YARN HAIRINESS

INTRODUCTION

Yarn hairiness is a complex concept, which generally cannot be completely defined by a single figure. The effect of yarn hairiness on the textile operations following spinning, especially weaving and knitting, and its influence on the characteristics of the product obtained and on some fabric faults has led to the introduction of measurement of hairiness.

FACTS ABOUT YARN HAIRINESS:

Hairiness occurs because some fibre ends protrude from the yarn body, some looped fibres arch out from the yarn core and some wild fibres in the yarn.

Pillay proved that there is a high correlation between the number of protruding ends and the number of fibres in the yarn cross-section.

Torsion rigidity of the fibres is the most important single property affecting yarn hairiness. Other factors are flexural rigidity, fibre length and fibre fineness.

Mixing different length cottons-No substantial gain in hairiness. Although the hairiness of a yarn could be reduced to some extent by the addition of a longer and finer cotton to the blend. The extent of reduction is not proportional to the percentage of the longer and finer component. This is probably due to the preferential migration of the coarser and shorter component, which has longer protruding ends, from the yarn body. The addition of wastes to the mixing increases the yarn hairiness; the effect of adding comber waste is greater than that of adding soft waste.

Blending-not a solution to hairiness. The blended yarns are rather more hairy than expected from the hairiness of the components; a result similar to that found in cotton blends. This may be due to the preferential migration of the shorter cotton fibers; a count of the number of protruding ends of both types of fiber shows that there is more cotton fiber ends than expected, although the difference is not very great.

The number of protruding ends is independent of twist, whereas the number of loops decreases when the yarn twist increases because of a greater degreee of binding between hte fibres owing to twist.

The number of wild fibres decreases only very slightly with twist because of their position on the yarn periphery.

The proportion of fiber ends that protrude from the yarn surface, counted microscopically has been found to be about 31% of the actual number of ends present in the yarn.

If the length of the protruding fibre ends as well as that of the loops is considered, the mean value of the hairiness increases as the cross-sectional area increases and decreases with the length of the loops. The hairiness is affected by the yarn twist, since an increase in twist tends to shorten the fibre ends.

Wild fibres are those for which hte head alone is taken by the twist while the tail is still gripped by the front drafting rollers.

Fibre length influences hairiness in the sense that a greater length corresponds to less hairiness.

Cotton yarns are known to be less hairy than yarns spun from man-made fibres.

The possible reason for this is the prifile of the two fibres.Because of taper, only one end, the heavier root part of the cotton fibre, tends to come out as a protruding end in a cotton yarn. With man-made fibres, both ends have an equal probability of showing up as protruding ends.

If the width of the fibre web in the drafting field is large, the contact and friction with the bottom roller reduce the ability of the fibres to concentrate themselves and hairiness occurs. This effect is found more in coarse counts with low TPI. This suggests that the collectors in the drafting field will reduce yarn hairiness.

The yarn hairiness definitely depends on the fibres on the outer layer of the yarn that do not directly adhere to the core. Some of them have an end in the core of the yarn gripped by other fibres, whereas others, because of the mechanical properties of the fibre(rigidity, shape, etc.) emerge to the surface. During the twisting of the yarn, other fibres are further displaced from their central position to the yarn surface.

Greater the fibre parallelization by the drawframe, lower the yarn hairiness.

An increase in roving twist results in lower yarn hairiness, because of smaller width of fibre web in the drafting field.

The number of fiber ends on the yarn surface remains fairly constant; the number of looped fibers reduces in number and length on increasing twist.

Combed yarn will have low yarn hairiness, because of the extraction of shorter fibres by the comber.

Yarn hairiness increases when the roving linear density increases . Yarn spun from double roving will have more hairiness than the yarn spun from single roving. This is due to the increased number of fibres in the web and due to higher draft required to spin the same count.

Drafting waves increase hairiness. Irregularity arising from drafting waves increases with increasing draft. Yarn hairiness also may be accepted to increase with yarn irregularity, because fibers protruding from the yarn surface are more numerous at the thickest and least twisted parts of the yarn.

The yarns produced with condernsers in the drafting field, particularsly if these are situated in the principal drafting zone, are less hairy than those spun without the use of condensers.

Higher spindle speed – high hairiness. When yarns are spun at different spindle speed, the centrifugal force acting on fibers in the spinning zone will increase in proportion to the square of the spindle speed, causing the fibers ends as they are emerging from the front rollers to be deflected from the yarn surface to a greater extent. Further, at high spindle speed, the shearing action of the traveller on the yarn is likely to become great enough to partially detach or raise the fibers from the body of the yarn. As against the above factors, at higher spindle speeds the tension in the yarn will increase in proportion to the square of the spindle speed, and consequently more twist will run back to the roller nip, so that it is natural to expect that better binding of the fibers will be achieved. The increase in hairiness noticed in the results suggests that the forces involved in raising fibers from the yarn surface are greater than those tending to incorporate them within the body of the yarn at higher spindle speeds.

Higher draft before ring frame-less hairiness. There is a gradual reduction of hairiness with increase in draft. In other word, as the fiber parallelization increases hairiness decreases. Reversing the card sliver before the first drawing head causes a reduction in hairiness, the effect being similar to that resulting from the inclusion of an extra passage of drawing.

Smaller roving package-less hairiness. Yarn hairiness decreases with decrease in roving (doff) size, and yarn spun from front row of roving bobbins is more hairy and variable as compare to that spun from back row of rowing bobbins. It may be noted that though the trends are consistent yet the differences are non-significant:

The spinning tension has a considerable influence on the yarn hairiness. The smaller the tension, the greater the hairiness. This is the reason why heavier travellers result in low yarn hairiness.

If the traveller is too heavy also , yarn hairiness will increase.

Spindle eccentricity leads to an increase in hairiness. Small eccentricities influence hairiness relatively little, but, from 0.5 mm onwards, the hairiness increases almost exponentially with eccentricity.

The increase in hairiness due to spindle eccentricity, will be influenced by the diameter of ring, dia of bobbin, the shape of the traveller,the yarn tension, etc.

Yarn hairiness will increase if the thread guide or lappet hook is not centred properly.

Heavier traveler- less hairiness. The reduced hairiness of yarns at higher traveller weights can be explained by the combined effect of tension and twist distribution in the yarn at the time of spinning. The spindle speed remains constant, but the tension in the yarn will increase with increasing traveller weight, and better binding of the fibers would be expected.

Parallel fibers-less hairiness. The improvement of yarn quality on combing is mainly ascribed to the reduction in the number of short fiber improvement in length characteristics, and fiber parallelization. There is a marked difference in hairiness of the carded yarn and the combed yarns, even with a comber loss of only 5%, but the effect on hairiness of increasing the percentage of comber waste is less marked. Combing even at low percentage waste causes a marked drop in hairiness relative to that of the carded yarn. In the case of combed cotton yarns the average value of hairiness decreases with increase in count, whereas in the case of polyester/ viscose blend yarns the hairiness increases with increase in count. In the case of polyester/ cotton blend yarns trend is not clear.

Flat and round travellers do not influence yarn hairiness, but a greater degree of hairiness was observed with elliptical travellers and anti-wedge rings.

Traveller wear obviously influences hairiness because of the greater abrasion on the yarn.

Yarn hairiness increases with the life of the traveller.

Bigger the ring diameter, lower the yarn hairiness.

Yarn spun in a dry atmosphere is more hairy.

Hairiness variation between spindles is very detrimental. Because these variation can lead to shade or appearance variaion in the cloth.

The variation in hairiness within bobbin can be reduced considerably by the use of heavy travellers alone or by balloon-control rings with travellers of normal weight. In both the cases yarn is prevented from rubbing against the separators.

Yarn hairiness is caused by protruding ends, by the presence of a majority of fibre tails.

This suggests that these tails will become heads on unwinding and that friction to which the yarn is subjected will tend to increase their length. It is therefore logical that a yarn should be more hairy after winding.

Repeated windings in the cone widning machine will increase the yarn hairiness and after three or four rewindings, the yarn hairiness remain same for cotton yarns.

Winding speed influences yarn hairiness, but the most important increase in hairiness is produced by the act of winding itself.

Because of winding, the number of short hairs increases more rapidly thatn the number of long hairs.
In two-for-one twisters (TFO), more hairiness is produced because, twist is imparted in two steps.
Yarn hairiness also depends upon the TFO speed, because it principally affects the shortest fibre ends.
Hairiness varitions in the weft yarn will result in weft bars.

Hairiness Testing of Yarns

Hairiness of yarns has been discussed for many years,but it always remained a fuzzy subject. With the advent of compact yarns and their low hairiness compared to conventional yarns,the issue of measuring hairiness and the proper interpretation of the values has become important again.Generally speaking,long hairs are undesirable, while short hairs are desirable (see picture). The picture shown below just give a visual impression of undesirable and desirable hairiness at the edge of a cops.

RING YARN COMPACT YARN

There are two major manufacturers of hairiness testing equipment on the market,and both have their advantages and disadvantages. Some detail is given below.

USTER

USTER is the leading manufacturer of textile testing equipment. The USTER hairiness H is defined as follows .
H =total length (measured in centimeters) of all the hairs within one centimeter of yarn .
(The hairiness value given by the tester at the end of the test is the average of all these values measured, that is,if 400 m have been measured,it is the average of 40,000 individual values) . The hairiness H is an average value,giving no indication of the distribution of the length of the hairs. Let us see an example

	0.1cm	0.2cm	0.3cm	0.4cm	0.5cm	0.6cm	0.7cm	0.8cm	0.9cm	1.0cm	total
yarn 1	100	50	30	10	5	6	0	2	1	0	398
yarn 2	50	10	11	5	10	0	5	10	0	11	398

Both yarns would have the same hairiness index H, even though yarn is more desirable,as it has more short hairs and less long hairs,compared to yarn 2.
This example shows that the hairiness H suppresses information,as all averages do. Two yarns with a similar value H might have vastly different distributions of the length of the individual hairs.
The equipment allows to evaluate the variation of the value H along the length of the yarn. The "sh value "is given, but the correlation to the CV of hairiness is somehow not obvious.A spectrogram may be obtained.

2.ZWEIGLE

Zweigle is a somewhat less well known manufacturer of yarn testing equipment. Unlike USTER,the Zweigle does not give averages. The number of hairs of different lengths are counted separately, and these values are displayed on the equipment. In addition, the S3 value is given,which is defined as follows:
S3 =Sum (number of hairs 3 mm and longer)
In the above example,the yarns would have different S3 values:
S3yarn 1 =2 .
S3yarn 2 =4 .
A clear indication that yarn 2 is "more hairy "than yarn 1. The CV value of hairiness is given a histogram (graphical representation of the distribution of the hairiness) is given.
The USTER H value only gives an average,which is of limited use when analyzing the hairiness of the yarn.The Zweigle testing equipment gives the complete distributionof the different lengths of the hairs. The S3 value distinguishes between long and short hairiness, which is more informative than the H value.