An Attempt to produce Wool Yarn through Rotor Spinning Machine

Karan Patel[1] Prof. (Mrs.) V.D. Shah[2]
[1]M. E. Student [2]Associate Professor
[1, 2] Textile Engineering
[1, 2]L. D. College of Engineering
[1, 2]Gujarat Technological University, Ahmedabad, Gujarat, India

Abstract— Woollen fabric having larger used in finished textiles, garments, knitwear, blankets, carpets, technical textiles, home tech. it is a very popular and desirable fabric for people cause of some of special properties of wool fibre. Woollen fabric is comfortable in any climate and region. Woollen yarn is generally produced with help of large passage of ring spinning. So aim of this study makes a woollen rotor yarn which is more economic compare to the ring yarn. But till now we have observed that high economical production rate which rotor spinning machine compare to ring spinning machine is not explore for the wool spinning so it attempts to make economical wool yarn. With the help of it possible to reduce the final product cost. Rotor yarn produces most economical compare to ring yarn.

Key words: wool yarn, rotor spinning, viscose wool blend yarn.

I. INTRODUCTION

Open end rotor spinning is normally used in cotton carded spinning. The frame is fed with slivers from the drawframes which transform the yarn directly into packages, eliminating the passage on the roving frame.

The main function of the rotor spinning unit is as follows. The sliver from the drawframe is introduced by a feeder cylinder and is subject to the action of an opener with saw-toothed wiring which rotates at a speed of between 6000 and 9000 rpm, separating the sliver into single fibres, and then the fibres are sent to the rotor through a vacuum channel. The rotor, whose diameter is between 28 and 54 mm, rotates at a very high speed over 200,000 rpm, and compacts the fibres partly thanks to its special shape, twisting the fibres at the same time.

While development in rotor spinning technology is continuing from last seven decades. In which there was not concentrated on wool spinning on rotor spinning. A disproportionately lower effort was directed towards development work in the long-staple sector. The rotor spinning advantage is its high production.

India has the 3rd largest sheep population country in the world having 6.40 crores sheep producing 43.30 million kg of raw wool. Out of this about 85% is carpet grade wool, 5% apparel grade and remaining 10% coarse grade wool for making rough Kambals etc. India produces mainly coarse wool in the range of 30 microns to 150 micron. The coarsest wool available in the state of Maharashtra and North Karnataka amounts to 7000 tonnes per year. This wool has a very coarse micron value (diameter) of around 50 micron, on average. India produces mainly coarse wool in the range of 30 microns to 150 micron. India also Imports 90 million tons of raw wool from Australia, New Zealand and many other countries.

The woolen product portfolio is equally divergent from textile intermediaries to finished textiles, garments, knit wears, blankets, carpets and an incipient presence in technical textiles.

Normally, wool yarn comes in length of 48.6 to 74 mm. the average staple length is 66.4 mm. the coarse wool in the range of 30 microns to 150 micron. Merino wool is typically 3–5 inches in length and is very fine. So it is very long fibre which cannot be spun on rotor spinning. So in this work, merino wool fibre e is used. Merino wool is very finer fibre originated from Australian region. The wool fibre is procured from the third passage of comber noil at worsted spinning process. The wool fibre is in range of 25 to 38 mm and there is less contain of trash, micro dust and foreign matter. More fibre specification detail in next.

Fig 1. Reiter R40

As per above, use of sort staple wool fibre. So it is bland with viscose fibre which staple length is 38 mm. The bland ratio is 50/50. It may be given good yarn quality.

The work is done on rotor spinning and contain with 100% wool yarn, 50/50 viscose-wool blend & it is comparing with OE cotton yarn.

Process parameters	For 100% wool	For 100% wool	50/50 VW
Yarn count (Ne)	6's	6's	9's
Hank of sliver	0.1098	0.1098	0.09849
Feeding speed (m/min)	2.63	1.68	1.66
Opening roller speed (rpm)	8750	8750	8750
Opening roller type	S21	S21	S21
Rotor speed	60190	69860	79870
Rotor diameter (mm)	33	33	33

Rotor type	t groove	t groove	t groove
Navel type	MIMA 1 fluted	MIMA 1 fluted	MIMA 1 fluted
TPM	658	658	608
Draft	35	55	79
Tension draft	0.985	0.985	1.017
Take-up speed (m/min)	91.4	91.4	131.3
Winding angle	33.8-34.1	33.8-34.1	33.8-34.1

Table. 1: Set parameters of yarn production

II. MATERIAL AND METHODOLOGY

A. Material Procurement

The basic raw material is wool fibre and viscose fibre.

The raw material of merino wool fibre from 3rd passage of comber waste is used for making an attempt to produce wool yarn through rotor spinning. The fibre parameters are as below:

- Micronaire : 7.34
- Maturity Index : 1.02
- UHML (Upper Half Mean Length) : 22.98
- UI (Uniformity Index) : 74
- SFI (Short Fiber Index) : 21.3
- Fiber Strength in g/Tex : 29.1
- Elongation : 50.6
- Moisture Content : 5.0
- Color (Reflectance Rd, Yellowness +b) : (60.2, 12.4)
- Color Grade: 54-1.
- Trash (% Area, Trash Count) : (0.12, 20)
- Trash Grade : 1

The viscose fibre is available at different staple length but here 38 mm is used which comes in range of wool fibre. Viscose fibre specifications are as below:

- Staple length : 38 mm
- Denier : 1.18
- Bright bleached viscose
- Color grade : 84% Berger
- Fibre Strength in g/tex : 25.65

B. Methods used

1) Sliver Preparation:

The wool fibre is conditioned by 0.35% antistatic agent SLV-600 with water. Because wool fibre generates more static charge and create problem in card web extracting from front pressure roller.

The bland of viscose and wool is prepared 50/50 weight of both fibres by hand blend and then lap is prepared.

Laxmi LC 300A card is used for sliver preparation. The sliver hank is

1. 100% wool sliver: 0.0464
2. 50/50 vis/wool sliver (vw): 0.09849

For more parallisation and improvement and mass reduction in sliver is given by first passage of drawframe. Truezschler drawframe is used for sliver preparation. The wool sliver is very coarse so it is reduce from 0.0464 hank to 0.1098 hank. VW sliver is given normal drawframe passage.

2) Rotor Spinning:

Reiter Rotor Spinning Machine R 40 is used for spinning. The laboratory R 40 machine has the most advanced SC-R spin box with up to 24 spinning positions, Unique

	Thin -40% /km	Thin -50% /km	Thick +50%/km	Thick +70% /km	neps +140% /km	neps +200% /km
wool	1966	560	120	40	1000	80
VW	0	0	20	0	1170	50
cotton	14	1	11	0	262	8

Table. 2: yarn evenness test on UT 3

AERO piecing technology for ComfoRo yarn with invisible, yarn-like piecing. Delivery speed of yarn up to 350 m/min and rotor speed up to 160’000 rpm.

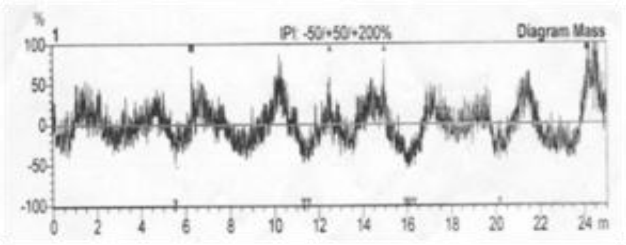


Fig 2. Mass digram of wool yarn in 25 m.

The prepared sliver is fed to the rotor spinning machine. The process was doing on pre prepare plan and then set by trial and error base.

There was changing in machine part like rotor diameter, rotor groove, opening roller, navel type. And sub-sequence there change in process parameters like rotor speed, feeding speed, opening roller speed, take-up speed, winding angle. Set different tpm, tension draft which is facilitate with processer of R 40.

Finally, the production of 100% wool yarn and 50/50 VW yarn is set parameters as per table 1.

3) Testing of yarn characteristics:

The yarn can then be tested on different testing standards method. Linear density is measured by yarn weight method on wrap wheel. Determination of twist in yarn by direct counting method on USTER® ZWEIGLE TWIST TESTER ASTM 1423, ISO 2061. The evenness, hairiness and mass variation spectrograph of yarn is measured on USTER® TESTER 3- ISO 2060, DIN 53 830 Determination of yarn count ISO 2649, DIN 53 817, Determination of yarn evenness ASTM 1423. Yarn tensile properties are measured on Instron tensile tester.

Breaking force, elongation Single-end tensile testing is measured on USTER® *TENSORAPID 3 with* ISO 2062, DIN 53 834, ASTM D-1578, JIS

The testing results of wool and VW blend yarn are comparing with the cotton yarn. Cotton yarn of 6’s Ne.

III. RESULTS AND DISCUSSION

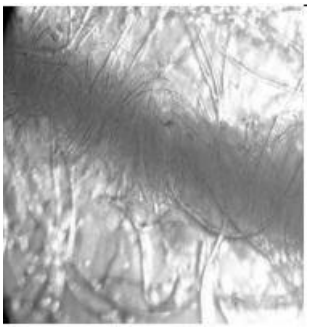
A. Linear density

Linear density is measured as below:

- Wool yarn count is 6’s Ne but actual count is 6.4’s Ne.

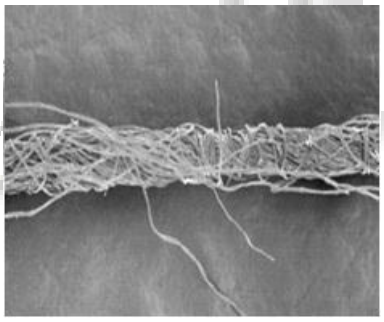
- 50/50 viscose-wool count is 9' Ne but actual count is 9.2' Ne.
- Cotton yarn count is 6's Ne but actual count is 5.83's Ne. it gives little more strength

B. Twist level



1)

2)



3)

Fig. 3. Microscopic view of yarn:

1) wool yarn
2) 50/50 viscose/wool yarn
3) Cotton yarn

Wool yarn has 5.64 tpi give less strength but more extension in yarn. VW yarn has 13.96 tpi and cotton yarn has 14.33 tpi.

C. Evenness testing

The wool yarn has more thin places in a range of -40% is 1966 and -50% is 560 this indicate that in sliver fibre is not linearly distributed or in feeding problem. Thick places in range of +50% is 120 and +70% is 40. Comparatively thick and thin places more so indicate the sliver unevenness effects on yarn properties. Neps of +200% is around 80. In VW bland yarn is as even as cotton yarn. Table 2 shows yarn evenness results.