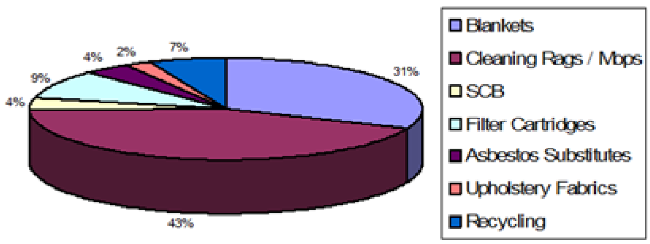

Fig 2. Dref yarn usage areas

The most products mentioned above are high-strength core yarns due to the spinning principle of dref spinning machine. If the high-strength filament or fiber in band form is not used in dref spinning systems, the number of ends down increases during production and the strength of the produced yarn are very low.

The yarns produced on the friction spinning machine have important properties such as high abrasion resistance, high dimensional stability and high durability compared to yarns produced in other spinning systems. In addition, friction yarns have significant advantages over traditional ring spinning machines, especially in thick yarn and technical yarn production. Compared to other spinning systems, the most important advantages are high production speed, ability to produce yarn from banded material and winding of the produced yarn in bobbin form.

2 Dref 2000 Spinning Machine and Spinning Principle

The Dref 2000 spinning principle forms the basis of the friction spinning system. In this spinning system, it is possible to produce "core yarns" using only endless filament or yarn. If we examine the process steps in the principle of the spinning system, respectively;

- Feeding the fiber band: The fiber bands are fed from the back of the machine and the yarn. It is recommended to use at least two tapes in its production. Feeding more than one belt to the machine reduces yarn evenness but increases the cost. In addition, it requires a high degree of opening.

- Opening the fiber band: Opening is done as in rotor spinning. Saw toothed opening roller is used for opening process. Opening rollers can be of different size and opening roller angle. The speed of the opening roller is too high or the saw teeth used in the opening roller are not suitable for the fiber properties used in spinning, which negatively affects the yarn quality. The belts fed to the machine reach the opening roller after passing through three feeding rollers, two at the bottom and one at the top. Feeding the fibers perpendicularly to the opening roller during the opening process minimizes the damage caused by the opening process to the fibers and ensures the best opening process. The main and only reason for producing very thick band yarn in the friction machine is the opening roller. Otherwise, it is not possible to obtain yarn from a very thick sliver.

- The accumulation of opened fibers in one place: The fibers opened by the opening roller fall between the spinning rollers and accumulate here as a result of the air turbulence created during the rotation of the opening roller and the air suction in the spinning rollers.

- Giving strength by giving twist: The fibers accumulated between the spinning rollers gain twist by the rotation of the spinning cylinders around themselves in the "same" direction. Thanks to twisting, yarn formation occurs.

- Yarn withdrawal: After yarn formation, yarn is pulled from the spinning rollers with the help of a special drive device. The angle of exit of the yarn from the spinning rollers during this drafting is very important. Studies have shown that the yarn strength increases when the yarn is pulled at a certain angle.

-Winding the yarn: The yarn passing through the conveying device is wound crosswise in bobbin form.

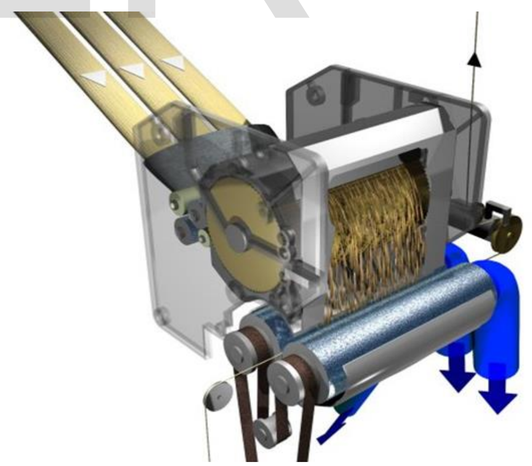

Fig. 3. Dref 2000 Spinning Machine

3 Dref 3000 Spinning Machine and Spinning Principle

The Dref 3000 spinning system is the same as the Dref 2000 spinning system principle. In this system alone, it is possible to produce core yarn using endless filament and yarn, as well as core yarn production using fibers in band form. Because, unlike the dref 2 spinning system, in this spinning system, a drafting system has been added to the left side of each spinning unit, with 3 cylinders below and 3 cylinders above.

There are two different shots in the drafting system, pre-draft and main draft. In this respect, it is very similar to the drafting system used in the ring spinning principle. However, in friction spinning the take-off roller is different from ring spinning. Instead of two cylinders as in ring spinning, a perforated cylinder with air suction feature is used under the delivery cylinder, which ensures smooth delivery of fibers to the spinning cylinder.

The amount of air suction in this perforated exit cylinder changes depending on the amount of air suction set in the machine during production. In other words, as the air suction selected on the screen of the machine for the spinning process increases, the air suction at the lower exit cylinder also increases. The air suction in the perforated cylinder is of great importance during spinning. For trial purposes, it was observed that when the air suction was interrupted, the fibers were not delivered to the spinning cylinder and accumulated to the take-off unit. The air suction collects the drafted fibers '>' so that they are thinning towards the end, and thus the small gap between the spinning rollers is properly shipped.

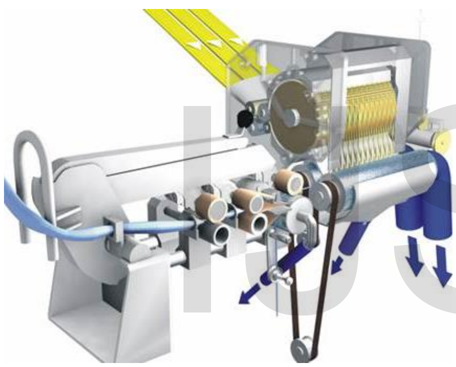

Fig. 4. Dref 3000 Spinning Machine

4 Previous Studies About Core Dref Yarn Spinning

The spinning principle of the friction spinning machine is highly complex and difficult to understand. The main reason for this is that many parameters affect the yarn quality characteristics during spinning. Since core yarns are produced in the scope of this research, previous studies on core yarn production in friction yarn machine are examined in this section.

Merati, Konda et al. (1998) found that core yarns produced on friction spinning machines gain false twist of the filament in the core part during spinning. In the study, firstly, the false twist that the filament gained was theoretically explained and then proved by these experiments.

Miao, How et al. (1996), studied the problem of the mantle sliding over the core. During the use of core yarns or some mechanical processes, the staple fibers in the mantle parts slide over the core part due to the forces they are subjected to, and as a result, the yarn structure is deteriorated.

Merati and Okumara, (2004) produced medium-fine and three-layer friction yarns from residual fibers. Filament is used in the innermost part of the yarn, residual fiber in the middle part, and cotton fiber is used in the mantle part that completly surrounds the residual fibers.

Bhattacharyya and Chatterje (2005) studied the friction properties of friction yarns produced from 100% cotton fiber. For this purpose, they tested the friction properties of yarns produced under different machine parameters.

Aydoğmuş and Behery, (1999) examined the spinning limits of the dref spinning system in their study. The spinning cylinder speed has a significant effect on yarn strength, elongation at break and thick places. The lowest spinning cylinder speed ensures the lowest elongation and highest strength.

Kimmel and Sawhney (1990) produced core yarns with three different counts with different core ratio by using the unique silver form of the same material with different counts on the friction spinning machine.

5 The Effect Of Spinning drum Speed On Dref Yarn Friction Coefficient

In the study, yarns having two different thicknesses, 40 Tex and 60 Tex were produced with dref 3 machine. During the spinning of yarns, in the core of the yarns 96 dtex PES filament was fed to the machine under the same tension with a special tension device. In the sheath and second passage draw frame Pes staple fibers, were used. The aim of the study is to examine the effect of spinning drum speed on the friction coefficient property of dref yarns. For this purpose, core yarns were produced using four different spinning cylinder speeds with standard constant production parameters. During the production of the yarns, the opening roller speed was chosen as 4000 turns/min, the production speed as 150 mtmin and the air suction amount is 3000. After producing yarns, all yarns were tested with the friction coefficient test machine developed in RWTH Aachen University. Each yarn sample was tested 20 times. The average values of the friction coefficient test results calculated and the results were given below:

Table1. The effect of spinning drum speed on friction coefficients of dref yarns

Yarn Linear Density (Tex)	Core/Sheath Ratio (%)	Dref Spinning Speed	Friction Coefficient
Tex 40	24	2000	1494
		2500	1500
		3000	1419
		3500	1371
		4000	1342
Tex 65	16	2000	1196
		2500	588
		3000	262
		3500	242
		4000	338

According to test results, it can be concluded that with the decrease of yarn linear density, the friction coefficient is incerases. This means that the decrease of the number of fibers in the sheath part of the yarns, the friction coefficient of yarn increases. In addition to this, the core/sheath ratio also affects the friction coefficient of the dref yarns. The increases in core-sheath ratio yarn friction coefficient increases.

In dref spinning the spinning drum initially gives the fibers a certain radial force and ensures that the fibers are wrapped properly around the filament in the core. The increase of spinning speed decreases the friction coefficient of yarns. The effect is clearer with the coarse yarn linear density.

6 Conclusion

With the popularity of functional textiles, the raw materials used in the production of these products have gained importance. Core yarns, as one of these raw materials, ensure that the fabric and clothing used are more comfortable, stronger and more dimensionally stable and adds an added value to the textile product.

In core yarn production, one of the most important spinning systems is dref yarn spinning system. This system could produce thick yarns for technical purposes. The different components could be used with this spinning, so it is possible to fully benefit from the advantageous aspects of each. In line with this feature of core yarns, many functional textile products can be produced in accordance with the intended use and place of use. With the work to be done in this area, it is thought that new functional clothes can be designed and produced with different and new materials that can be used in core and coat.

The spinning production parameters affect the yarn physical properties significantly. The most suitable parameters could be observed with previous studies in order to obtain the highest quality of yarn.

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