Wear & tear of a spinning front line rubber cot and factors affecting it in terms of usage, abrasion resistance of the rubber compound, traverse length, traverse rate, shore a hardness, top arm loading, fibre volume handled and frictional properties of the processed material.

B. Sujai
Manager –Application Technology
Inarco Ltd

Email: products@inarco.com

Abstract

In general yarn quality is influenced by:

• Quality of raw material
• Opening & cleaning operations at Blow room & Carding
• Speeds & 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. These are the main components of the drafting mechanism and certainly it has more influence on the quality of the yarn produced. Apart from above mentioned factors that decides ultimate quality of yarn there are other factors which has a major influence on yarn quality like shore A hardness of rubber cot used , wear out rate of the cot in traverse area , abrasion resistance of the rubber compound and other parameters kept at spinning.

Keywords

Shore A Hardness, wear out rate, abrasion resistance, volume loss, material passage, traversing path, traverse rate, traverse length, fibre volume handled , top arm pressure, fibre friction, usage period , buffing frequency , depth of cut, wall thickness of cot , diameter of the cot , traverse area , Non –traverse area

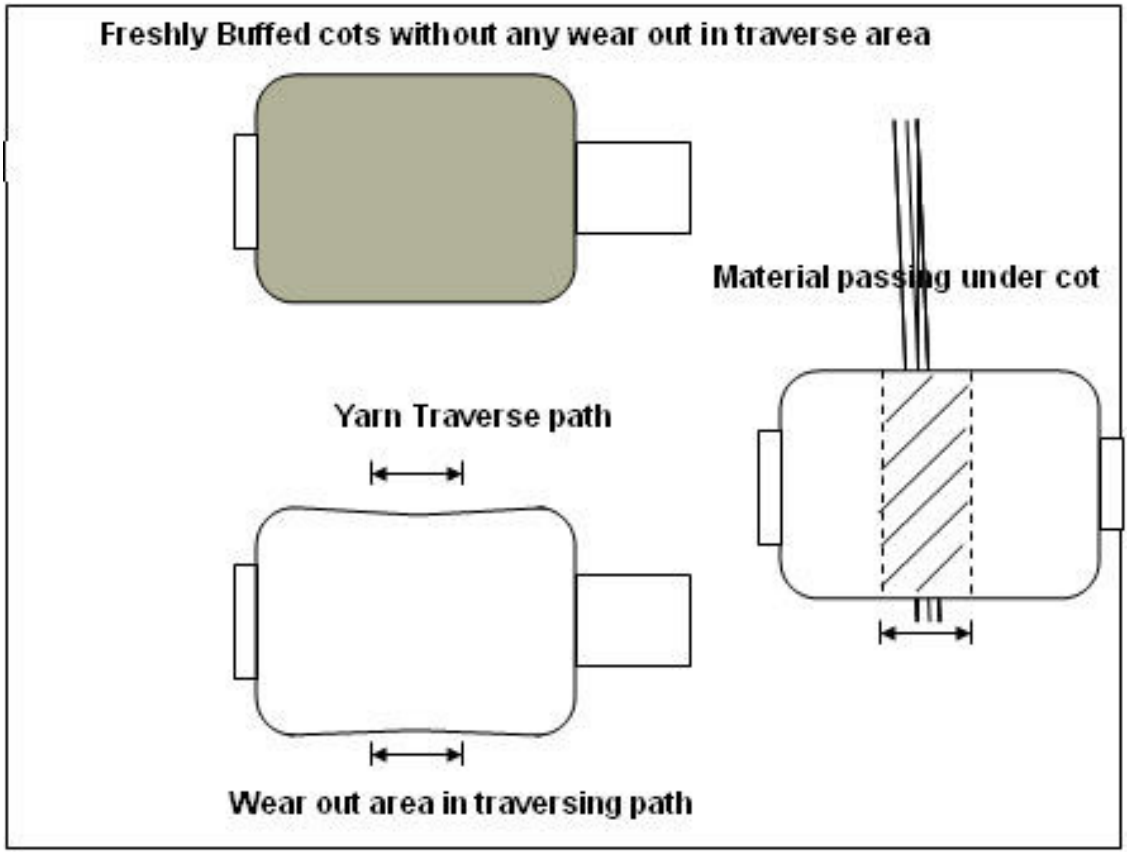
Introduction

Front line cots is a vital component at spinning drafting zone and its has a major influence of yarn quality and overall working performance of the spinning shed even though much of the concern is with working, quality output of the drafted strand is still influenced by front line cots. The common factors that influence the yarn quality with respect to cots are as follows

Shore A Hardness of the cot.
Contact area with the steel bottom fluted roller.
Surface characteristics in terms of Ra Value etc.,
Fibre control and fibre pulling characteristics.
Resilience and Low compression set properties of rubber compound
And mainly, abrasion resistance of the compound that decides the rate of worn out in yarn traversing path.

In this article we will discuss the wear & tear of a spinning front like cot based on its abrasion resistance value and all other factors that influence the wear out rate or volume loss of rubber cot under continuous operation.

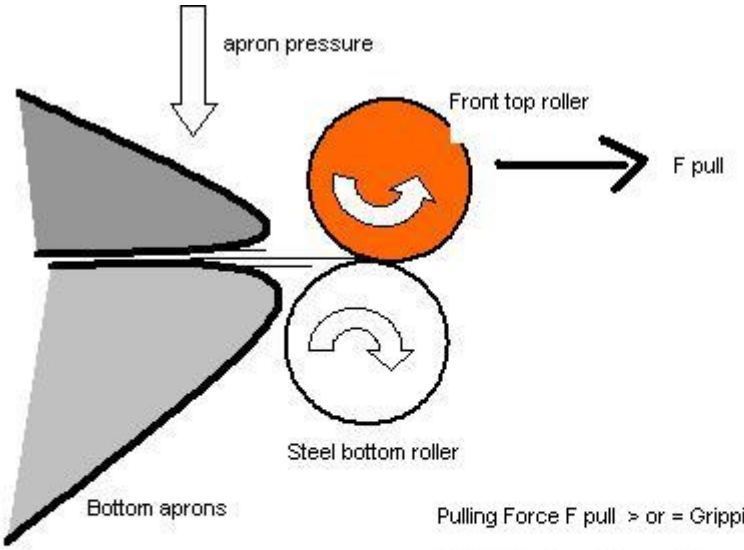
Fig-1



Theory

A Spinning front line cot is made out of Synthetic Carboxylated Nitrile Butadiene Rubber and has the following advantages like better tensile properties, higher continuous service temperature, Very good hardness/density balance, Good abrasion resistance, Compression set - points to a higher cross linking ratio, Good Tear resistance . In spite of these good physical & chemical properties a rubber cot is constantly abrade by passing fibre mass at high velocities. The cot will run under a specific mechanical load (Either by means of pneumatic or spring load) and friction between fibres and rubber surface will slowly abrade the surface.

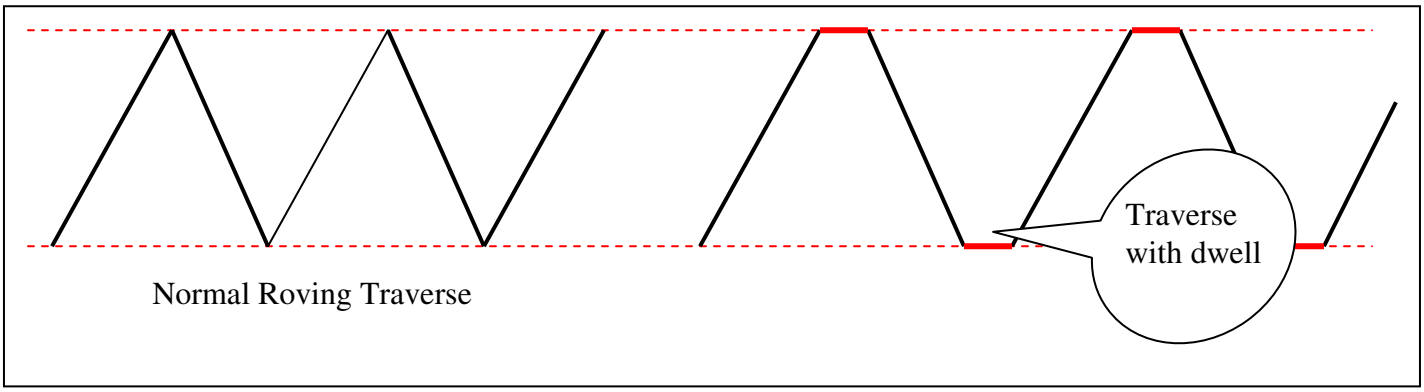
In a typical 3/3 – Double apron drafting system while drafting the feed material (roving) to Yarn , two types of physical forces are involved in order to hold , grip and draft the material particularly at Front zone I.e. Between Apron nip to Front Cot nip. One is Fibre pulling Force F PULL offered by the front cot at the nip point with Steel fluted bottom roller and other id Fibre Gripping Force F GRIP
Offered by the top and bottom aprons nip point These two forces are highly responsible to achieve better yarn quality, to introduce minimum drafting related faults in delivered yarn, to control the floating fibres mass, etc. At the same time these forces also responsible for wear & tear of drafting aprons and front line cots. Since if apron pair offers more grip on fibre strand then front line cot should pull that strand even at higher force that increases the wear out of cot.



Pulling Force F pull > or = Gripping Force G F (by aprons)

Net frictional resistance between fibres = $F = \frac{(F1+F2+F3+..+Fn)}{n}$

To avoid quick wear & tear of the cot, to prevent groove or Channel formation on the cots working surface, Roving Traverse Mechanism is provided. These traverse mechanism is provided in the machine so that at least one third of the width of the drafting components is utilized .Having optimum width of the roving traverse is not just enough , the mechanism should function properly and should have minimum dwelling time .



Apart from traverse length, the other factors that greatly influence the wear out rate of rubber cots are

I. Shore A Hardness of the cot used.
II. Abrasion resistance of the rubber compound Volume Loss / mm^3
III. Surface velocity of the cot or Delivery rate in mm / sec
IV. Load acted upon the cot In Kgs.
V. No of fibres passing under the cot per sec
VI. Frictional properties of the fibre processed.
VII. Traverse length kept in mm.
VIII. Traverse rate in mm/sec.
IX. Usage period of the cots in sec.

Volume Loss in mm^3 of the cot can be calculated by the below given formula

If Mean Ø of cot in Non –Traverse area of a cot = $Ø_{NON\ TRAVERSE}$
Wall thickness of the cot in Non –Traverse area = $WT_{NON\ TRAVERSE}$
Traverse length kept in mm = T_{LENGH}
Mean Ø of cot in Traverse area of a cot = $Ø_{TRAVERSE}$
Wall thickness of the cot in Traverse area = $WT_{TRAVERSE}$

Then,
Vol. Loss in mm^3 = $3.14 \times T_{LENGH} (Ø_{NON\ TRAVERSE} \times WT_{NON\ TRAVERSE} - Ø_{TRAVERSE} \times WT_{TRAVERSE})$..1

For e.g., If $Ø_{NON\ TRAVERSE}$ = 30 mm
$WT_{NON\ TRAVERSE}$ = 5.5 mm
T_{LENGH} = 8 mm
$Ø_{TRAVERSE}$ = 29.90 mm
$WT_{TRAVERSE}$ = 5.45 mm

= 3.14 x 8 (30 x 5.5 – 29.9 x 5.45)
= 50.26 mm^3

% of wear out on traverse area can be given as follows

% of wear out = $(Ø_{NON\ TRAVERSE} - Ø_{TRAVERSE}) / Ø_{NON\ TRAVERSE} \times 100$ ….2

= (30.00 – 29.90) / 30.00 x 100
= 0.33%

Mathematically, Volume loss in mm^3 σ 1 / Shore A hardness of the cot
σ 1 / Abrasion resistance or Vol.loss in mm^3 = **AR**
σ 1 / Traverse Length kept in mm = **T**
σ No of fibres passing / sec = **N**
σ Top arm load acted upon the cot in Kgs = **L**
σ 1 / Traverse rate in mm/sec = **TR**
σ Usage period in sec = **U**
σ Delivery rate in mm/sec = **D**

No of fibres passing / sec = $\frac{\text{Dely rate of cot in Mts / Min X 1.09 X } 10^8}{\text{60 X 840 X Count spun in Ne x 2.2045 x Fibre Mic}}$

$$\textbf{Volume loss in mm}^3\textbf{ During working} = k. \frac{D \times U \times N \times L}{\text{Shore A} \times AR \times TR \times T.3}$$

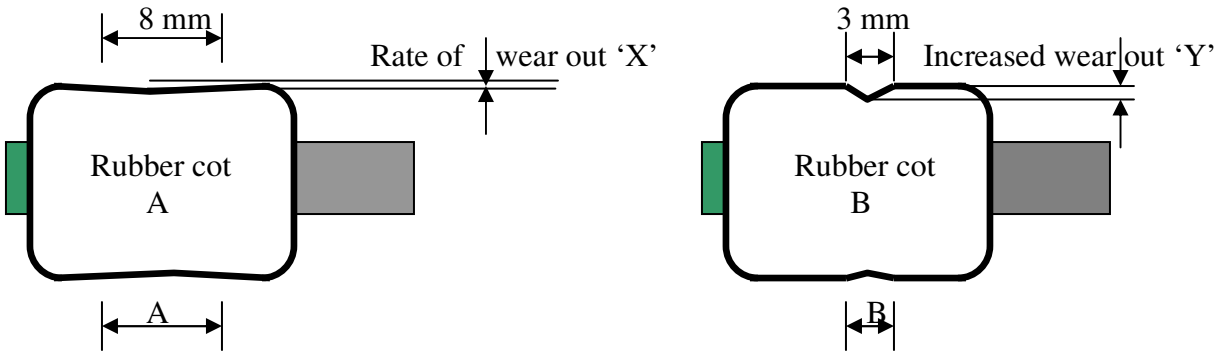
K is a constant that depends upon the frictional properties of the fibre used and the value Ranges from 2.5×10^{-9} to 3.0×10^{-9}

According to the Equation -3 Volume loss on the surface of the rubber cot due to wear & tear can be estimated if other parameters are known. Shore A Hardness, Abrasion resistance of the rubber compound plays an important role in deciding the wear out rate apart from spinning conditions. Since these factors are inversely proportional to the Volume loss in mm^3. In drafting zone top arm loading, Delivery rate of the machine, Usage period, No. of Fibers passing through the cot per unit time are directly proportional to the wear our rate or Volume loss on the traverse area .

Traverse length and rate of traverse and its influence on wear out of rubber out:

Traverse Length:

Length of the traverse kept for a given spinning system plays a key role in deciding the wear out rate of the front line cot. Mathematically, Length of the traverse kept is inversely proportional to the Volume loss of the rubber cot in mm^3.



Where, A & B are the traverse path of the yarn and X & Y are the extent of wear out rate of rubber cot.

If A>B then X < Y. In terms of Yarn quality rubber cot B will significantly affects the yarn quality since control of fibres will be less, in-directly pulling force offered by the cot on the fibres will be in adequate or lower to overcome the Net Gripping force at the Apron nip. This affects the basic drafting at front zone

Rate of traverse:

Like traverse length, Rate of traverse is an important factor in abrading the surface of the cot. According to Equation -3, No. of fibres passing / sec is directly proportional to the volume loss in mm3. No. of Fibres passing / sec and traverse rate / sec are well connected. Decreasing the rate of traverse / unit time will proportionately increases the no. of fibres passed on the same area of the cot per unit time or vice - versa

Conclusion:

Wear out rate or Volume loss in mm^3 of a spinning cot has been studied .A theoretical formula has been derived based on physical & visco-elastic properties of rubber compound like Shore A hardness and abrasion resistance. And other important spinning parameters like Surface velocity of the cot, Load acted upon the cot In Kgs, No of fibres passing under the cot per sec,Frictional properties of the fibre processed, Traverse length kept in mm,Traverse rate in mm/sec and more important ,Usage period of the cots in sec has been incorporated in the equation.