International Conference on Systems, Science, Control, Communication, Engineering and Technology 2015 [ICSSCCET 2015]

ISBN	978-81-929866-1-6	**VOL**	01
Website	icssccet.org	**eMail**	icssccet@asdf.res.in
Received	10 - July - 2015	**Accepted**	31- July - 2015
Article ID	ICSSCCET001	**eAID**	ICSSCCET.2015.001

OVERVIEW AND SIGNIFICANCE OF VISCOSE YARN QUALITY CHARACTERISTICS AND SUGGESTIVE PROCESS TO IMPROVE IT

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Abstract: *Viscose ring spun yarn has more hairiness than cotton &polyester of same linear density and poses problem in the subsequent processes due to protruding of hairs. It is also quite peculiar that despite Viscose being man made and comes in precise 'cut length' with zero short fibres, it behaves differently than other fibres like polyester or cotton as far as hairiness is concerned. This article gives an insight as to why Viscose fibre-yarn characteristics are different than cotton and polyester. Despite all these limitations, still Viscose is the most preferred fibres for blending with either cotton or other synthetic fibres for better usage in textile applications.*

Keywords*:* Viscose, hairiness, linear density, blending, synthetic fibres, textile applications

Introduction

It is proven fact that Viscose Ring spun yarn is more hairy than cotton and polyester of the same linear density. It is quite peculiar that despite viscose fibre being man made and supplied in fixed cut length with no trace of short fibres like cotton, yet the hairiness is relatively higher. In general, synthetic fibres like polyester is less hairy due to advantage of zero short fibres and fixed cut length unlike viscose. Viscose although being more hairy still has several good characteristics than polyester and hence viscose is generally blended with polyester & cotton for better use in apparel applications and textile applications in general. This paper gives answer as to why viscose yarn behaves differently and its impact on quality characteristics.

Manufacture of Viscose

Wood pulp is dissolved in caustic soda and after steeping it for a specific period of time it is shredded and allowed to age. Ageing contributes to viscosity of viscose. Longer the ageing time, lesser the viscosity value. The aged pulp is then treated with carbon disulphide to form a yellow colour cellulose Xanthate, which is dissolved in lower concentrated caustic soda again. This is starting stage of viscose formation. An acetate dope is added to alkali cellulose for yarn lustre.

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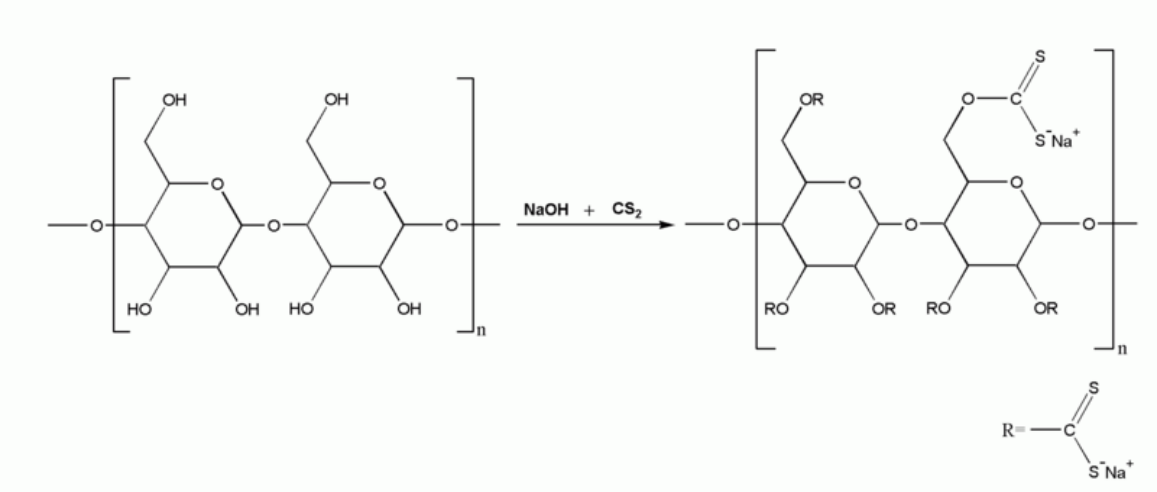

Fig 1: Cellulose is treated with alkali and carbon disulphide to yield viscose (Source: Wikipedia)

Viscose Fibre Morphology

Viscose is a fine regular filament or staple fibre. The staple fibre is manufactured in a crimped configuration to enhance the inter fibre friction for better fibre cohesion for easy further processing. Crimped viscose staple fibre spins into yarn with sufficient irregularity to make the crimped fibre yarn aesthetically more desirable.

Viscose Polymer structure

Viscose polymer is a linear cellulose polymer, which is similar to cotton but without spiral configuration like cotton polymer. Unlike cotton, Viscose polymer is 60-65% amorphous and shorter polymers. On the contrary, Cotton has 65-70% crystalline region and 30-35% amorphous region. Polymer thickness of all viscose and cotton is similar, which is 0.8nm. Degree of polymerization of viscose is very low as 175 than cotton, which has high degree of polymerization of 5000. Due to this, polymer length of viscose is just 180 causing low strength than cotton, which has polymer length of as high as 5000.

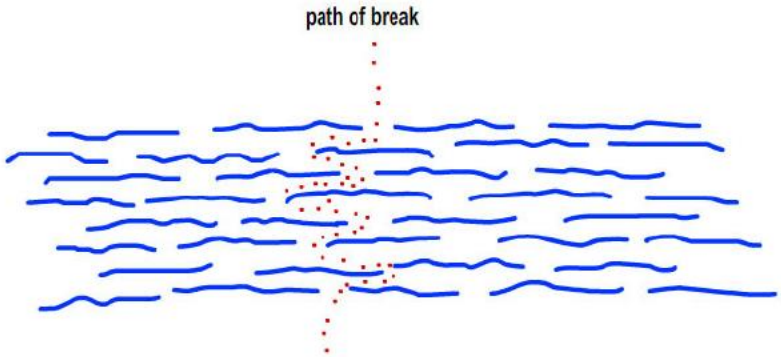

Fig 2: Weak fibre as it has short 'path of break' (source: www.nptel.ac.in)

Effect of polymer structure on quality characteristics of viscose yarn

The very high amorphous region, shorter and poor alignment of viscose polymers gives rise to fewer hydrogen bonds. Very amorphous nature of its polymer system permits the entry of water molecules , which pushes the polymer molecules apart, breaking a significant number of hydrogen bonds, resulting the weaker fibre when wet.

When the fibre is put under strain, its amorphous region and fewer hydrogen bonds give away easily causing permanent de-shape. Hence viscose material will become distorted, stretched, wrinkled or creased.

Due to very high amorphous region (60-65%) of viscose fibre, it has following properties by virtue of it:

- More absorbent
- Weak
- Less durable
- More easily degradable by chemical
- More easily dyed
- More pliable and softer handling
- Plastic and more easily distorted

The table below shows the comparative rating of Cotton, Viscose and Polyester

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Sl No	Parameter	Comparative Rating		
		Cotton	Viscose	Polyester
I	**Comfort**			
1	Moisture Regain	Good	Very Good	Poor
2	Thermal Protection	Good	Very Good	Poor
3	Air Permeability	Very Good	Good	Poor
4	Softness	Good	Very Good	Poor
5	Smoothness	Poor	Good	Very Good
6	Static dissipation	Good	Very good	Poor
II	**Aesthetic**			
1	Drape	Good	Very Good	Poor
2	Lustre	Poor	Very Good	Very Good
3	Crease recovery	Poor	Poor	Very Good
4	Colour Uniformity	Poor	Very Good	Good
III	**Utility Performance**			
1	Anti-Pilling	Good	Very Good	Poor
2	Wash & Wear	Good	Poor	Very Good
3	Durability	Fair	Fair	Very Good

Table 1: Comparative rating of Cotton, Viscose & Polyester (Source: www.Swicofil.com/viscose)

From the above table it is evident that viscose has several good characteristics than other synthetic fibres and hence when blended properly with other synthetic fibres, it exhibits extraordinary quality characteristics for the blended yarn-fabric.
Viscose fibre when processed to form a yarn, particularly in Ring spinning route, passes through several mechanical actions at different processes from fibre stage to yarn stage and also up to winding. Due to peculiar viscose polymer structure as explained above, these mechanical processes give rise to more strain to the fibres causing lesser inter fibre cohesion and leading to fibre migration and more hairiness than cotton or other synthetic fibres like polyester.

Yarn Hairiness

Yarn hairiness is either being a desirable or undesirable property; hence it assumes importance in measurement and controlling. Hairiness keeps important role for producing quality yarn. High hairiness causes pilling on fabric. Hairiness imparts fuzzy appearance to the yarn and reduces lustre of yarn. It also hampers sizing process and causes more breaks during weaving.
As per study conducted by Pinar celik & Huseyin Kadoglu[2], Viscose yarn has the least liveliness factor, Kr (Kringel factor) than cotton & polyester for the same twist factor values. This proves that due to mechanical action of viscose during various processes, the internal polymer structure causes permanent damage to the structure and behaves like plastic. Hence more the mechanical action is involved to viscose fibre, more hairiness is generated. This causes even the compact spinning of viscose is not as successful as for cotton although

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efforts are on to bring in more successes. Therefore, the best way to remove hairiness is by singeing process, where the removal of hairs is permanent and less chance for pilling at later processes and usage. By singeing process the hairiness on viscose yarn surface can be controlled very effectively than other processes like compact spinning.
Recently vortex method of spinning is quite popular and proven to produce less hairy viscose yarns and the hairiness on vortex viscose yarn surface is much lower than the ring spun viscose yarn of same linear density, but at the cost of compromise on fabric feel with vortex yarn. Vortex viscose yarn is relatively rougher than ring spun viscose yarn of same count. So ring spun viscose yarn with singeing process can yield better hairiness results without compromise on yarn and fabric feel.

Conclusion

Viscose fibre polymer has high amorphous region of 60-65% and crystalline region of only 35%-40%. The high amorphous region together with shorter polymer chain and less degree of polymerization (175) than cotton (5000) causes viscose yarn more weak. The above is responsible for viscose to behave like plastic causing permanent damage to the yarn structure. However, by virtue of presence of high amorphous region, viscose has certain good properties, which makes the fibre best suitable for blends for achieving ultimate fabric properties for textile applications. The fabrics made out of viscose blends are widely popular due to its user friendly quality characteristics.

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