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Optimizing Effects of Cots Shore Hardness on Cotton Yarn Properties at Ring Frame

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Abstract

The effect of eight different spinning front and back line cots (Synthetic rubber cot) varying only in shore A hardness (65°,83°) on 100% cotton 30's ring spun yarn has been investigated. The change in cotton yarn properties like mass uniformity, unevenness percent, Imperfection levels (in all class) with progressive change in shore A hardness has also been reported. The count and process parameter's from opening and cleaning machines that covers blow room and carding then breaker and finisher drawing, speed frame and up to ring spinning kept identical. As one progress from lesser shore hardness (65°) to higher shore hardness (83°) the yarn unevenness percent and imperfection levels gradually increases.

Keywords: Cotton; Spinning; Yarn

Introduction

Yarn quality is essential to the economic success of spinning plants. International competition and market requirements dictate the necessity to produce quality yarns at an acceptable price [1,2].

In general yarn quality is influenced by:

- Quality of raw material
- Opening and cleaning operations at Blow room and Carding
- Speeds and Settings kept at various stages of yarn production and its functions.
- Process control techniques and parameters kept at spinning
- Humidification, (temperature and humidity)
- labour force training and their skills.
- Maintenance of production equipment and vital components.

Drafting components have a significant influence on yarn quality and production costs in ring spinning. Especially spinning top roller covers i.e., cots and drafting aprons [3]. These are the main components of the drafting mechanism and certainly it has more influence on the quality of the yarn produced Cots are used in draw frame, comber, speed frame and ring frame, whereas aprons are used only in speed frame and ring frame. The purpose of cots is to provide uniform pressure on the fibre strand to facilitate efficient drafting and use of aprons help to have better grip and control on fibres particularly floating fibres [4]. A front line cot in ring spinning should also offer sufficient pulling force to overcome drafting resistance. Mathematically, Force of pulling required at front line cot Frictional resistance between fibers and Force exerted by the aprons on fibers [5-7].

Essential characteristics of a spinning cot

The raw material Compounds on the basis of special rubber in the hardness range of approx. 65 to 83 Shore A hardness are used as coating raw materials [8].

The composition of the raw material determines the characteristics of the cot such as

- Shore A hardness of the rubber cot
- Resilience properties, low Compression set values and elasticity of the cot.
- Surface Characteristics like grip offered on fibre strands.
- Abrasion resistance.
- tensile strength
- Swelling resistance
- Color - These characteristics should fulfill the following demands made on a top roller cover
- Good fiber guiding
- No lap formation
- Long working life
- Good ageing stability
- Minimal film formation

Normally synthetic top roller cots are available in cylindrical form. The technical specifications of a top roller cot are i) Bare roller diameter BRD ii) Finished outer diameter FOD iii) Width or Length iv) construction like Alufit or PVC core and v) Shore A hardness. Shore hardness is one of the main properties of top roller cot and varies for different types of fibre, application etc. (Figure 1).

Literature Review

Shore hardness

Generally Shore hardness of a rubber cot is measured by using an

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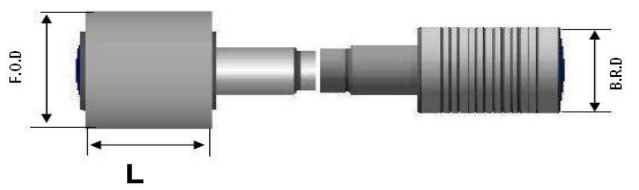

Figure 1: Top roller cot.

instrument called 'Durometer' and the value is expressed in A scale. Cots are available in wide shore hardness ranging from 63° to 90° shore.

Definition of shore hardness

Hardness may be defined as the resistance to indention under conditions that do not puncture the rubber. It is called elastic modulus of rubber compound. These tests are based on the measurement of the penetration of the rigid ball into the rubber test piece under specific conditions. The measured penetration is converted into hardness degrees. Shore ADurometer is used for measuring soft solid rubber compounds. Other scales are also used like Shore D which is used to measure the hardness of very hard rubber compounds including ebonite. The main drawback is in reproducibility of results by different operators. So, a practical tolerance of 5° is acceptable. As per the ASTM (D 2240 – Defines apparatus to be used and its sections such as diameter, length of the indentor, force of spring and D 1415 –Defines specimen size), DIN, BRITISH and ISO Standards following test conditions have been laid for measuring.

Shore a hardness of rubber products (Figures 2 and 3)

1. The specimen should be at least 6 mm in thickness.

2. The surface on which the measurement made should be flat.

3. The lateral dimension of the specimen should be sufficient to permit measurements at least 12 mm from the edges.

Mathematically, Arc of contact or the nipping length made by top roller cot with fluted roller (I) is inversely proportional to the shore hardness of the rubber cot. In general, Lower the shore hardness higher will be the contact area with steel bottom roller better so that there will be positive control on fiber's strand producing the yarn with better mass uniformity, lesser imperfection levels. Under Identical condition a cot measuring 65° Shore Hardness will make larger arc of contact with steel bottom than a cot measuring 83° Shore hardness.

Experimental Work

The Experimental work flow is shown in (Figure 4)

Material Methods

In this investigation 100% MCU -5 cotton was chosen as raw material with the following fiber parameters and 30 s Ne combed count was produced at ring spinning. In the production process, cotton processed through blow room, carding, breaker draw frame, unilap, finisher draw frame followed by speed frame and ring frame. Table 1 indicates the properties of cotton used in production of 30's cotton yarn. At ring frame altering the positions of front shore hardness and back shore hardness 30's yarn produced. Obtained yarn tested for unevenness, Rkm, Elongation, Imperfections on Uster Uneveness tester (UT-5) and Uster tensorapid tester (UT-3) in order to assess the yarn properties of 30's count.

Figure 2: Durometer analog and digital models.

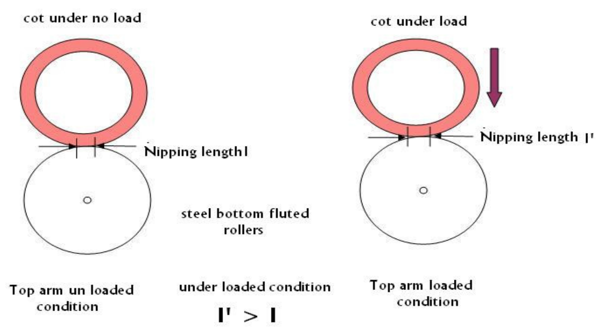

Figure 3: Shore hardness and bottom roller contact area relationship.

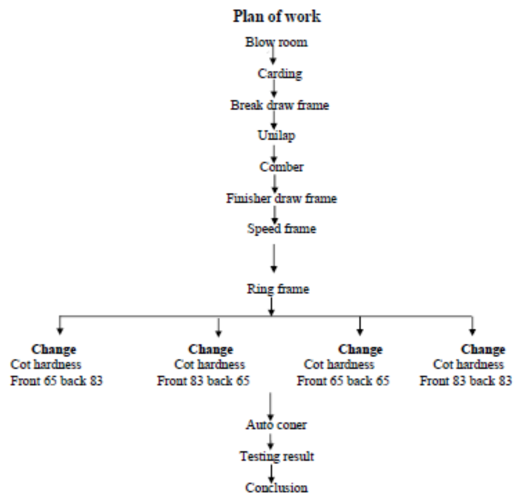

Figure 4: Experimental work flow.

HVI test data

Fibre parameters are shown in the Table 1.

Result and Discussions

From Table 2 and Figure 5 The present investigation summarized that, The effect different spinning front and back line cots (Synthetic rubber cot) varying only in shore A hardness (65°, 83°) on 100% cotton 30's ring spun yarn has been investigated. The change in cotton yarn properties like mass uniformity, unevenness percent, Imperfection levels (in all class) with progressive change in shore hardness has also

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2.5 % Span Length in mm	**30.70**	**Bundle Strength at 3 mm Gauge**	**23.5 gms / Tex**
50 % Span Length in mm	13.70	FibreMicronaire	3.8 µgs / Inch
Raw Material Trash %	3.3 %	Short Fibre Content by (n)	27.8 %
Short Fibre Content by (w)	10.3 %	Maturity Ratio	0.88
Immature Fibre Content	6.2 %	Neps / Gram	106

Table 1: Shows fiber parameters selected in manufacturing of cotton yarn.

Count	**30 Ne**	**30 Ne**	**30 Ne**	**30 Ne**
Cot Shore Hardness	F 65/ B 83	F83/ B 65	F65/B 65	F 83/ B 83
Count	29.73	29.59	29.54	29.14
U%	8.97	9.55	8.79	9.54
CVm%	11.07	12.09	11.12	12.08

Table 2: Effect of shore hardness on 30's count.

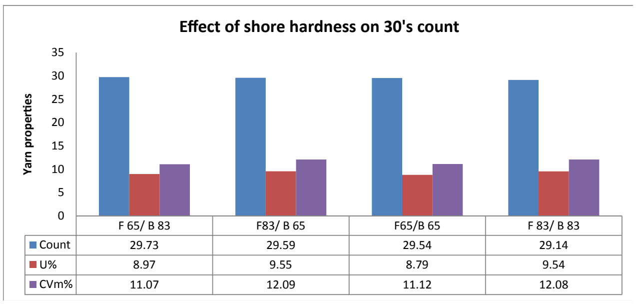

Figure 5: Shows effect shore hardness on unevenness of 30's count.

Count	**30 Ne**	**30 Ne**	**30 Ne**	**30 Ne**
Cot Shore Hardness	**F 65/ B 83**	**F83/ B 65**	**F65/B 65**	**F 83/ B 83**
Thin -30%	503.3	875.5	442.5	796.3
Thik +35%	156.3	318.5	139.8	300
Neps +140%	310	348.8	292	78.8
Total Sensitivity	**969.6**	**1484.8**	**874.3**	**1174.6**

Table 3: Effects of different shore hardness on Imperfections of 30's count.

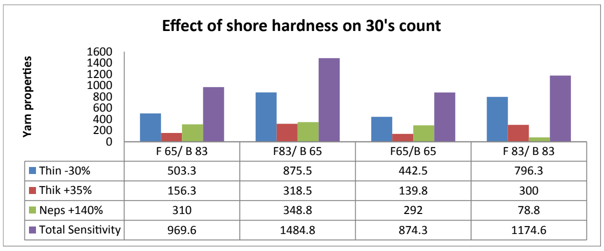

Figure 6: Shows effect shore hardness on thick thin, imperfections of 30's count.

Count	**30 Ne**	**30 Ne**	**30 Ne**	**30 Ne**
Cot Shore Hardness	**F 65/ B 83**	**F83/ B 65**	**F65/B 65**	**F 83/ B 83**
SH	0.92	0.95	0.89	0.92
UTR 3 Results	_	_	_	_
RKM	17.23	17.55	17.76	18.03
CV%	6.54	7.61	6.27	6.65
Elongation	4.33	4.3	4.37	5.2
CV%	7.93	9.96	9.77	7.03

Table 4: Effects of different shore hardness on Rkm and elongation of 30's count.

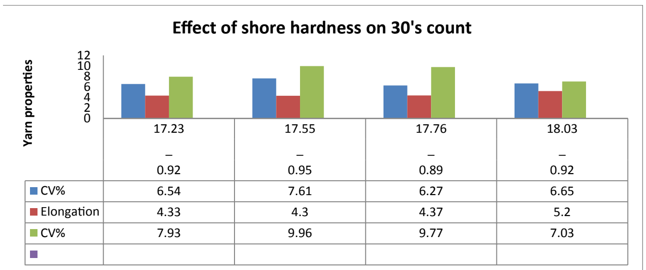

Figure 7: Shows effect shore hardness on Rkm. Elongation of 30's count.

been reported.

Unevenness (U percent)

From Table 3 and Figure 6 summarized that, among the three shore hardness, yarn obtained F65, B65, shows improvement in Upercent, RKm, IPI, of 30's yarn, this is due to the fact that lower shore hardness cot helps for increase in area of contact with the fluted bottom roller, which significantly shortens the uncontrolled area between apron to cot nipping point.

Among the all shore hardness third F 65/B65 shows optimum quality because it produce less thick, thin, neps this is obtained due to Lower the degree of shore hardness, higher the softness of rubber compound and vice –versa. Even though softer cots under normal spinning conditions produces better yarns with better mass uniformity and IPI levels

Yarn strength Rkm and IPI

From Table 4 and Figure 7 summarized that, among the three shore hardness, yarn obtained with F65, B65, shows improvement in RKm due to Lower the degree of shore hardness, higher the softness of rubber under normal spinning conditions produces better yarns gripping and twist realization in yarn which results in increase in strength and improvement in IPI alue.

Among the shore hardness {65, 83°) the third combination found more suitable for cotton processing of 30's count because it would give optimum strength and elongation. From the data it was inferred that F65/B65 gives optimum result in the production of 30's count.

The effect of nine different spinning front line cots (Synthetic rubber cot) varying only in shore A hardness (65°, 83°) on 100% cotton ring spun yarn has been investigated. The change in cotton yarn properties like mass uniformity, unevenness percent, Imperfection levels (in all class) with progressive change in shore hardness has also been reported.

Conclusions

Present investigation summarized that

- In cotton yarns, with increase in shore hardness form 65° to 83°, the co-efficient of variation of yarn mass CV (m) percent and Yarn Unevenness, U (m) percent increased
- Imperfection level and yarn unevenness percent usually increases with increase in shore hardness. This is due to the fact that lower shore hardness cot helps for increase in area of contact with the fluted bottom roller, which significantly shortens the uncontrolled area between apron to cot nipping point.
- Lower the degree of shore hardness, higher the softness of rubber compound and vice –versa. Even though softer cots under normal spinning conditions produces better yarns with better mass uniformity and IPI levels.

Scope of the study

This investigation is done with respect to one particular yarn count (30 s combed yarn), further studies can be conducted with different count range, raw material and other yarn quality parameters can be tested and the relationship can be further extended with respect to cots shore hardness.

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