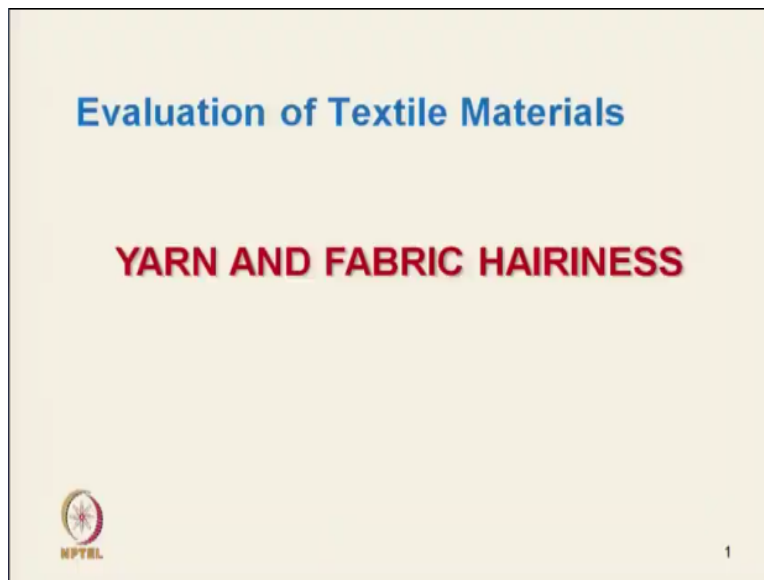


Evaluation of Textile Materials
Prof. Apurba Das
Department of Textile Technology
Indian Institute of Technology-Delhi

Lecture-25
Evaluation of Yarn and Fabric Hairiness

Hello everyone, we will continue with this course evaluation of textile material and today we will discuss another parameter which is extremely important for particularly for spun yarn.

(Refer Slide Time: 00:45)




That is yarn and fabric hairiness, so hairiness basically it is a most of the applications hairiness it is a the property which is not desirable ok, why I am saying it is a most of the applications. There are some applications where fabric hairiness is required particularly for some particular effect or yarn in yarn hairiness some special effect if we need. In those applications hairiness is important we need hairiness.

In fabric we sometime try to brush the fabric surface to get more and more hair to have certain special effect well but like effect are to get some warmth or a softness ok. And here in this class we will try to see the different aspects of hairiness they are causes or their effects and also we will see the how to measure their different principles of measurement we will see the different principles of measurement here.

(Refer Slide Time: 02:10)

Yarn hairiness

- ✓ It is in most circumstances an undesirable property
- ✓ Giving rise to problem of fabric production
- ✓ Also deteriorates the fabric appearance
- ✓ Measurement of hairiness dependent on the method chosen for detecting the hairs



2

So, it is a most undesirable, most of the circumstances it is basically an undesirable property we do not need. We need a yarn with free of hairs ok and if at all some hairs of there, there are some techniques to eliminate this hair like sinzing shearing. So these are the techniques and the rings form yarn like compact spun yarn is developed where the hairs are almost not there, it is almost absent, problem is not only the visual appearance.

But it gives problem with the production of fabric and fabric production it creates problem and it deteriorates the fabric appearance due to that protruding hairs it makes the fabric appearance down ok. That is a due to that random reflection fabric looks little bit dull and now how to measure the hairiness. It is actually there are various techniques I will discuss in detail the measurement technique actually depending on the techniques of measurement the number of hairs are result changes ok.

So measurement of hairiness depend on the method chosen for detecting the hair, it can be number of hairs per unit length of yarn or it can be total length of hair protruding beyond the yarn surface.

(Refer Slide Time: 04:11)

Yarn hairiness

✓ It is not possible to represent hairiness with a single parameter because the number of hairs and the length of hairs both vary independently.

✓ A yarn may have a small number of long hairs or a large number of short hairs or any combination in between.

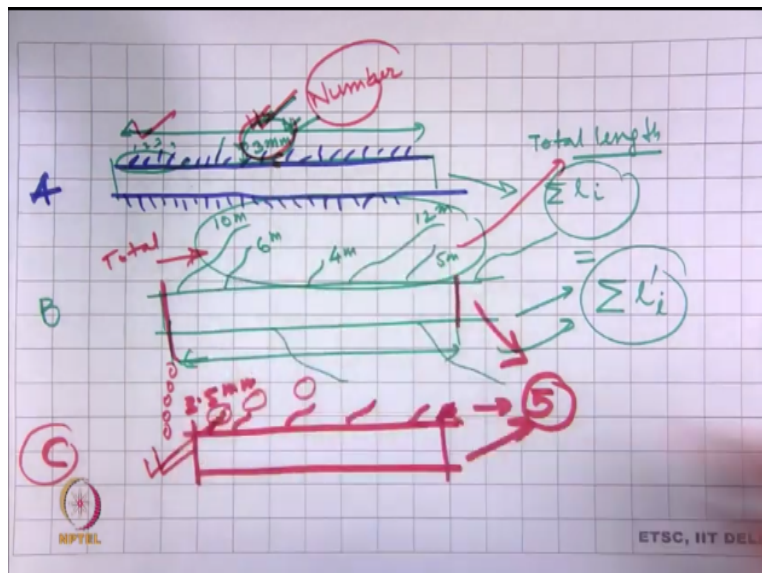
✓ The problem is then which combination should be given a higher hairiness rating.

NPTEL

3

So, this technique we will discuss here, now it is not possible to represent hair with the single parameter ok. Because the number of hairs and the length of hairs both vary independent ok, they are not dependent, so length of hair.

(Refer Slide Time: 04:41)



Thing is that suppose we have 2 yarns, yarn A having large number of hairs on the surface but the lengths are smaller length, large number of hairs with smaller length this is yarn A. Another yarn, yarn B is having fewer hairs, but the length of hair are longer. Now as per as the measurement technique if we try to measure the length of hair total length of hair protruding beyond the yarn surface, if we try to part unit length of yarn.

Suppose this is the unit length of yarn, here it is a unit length and if we try to measure the length total calculate the length of hair protruding. So this total hairs 1, 2, 3, 4 whatever number of hairs if we totally add all these hair length ok l_i this is the total length of hair in yarn A. And here if we add total length of hair l_i in yarn B and it may so often this are equal because if we add all these length of hair.

Here the smaller length or number of hairs more and larger length number of hairs are small and if we add this 2 and then we try to find the total length of hairs protruding beyond the yarn surface. This are coming out to be same equal then our conclusion will be that hairiness of this 2 yarns are same. But problem is that actual appearance or actual effect on different characteristics of fabric or processing performance will be entirely different.

So measurement of length may create some problem so, to counteract this problem what we can have, we can have we can measure the number of hairs in terms of number of hairs protruding beyond certain specified length ok. So suppose there are this is length of 3 millimeter, so we will try to measure the number of hairs more than 3 millimeter ok, so this will give us an indication that the yarns are full of hair ok.

And now in that case this will actually differentiate between these 2 but if we use the same technique here, same technique in this yarn B, same technique means the number of hairs beyond 3 millimeter. In that case the suppose this hair say 10 millimeter, so 12 millimeter another yarn, another hair it is a 6 millimeter another 4 millimeter ok, 5 millimeter. In that case this technique of 3 millimeter beyond 3 millimeter this yarn will give it is a.

All this hair will come into the picture okay, now this yarn B, now let us take another yarn it is a C yarn with hairs which are just 3.5 millimeter. This hairs length are 3.5 millimeter. Now 1, 2, 3, 4, 5 ok let us say 5 now here also if we use 3 millimeter distance length of hair this will give us the hair count number of hairs per unit length. This is the unit length number of hairs per unit length for both the yarns it will give us 5.

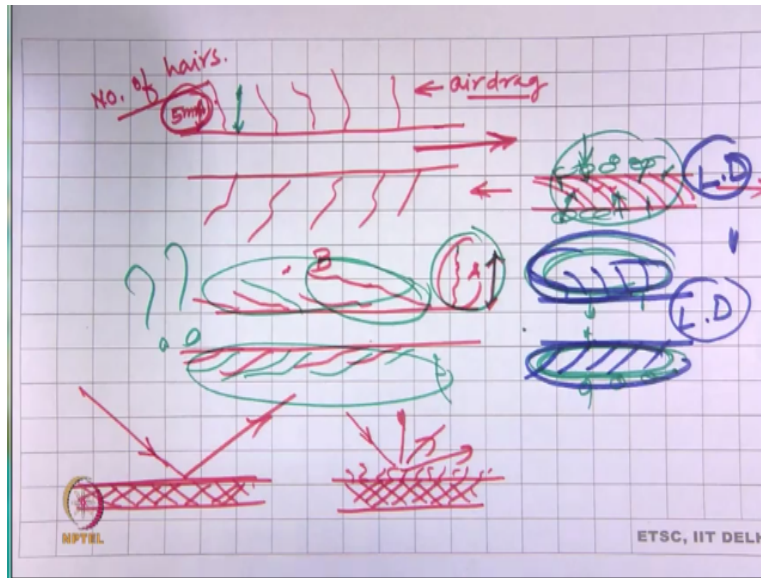
So, effectively actually this B yarns they are in as per as hair is concern they are totally different in characteristics. So, this total methods of measurements it creates problem and confusion ok, so that we should be very careful in interpreting data we have to see which technique has been used. So all this both the techniques are being used but we have to see that which technique we cannot compare or result data from 1 instrument, 1 method to the result of other method.

So this problem of yarn C are this here that can be solved in some extent by not by using only one that sensor if we can use a multiple sensors, which will give idea about the length distribution, length of hair distribution ok. Distribution of length say more than 3 millimeter how many this hairs are there between 3 to 4 millimeter how many hairs are there. So, like that one can get idea detailed idea.

Another problem of hairiness measurement is that suppose we if we measure in this method. So what we see the method of measurement by say length of hair it is it gives us clear idea about the total length of hair appearance whereas this measurement of total length, total length of hair. So one is the number based, so this one is number based this one again number based number of hairs.

But the principle which we have discussed this is the total length of hair ok, total length of hair you have measured here. But main another problem with this number measurement is that suppose the hairs are longer ok.

(Refer Slide Time: 12:50)



Now the hairs are longer hairs, this is the hair ok, now if we want to measure the length of hairs protruding number of hairs protruding beyond say 5 millimeter you want to measure beyond 5 millimeter what is the number of hair. In that case, so this is a yarn it will move and the due to the movement of hair movement of the yarn the hairs will come across against the air drag.

Due to the air drag this hairs will have situation like this they may like they are the alignment may change. And also during the movement the yarn will pass through some guide something this hair will not be straight. So in that case if we try to measure the number of hairs beyond certain the projected length in that case we will have wrong result. Because 1 hair of this type this is a smaller hair, this is a longer hair, hair A is a smaller hair, hair B is longer hair.

But this A if we try to measure the number of hair beyond certain this is the length beyond certain projected length. So this if the projected length is this one, so A will be counted as a hair but it will miss B here because the measurement of number of hairs protruding beyond certain length of the beyond the yarn surface that is good, the good indication but the problem comes here if the hair it depends the result depends on the hair alignment.

So, if the yarn passes through a guide, fine guide the totally hairiness reading will change. So, in that case the measurement of number of hairs has some problem. So the main solution is that in that case the measurement of total length of hair. If we measure the total length of hair then

whatever maybe the alignment of fibres beyond the surface that will be totally measured this will the system will measure total length.

So the 2 methods are there 1 is measuring the number of hairs another is measuring the total length of hair, they have their positive point as we have discussed and negative point. So, if we have to if we test the yarn hairiness using one of this techniques we have to be careful in selecting the parameters ok. So number of hairs and the length of hairs one can select one of these ok.

A yarn may have small number of long hairs or a large number of short hairs or any combination of this. So that depending on the type of hairs one can select, the problem is then which combination should be given higher hairiness rating, this things we have to discussed ok. So, this techniques they have got their positive and negative points.

(Refer Slide Time: 17:04)

Yarn hairiness- Causes


a) Raw Material:

✓ Maturity

- In case of cotton 70% maturity of the fibres is needed
- if less then cause hairiness. Immature and dead fibres result in hairiness.

✓ Uniformity Ratio

- Normally fibres uniformity ratio is 40-50%.
- If it is less then hairiness results

 4

Now we will discuss the various results, various causes of hairiness ok, first if we talk about the cotton yarn, first reason is that it is a maturity. It has been observed that immature cotton results hairiness because it does not get opened it is a it actually does not penetrate inside the yarn structure, it remains in the surface and it creates hairiness ok. So, in case of cotton 70% maturity of the fibers is needed okay, if the maturity is less.

So, when we discuss the maturity we have seen around 70% matured fibre should be there okay. If it is less then that causes hairiness immature and dead fibers result hairiness because they do not penetrate inside the yarn structure. Another thing is that uniformity ratio, what is uniformity ratio that we have discussed it is the ratio of 50% spun length divided by the 2.5% spun length. The and it is express in percentage and normal cotton it is ranging from 40 to 50%.

Now if the hair uniformity ratio is less what does it show, uniformity ratio is less means it contains large quantity of short fibres ok. Large quantity of short fibers means those short fiber will not penetrate in the yarn structure those will not take part in migration and those will come in out that will those will be projected outside the yarn surface ok as they will not be taking part in the proper migration. So, if it is less then hairiness is there less means it is a that short fibre percent is more.

(Refer Slide Time: 19:21)

Yarn hairiness- Causes

a) Raw Material:

✓ Micronaire

- **Range of micronaire value for cotton yarn is (4.2 ± 0.2)**
- **Micronaire value of (4.2 ± 0.6) results in increased hairiness which is used in flannel like fabrics having soft feel**

 5

Next is that raw material, so it is a micronaire, so after the maturity then it is a micronaire value. So, micronaire it is a important if we have uniform micronaire then the total all most of the fibre will take part in the yarn structure. But if micronaire barriers if the standard deviation or CV% of micronaire or range of micronaire increases then that what does it mean it means that it has got force fibre along with the fine fibre.

So, if it is a mixture of force and fine fibre then the closer fiber will have tendency to come out from the yarn structure and produce hairs. So, the micronaire range is in for cotton, so normal say cotton say for with 4 micro 4.2 micronaire it is a +/-2 is the range. If it is within this range then the problem of hairiness is will not be too much that is the acceptable range but if it is more. So, it has been observed that micronaire value of 4.2 ± 0.6 results in increase in hairiness which is used in flannel like fabric having soft feel.

So, this has got it is use this if we have if we want to some who want to some who want to have some fabric which has got flannel like felling then we need cotton with higher variability in micronaire. In some if we need this type of fabric it has been actually one can always try to mix 2 different varieties of cotton with different micronaire value. Then we can create hairiness, so if the micronaire value ranges too much then it will create hairiness.

(Refer Slide Time: 21:38)

Yarn hairiness- Problems

- ✓ **Low strength in yarns**
- ✓ **Sizing:** If yarn is fuzzy, size material will not penetrate to required amount and a greater amount will accumulate on yarn surface (coating is more and penetrating is less)
- ✓ **Shedding problems:** In case of air jet, clear shed is not produce. Similarly if yarn density in fabric is more, the two consecutive yarns due to hairiness causes problems.

NPTEL 6

And another problem is that hairiness will result low yarn strength because if the hairiness is less means the most all the fibres are inside the yarn structure ok, no hairs. So, that means individual fibers will take part in the tension, in the strength, it will individual all the fibres will take their give their contribution. But if we have high number of hairs, very high number of hairs, so hairs this hairs protruding here will not take part in the strength.

But it will take part in mass, so the total linear density of yarn, so both this yarns linear densities will be same. But the effective number of fibres taking part in strength will be much less in case of the yarn with higher hairiness. So, effective strength of this yarn will be low, then problem there is a major problem in sizing. So, if there is a hairiness, so the yarn is fuzzy with high amount of hairs.

Then what will happen, so if we apply say size material here in this yarn if we apply size material. So size will be applied here as well as, as it is directly in contact with the surface they will penetrate inside the structure. So which we actually want ok that will create required characteristics, but here in the yarn with higher hairiness if we apply size this will be actually blocked by the hairiness in the surface and size will not penetrate inside.

So yarn quality and strength and other quality parameters will get affected it will actually create on coating. This stiff size coating at the surface and during and the yarn will be very stiff and so that this size coating will be removed during weaving process and the higher breakage will occur. So that the sizing process needs have less quantity of hairiness, so if yarn is fuzzy, size material will not penetrate to the required amount and a greater amount will accumulate on the yarn surface ok.

And coating is more and penetration is less, so that will create we have been sizing penetration is very important. If it is only coating in the surface that will after drying this coating will be very stiff and they will come out during weaving oppression and then the yarn will be as uhhh like a unsized yarn and it will immediately brake. So, higher breakage will occur if the yarn is hairy ok, shedding problem is there.

So if the yarn suppose we are using 2 ply yarn double yarn where sizing is not there, in that case in case of air jet cleaner shed. So total clear shed is not produced which is important ok, similarly if yarn density in the fabric is more like war number of war thread is more than consecutive threads during up and down motion due to hairiness it will create higher friction and that will not actually that will not allow clear shed formation and breakage may occur ok.

(Refer Slide Time: 26:00)

Yarn hairiness- Problems

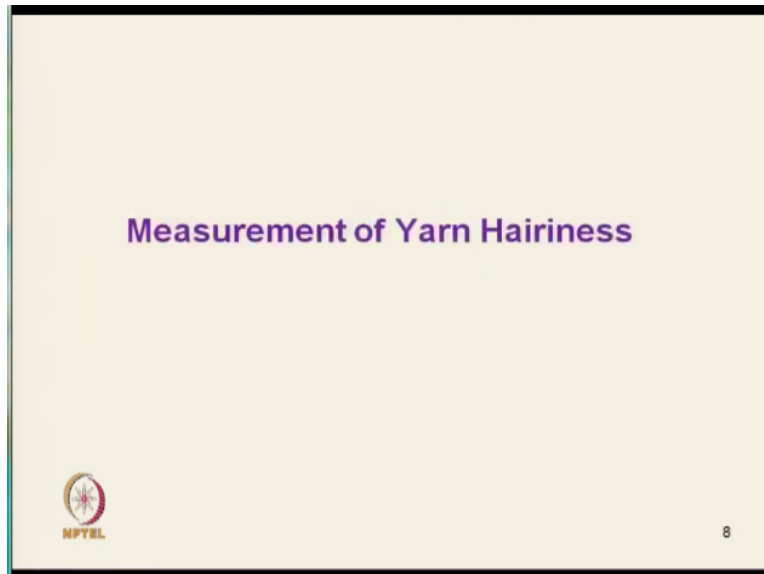
- ✓ **Wear out:** The machine parts; drop wires, heald wires and reed
- ✓ **Knitting:** In knitting needles are worn out quickly
- ✓ **Appearance:** Poor appearance of fabric



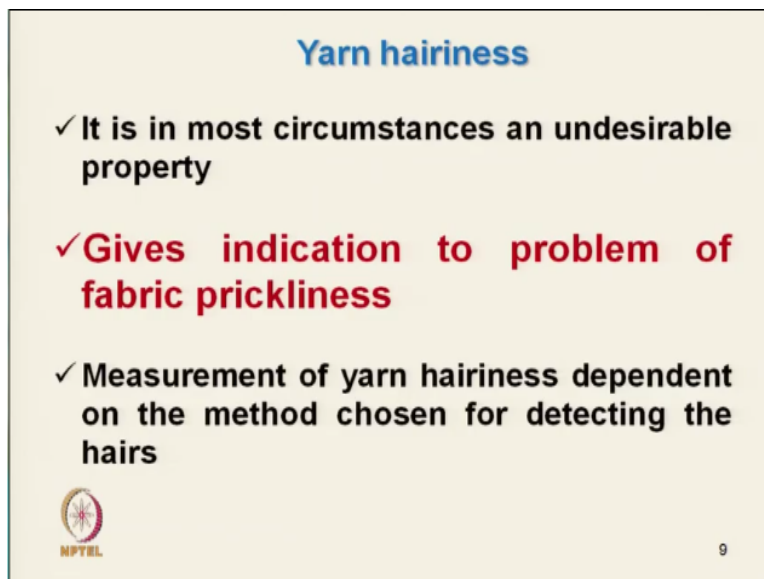
And it is a wearing out of the of different machine part like drop wire, healed wire for any other different machine part of through which the yarn passes due to the hairiness it will actually this is it will damage the machine part. And also in the knitting the knitting needle are be worn out and quickly and it will create the problem maybe it will damage the fabric also and obviously fabric will have poor appearance that I have already mentioned.

Due to the due to unequal reflection ok, uneven reflection like 1 this is 1 fabric with the clear surface ok. This is fabric without any hairiness, this is another fabric with large number of hairs on the surface. Now when light comes this will this fabric clean fabric with will have regular reflection, so that will create the shine measure. But here this will create a random reflection, so that will make the fabric surface dull in look ok. So fabric appearance will be poor and also it will have the peeling and many other effects ok.

(Refer Slide Time: 27:50)



Now we will see the measurement techniques how to measure the hairiness ok.
(Refer Slide Time: 28:00)



So, that it is a undesirable property we have discussed and it gives indication of the problem of prickliness ok. It creates problem of prickliness and the measurement of hairiness is actually dependent on the method chosen ok that we have discussed already.

(Refer Slide Time: 28:24)

Yarn hairiness

✓ It is not possible to represent hairiness with a single parameter because the number of hairs and the length of hairs both vary independently.

✓ A yarn may have a small number of long hairs or a large number of short hairs or any combination in between.

✓ The problem is then which combination should be given a higher hairiness rating.

And also we have mentioned it is not possible to represent hairiness with a single parameter because the number of hairs and length of hairs both vary independently. Yarn may have a small number of long hairs or a large number of short hairs or any combination of that. So the problem is then which combination should be given higher hairiness rating ok.

So, that different combinations I have discussed that measurement of hairiness in by measuring the number of hairs or by measuring the length of hairs will create different problems ok. So, we will stop here, we will continue in the next class when we will discuss the all the measurement techniques of yarn hairiness, thank you.