Recent developments in two-for-one twisting and their relevance to Indian textile units

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Two-for-one twisters have gained wide acceptance in the international as well as in the Indian markets. This paper describes the recent developments, including those exhibited at ITMA-91, in TFO twisters and their relevance to Indian textile units. The developments are mainly in the application areas, machine productivity, refinement in the functional parts, automation and process control instrumentation, and environmental compatibility of the machines. A cost comparison of twisting on low-cost completely indigenous machine and high-cost but high productivity machine is also made.

Keywords: Automation. Two-for-one twisting. Machine productivity. Pneumatic threading

1 Introduction
The two-for-one (TFO) twisters have the following inherent advantages over the ring twisters: (i) production of long lengths of knot-free yarn which facilitates better performance in subsequent processes; (ii) higher productivity per spindle, about twice that of ring twisters; (iii) fewer pre- and post-twisting operations as compared to that in ring-twisting process; and (iv) low manpower requirements. However, as the TFO machines are capital and energy intensive, the production cost per kg of doubled yarn is higher compared to that on ring-doublers in India. Even so there is demand for TFO twisted yarns mainly from the synthetic spun yarn sector and from the exporters of cotton yarns, where the buyers are willing to pay extra price for the knot-free long lengths.

The concept of TFO twisting was first mentioned in a British Patent in 1855. The practical exploitation came in 1930s for filament yarns1 and in 1950s for spun yarns. Till then, there was neither market pressure for the long lengths of knot-free twisted yarn nor the technology was sufficiently developed. TFO twisting entered India in early 70s and the manufacture of TFO twisters started in late 70s, when a textile machinery manufacturer developed indigenous TFO twister with the assistance of South India Textile Research Association (SITRA), Coimbatore. This machine had certain limitations in speed, applications, etc. In the early 80s, Volkmann GmbH (Germany), a world leader in TFO twister manufacturing, started the manufacturing activities in India in a joint venture. At present, four manufacturers make TFO twisters in India.

This paper describes the developments in TFO twister for spun yarns on the international scene. The relevance of these developments to Indian textile units is indicated in each case.

2 Developments in TFO Twister
The developments that have taken place during the last decade in the TFO technology can be classified under the following areas:

- Application areas
- Machine productivity
- Refinements in functional parts
- Handling aids, automation and process control instrumentation
- Environmental compatibility of the machine.

2.1 Wider Applications
The possible applications are governed by the design of the machine, mainly those of spindle zone and feed package assembly. With the improvements in these functional parts, TFO twisters can now also be used to twist the following yarns:

- Synthetic fibre spun yarns
- Open-end yarns
- Air-jet yarns.

Twisting of synthetic spun yarns on TFO machine became economical mainly due to the incorporation of on-line lubricating system which facilitates twisting at high speeds without impairing the yarn quality. Suitable redesigning of feed-package
The change in twisting costs by using a low-cost indigenous machine (TFO A) and a high-cost imported machine or an Indian machine with imported critical components (TFO B) is shown in Table 1 and Fig. 1. It may be observed that the twisting cost for counts beyond 2/20s is comparatively lower on B type of TFO twisters due to higher productivity.

2.3 Refinements in Functional Parts

In the last one decade, commendable improvements have been made in some of the functional parts of TFO twisters towards reduced energy consumption, lower noise level, gentle handling of yarn, longer life (less wear and tear), etc. The salient improvements are discussed below:

2.3.1 Spindle and Feed Zone

(i) Optimization of the shape and dimensions of the spindle diameter for minimizing twisting costs through reduced energy consumption, labour complement, etc.—the number of models offered by leading manufacturers is large to suit the varying requirements, e.g. Volkmann offers about 10 models...
with 6 different spindle specifications to cover counts from 2/17s Ne to 2/118s Ne and Savio offers about 13 models with 7 different spindle specifications.

The energy requirement, as claimed by one of the manufacturers, is about 115 W per spindle for twisting 2/50s yarn at 12,000 rpm with 1300 g feed package and about 155 W per spindle for twisting 2/20s yarn at 8750 rpm with 2300 g feed package.

The indigenous machines are available in limited ranges and hence limiting the choice available to user for minimizing twisting costs. One leading manufacturer, offers only 2 models, each with different spindle diameter. However, another leading manufacturer, with foreign collaboration, offers 6 models with 4 different spindle specifications.

However, in India, the users prefer to have a versatile machine. This thinking needs to be re-examined.

(ii) Acceptance of much wider feed package formats like two separate single-end packages, thus eliminating assembly winding, and of denser precision wound assembly packages which result in lower ends down and also in reduction of labour. Redesigning of feed package assembly has permitted quick adoption of TFO technology to the developments in spinning, specifically the open-end spinning and the air-jet spinning, and also to the automation in the processes.

Some of the machines are designed to accept assembly wound packages of traverse as high as 254 mm or two single packages of traverse 152 mm (2 × 152 mm), which is equivalent to a feed package weight of about 4500 g, depending on yarn count, material, etc.

Most of the indigenous machines are lacking in this area and also many users are reluctant to adopt two single-end feed packages. The slow adoption of single-end feed packages is mainly due to: (i) the difficulty in maintaining identical lengths of yarn on feed packages which otherwise result in higher yarn waste, (ii) the higher end-breaks due to greater variation in tension, and (iii) the difficulty in piecing due to larger feed package assembly.

(iii) Provision for unwinding aids like 'floppy discs' between two single-end feed packages or on top of the upper package to reduce tension peaks and to prevent snarling.

(iv) Redesigning of tensioning devices to suit the pneumatic threading.

(v) Coating of protection pot with low friction material. This ensures minimal damage to yarn even at high speeds.

2.3.2 Winding Zone

Winding of take-up packages to suit different end uses, e.g. soft wound package to suit dyeing.

2.3.3 Drives

Redesigning of driving systems mainly (i) to enhance the versatility of the machine, e.g. double gear system to facilitate independent driving of the two sides and driving of different shafts individually using low power motors which facilitate quick adjustments in machine parameters, and (ii) to suit the changing designs of TFO machines, e.g. long length machines with about 372 spindles. These machines are equipped with two motors to drive each side individually.

2.4 Handling Aids, Automation and Process Control Instrumentation

The developments in the area of automation, ease of operation, process control systems, etc. have been dramatic in the international scenario. However, most of the indigenous TFO twisters have remained virtually unchanged in these areas since their introduction. Some of these recent developments are as follows:

2.4.1 Pneumatic Threading

Traditionally, threading in case of an end-down is performed using a plastic leader. This operation, though simple on machines having smaller feed packages, becomes cumbersome and time consuming with the larger packages. Incorporation of pneumatic threading simplifies the operation and also saves operators time. The pneumatic threading system may be either an integrated system with the machine or a portable one serving many spindles. The system works either on blowing principle or injector principle. Pneumatic threading offers an added advantage in the form of forced cleaning of the inside of the spindle by the air current. This is particularly advantageous while processing rotor-spun yarns.

Owing to the poor techno-economic returns from the system of pneumatic threading in India, this system is not popular. However, the adoption of larger feed packages/two single feed packages, increase in wage rates, etc. may necessitate the simplification of piecing operation by suitable means.

2.4.2 Material Transport Aids

(i) Take-up package conveyor belt: In the TFO twister meant for coarse yarn twisting, take-up packages sometimes measure up to 350 mm in diameter and 250 mm in traverse length. Manual
handling of these heavy packages becomes problematic. Hence, such machines are often provided with a conveyer belt between the two rows of take-up packages and the package holders are such that after opening the spindleless holders, the package has only to be rolled back onto the belt. At the end of the machine, the belt delivers the packages into a transfer device, which puts the full twisted yarn packages into the transport containers.

(ii) Feed-package conveyer belt: This automation equipment links the preceding processes, e.g. winding with the TFO twisting. The modern spinning systems, viz. OE spinning and air-jet spinning, which deliver large single packages, can be easily linked to TFO machine by using bobbin conveyer system. One of the bobbin conveyer systems offered by Volkmann in association with Schlafhorst can select the single packages originating from the same winding position and then deliver to the individual twisting position on TFO machine 2.

2.4.3 Package Transfer Robots

Recently, some of the manufacturers like Murata, Sauer-Allma and Volkmann have demonstrated the use of package transfer robot for loading and unloading of packages. The prototype robot exhibited by Murata can replace full package with empty tubes and string up the thread.

2.4.4 Process Data Collection System

Data collection systems help in the production control. 'Volkotronic', a system supplied by Volkmann, collects data from various machines and this can be evaluated from a central point. The 'BDE' system of Sauer-Allma monitors individual spindles also for the end-breaks, feed package changes, etc. and the data can be called upon a terminal provided on the machine.

At present, none of the indigenous TFO twistes are equipped with data collection systems. It is desirable to equip TFO twisting with these systems since they provide vital information essential for better process control.

2.5 Environmental Compatibility of the Machine

The present machines are environment-friendly in the sense they have better noise control, dust control and ambient climate control equipments.

2.5.1 Noise Control

Several technical improvements have contributed to reduction in noise. Some of these are:

(i) Suppressing or reducing the noise at its point of origin by design measures like specially engineered spindle bearings, spindle drive mechanism, etc.

(ii) Preventing the propagation of noise by measures like encapsulating the machine parts, use of noise absorbing materials, etc.

(iii) Use of balloon limiters which reduce noise levels by about 5%; the application of balloon limiters has been extended to synthetic yarns because of efficient on-line lubrication system.

2.5.2 Dust and Ambient Climate Control

Fly and dust are generated during twisting. Also, heat is dissipated at spindle and other machine parts. The heat dissipated at spindles ranges from 100 to 300 W depending on speed and yarn count. Some of the measures provided on the new generation machines are:

(i) Use of travelling blowers which blow and/or suck the fly deposited in the vicinity of the twistes.

(ii) Provision of an air conditioning unit integrated with the machine; this can effectively maintain the ambient humidity and temperature and also keeps the machine clean.

3 Conclusion

The developments in the two-for-one twistes are mainly in the area of increasing productivity, keeping the twisting costs low by the proper selection of machine specifications and simplification of operations; and automation and process control instrumentation. The developments in automation are intended to satisfy the market requirements in the developed countries.

In India, some of the developments relating to higher productivity, wider application range, and simplification of operations need to be adopted in the machines having majority of components manufactured indigenously. Also, to enter into the field of export of TFO twistes, incorporation of some of the advanced developments like pneumatic threading as well as making the machine compatible to adapt to further automation are essential.

References

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