Evaluation of Textile Materials
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Lecture – 11
Evaluation of Fibre Length (Contd...)

Hello everyone, so, we will continue with the fibre length technique. So, we have seen the difference between shorter diagram and fibrogram.

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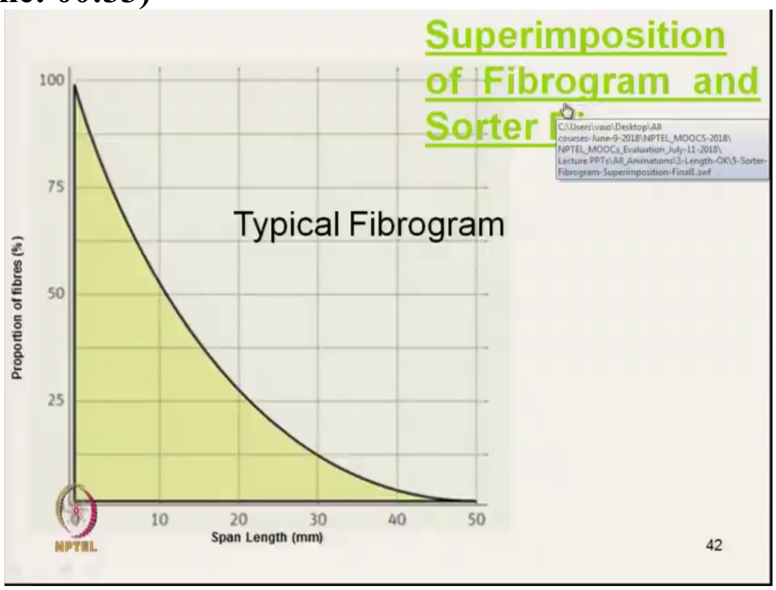

Of say polyester staple fibre of equal length and we also see the super imposition of fibrogram of cotton.

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Fibrogram and the shorter diagram let us see once again. So, this is the fibrogram where the x axis shows the length where y axis is the proportion of fibre. This is the fibrogram and in shorter diagram the x-axis will be proportion of fibre and y-axis will be the length of fibre which is shown in the red colour ok. And this is the length of fibre and here the x-axis will be proportion of fibre. And this is the typical form of shorter diagram.

And now if we super impose this is for the same fibre ok same fibre. If we now superimposed these two, we will get typically; this will be the fibre diagram superimposition of both ok. What is, it is showing here is, this is the proportion and the maximum length of both the fibres are almost same this is the maximum length point. And here it is the approximately it is the 100% fibres are there. But this difference, this is the difference because it is ideally appears.

If it is; if we assume that the fibres are arranged in same order in case of fibrogram also in shorter diagram exact fibre length are taken. This is the longest length and in horizontal way it is arranged the fibres are arranged in a horizontal way as we have discussed from long longest fibre to shortest fibre. This is the way it is arranged. But if we see if we assume that it goes in the same way as in the fibrogram but we see is that entirely different ok.

And this is the due to the assumptions we have two assumptions, one is that this is due to that clamping. Now in the clamp ideally if you see; in the clamp if we see that let us see here.

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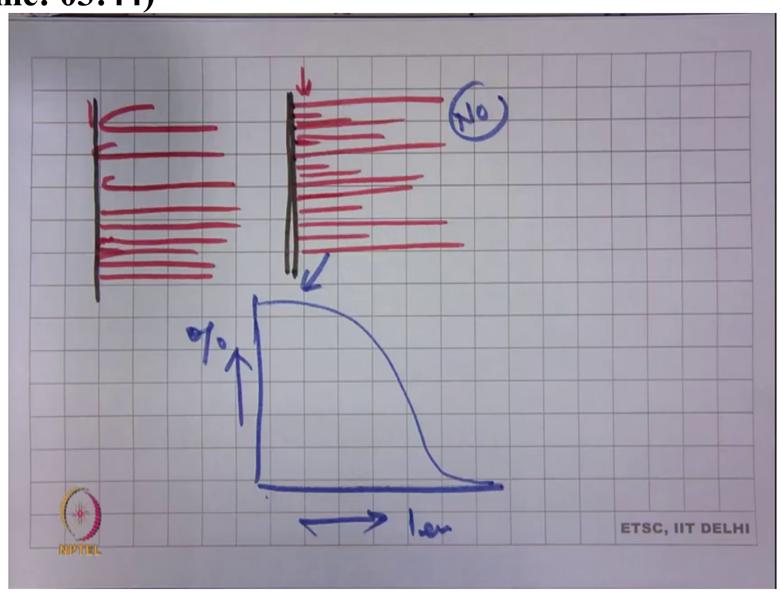

As we have discussed earlier that in that clamp fibre are arranged in random fashion like, in this way, these are the fibres are clamped ok. At any point ok and randomly measure the longest fibre will be selected. These are the two assumptions. But ideally suppose if we see in fibrogram about somehow if we clamp the fibre at the end point, ideally we are clamping the fibre at the end point always and all the fibres, all the fibres are clamped.

If we can clamp in that way all the fibres are clamped irrespective of there is no length biasness. If we prepare in this way and if we get the spectrogram by scanning, in that case what we will do we will get here. This is the ideal fibre no length biasness and also the fibres are clamped at the end point, there is no loop formation. In that case we will get the fibrogram, so this is the proportion and here it is the length. We will get the fibrogram like this exactly same as the shorter diagram.

But we get the fibrogram is in this fashion this is mainly due to two assumptions one is the due to length biasness another is due to folding of the fibres. So this difference here is due to the two assumptions ok, otherwise I really it should match.

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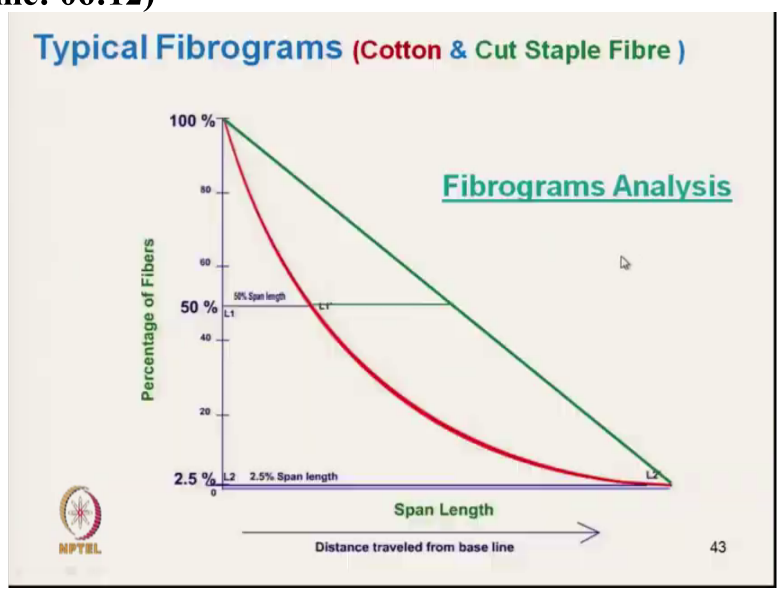

As we have discussed earlier the typical fibre length that is the fibrogram, this is the fibrogram. Here for cut staple fibre, this one is the cut staple fibre fibrogram. Analysis this we have already discussed fibrogram we can get the uniformity index and uniformity ratio. Analysis we are not discussing again and we can now do some calculation very simple calculation.

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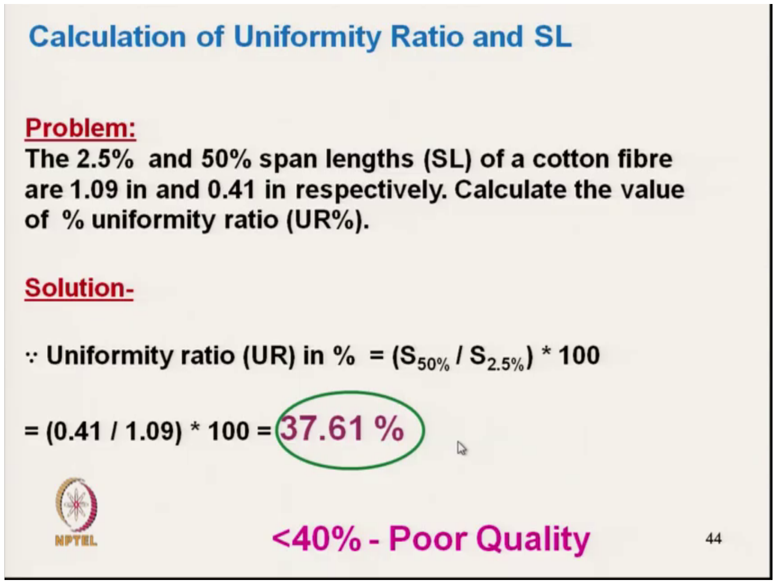

The problem is that here the 2.5% and the 50% span length are given 2.5% span length 1.09 inch and 50% span length is 0.41 inch. In value wise 50% span length is always lower than 2.5% span length. Calculate the value of uniformity ratio. So, what is the uniformity ratio it is simple the ratio of the 50% span length and 2.5% span length.

So you just we can use these two values get the value that is 37.61% value. So if it is said that this result, so if we, if someone ask what will be the actually your conclusion about the quality of fibre. Quality of uniformity as it is 37.61% so we can simply say it is a poor quality, so it is less than 40% it is a poor quality.

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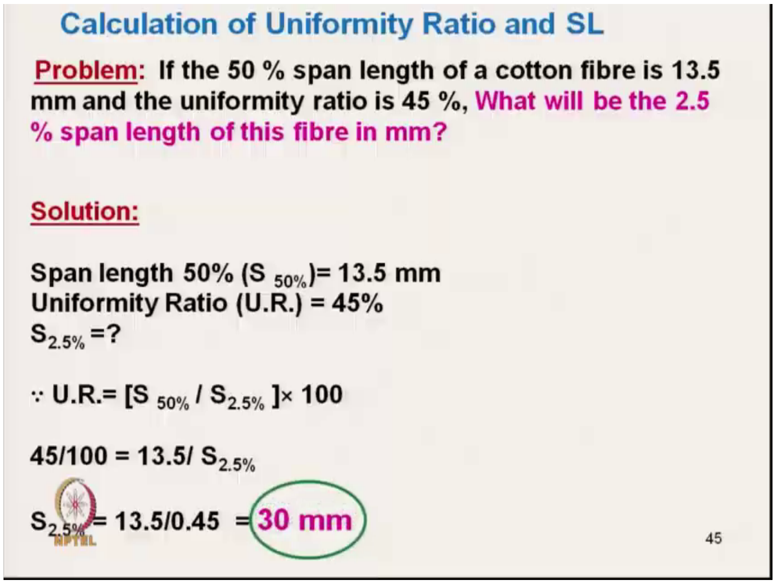

Next problem is the uniformity ratio and it is a same problem, similar. If the fibre as the 50% span length it is 13.5 mm. If 50% span length of cotton is 13.5mm and uniformity ratio is given 45%. What will be the 2.5% span length in mm. Again it is a simple formula we know the uniformity ratio this is the equation. So, from there we can calculate the 2.5 % span length. So, 2.5% span length is 30 mm. So in this way we can if we know few data we can calculate, 30 mm is the answer.

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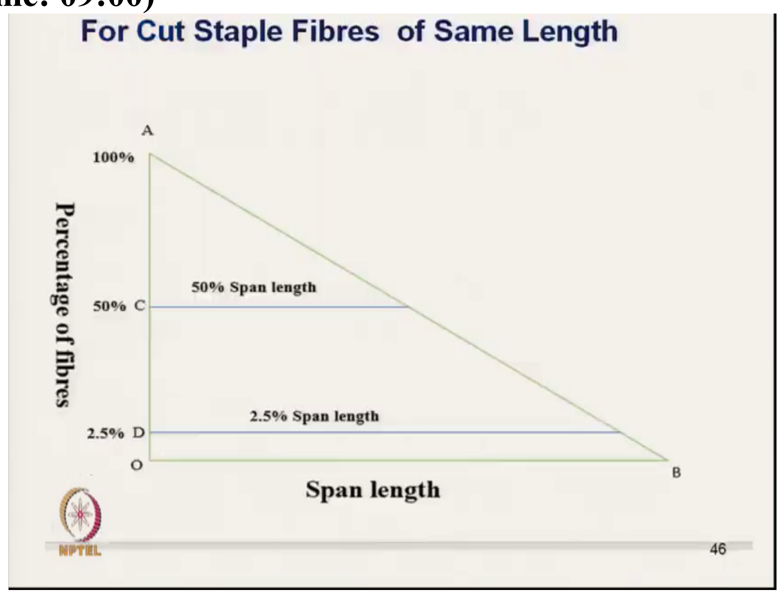

Can you calculate the uniformity ratio of cut polyester staple, cut staple fibre? So, if immediately if it is asked that what is the uniformity of any cut fibres immediately it will come to our actually mind that ok it is the cut polyester fibre cut fibre that means that uniformity should be 100%. So uniformity ratio will be 100% because cut fibre there is no variation. But if we see in the fibrogram as we have discussed earlier it is not the rectangular form it is a triangular form.

So, this is the ideal cut polyester staple diagram it is not always triangular but it is very close to a triangle. We can for all practical purpose we can assume it to be triangular image. It is in triangle form ok, then this triangle we can analyse. So, what is 50% span length, 50% Span length is from 50% point from C to this point ok. And 2.5 % span length is this one ok. Now here if you see we can consider this triangle AOB is the triangle and uniformity ratio what is the uniformity ratio?

Is the ratio of this D and this side this C and this side ok is the uniformity ratio. So this is there at 50% span length this one and in this direction length 2.5% and this ratio is the uniformity ratio.

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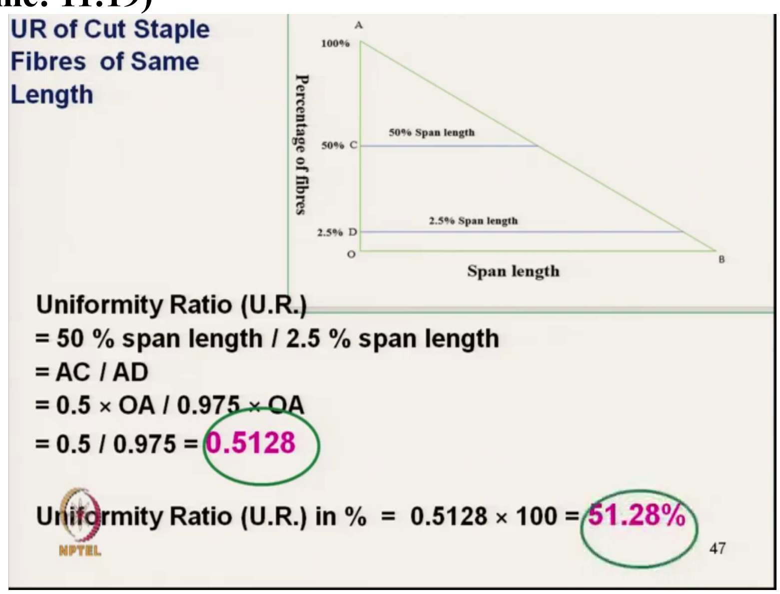

Now this is the ratio now if we consider this as the triangle so this will be our similar triangle so their angles are same. So for any similar triangle the uniformity ratio will be 50% span length by 2.5% span length. So, 50% this 50% span length by 2.5 % span length, if we consider the triangles AOC, AD this point, AC this point. This three triangles if we so the 50% span length and 2.5% span length will be AC by AD, this divided by this equal to AC by AD.

So, that will be the ratio of the site, for any similar triangle the ratio of the side will be equal to equal ok. This side by this side will be AC by AD. Now what is AC? AC is the 50% of AO that means .5 AO and what is AD? AD is 97.5 * AO, so, 50 by 97.5; 0.5 * OA/ 0.975 * OA. So, if we see take the ratio it is coming out to be 0.5128 that is the uniformity ratio of cut fibre any cut fibre, so, that we can see and for cotton the maximum uniformity ratio that we can reach up to say 50%.

And for polyester cut polyester of equal length we can; maximum theoretical we can reach up to 0.5128 we cannot go beyond that ok. This is the value we are getting and if you want to know the uniformity index what is that uniformity index? Uniformity index is ratio of the mean length by upper quartile length. Now let us try to see uniformity ratio is in percentage it is 51.28% and this .5128 is 51.28%.

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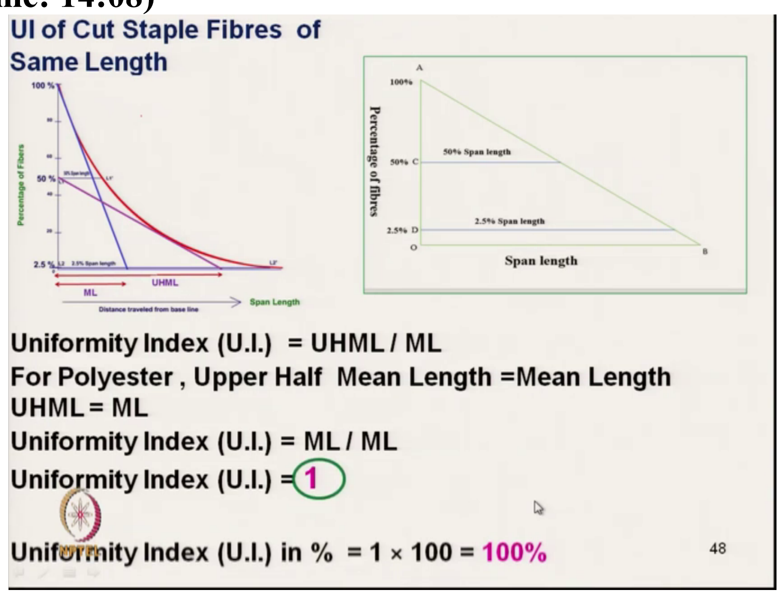

Now uniformity index you know this is the way we can calculate the uniformity index it is the mean fibre length buy upper of mean length. For polyester cut polyester the uniformity index will be it is the; these length always same for that. Uniformity mean length and upper half-mean length will be exactly same because if we take the tangent from two points it will go meet at the same points uniformity index for cut polyester fibre is the mean length equal to upper of main length so this will be one ok and it is 100% in terms of percent.

So, for polyester fibre the mean length, the uniformity index is 100% and uniformity ratio is 51point something. It is the theoretical uniformity index ok.

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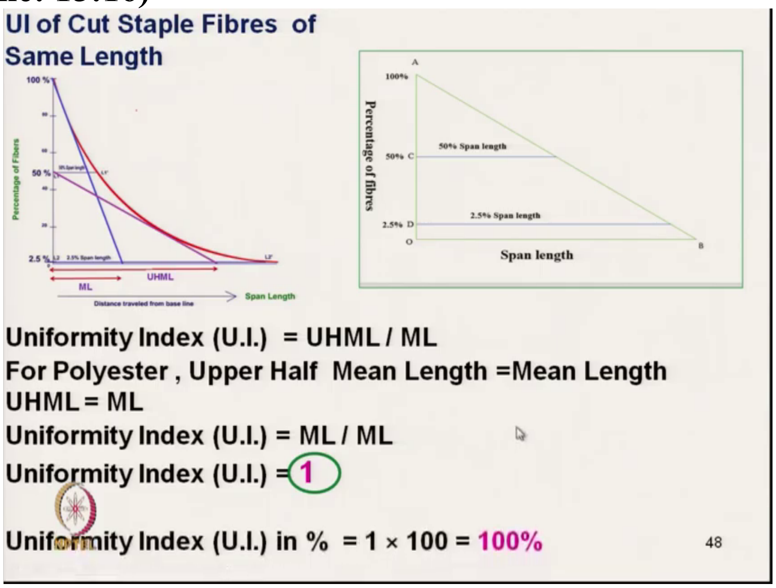

But if we test, but if we test the fibre in fibrogram we will not get exactly 51.28% but it will get little bit variation but it will be definitely close and also will not get the uniformity index as the hundred percent it will be vary because it is a matter of probability it will not come exactly triangular it will be little bit different little bit variation will be there. Once we get little variation we will some value ok.

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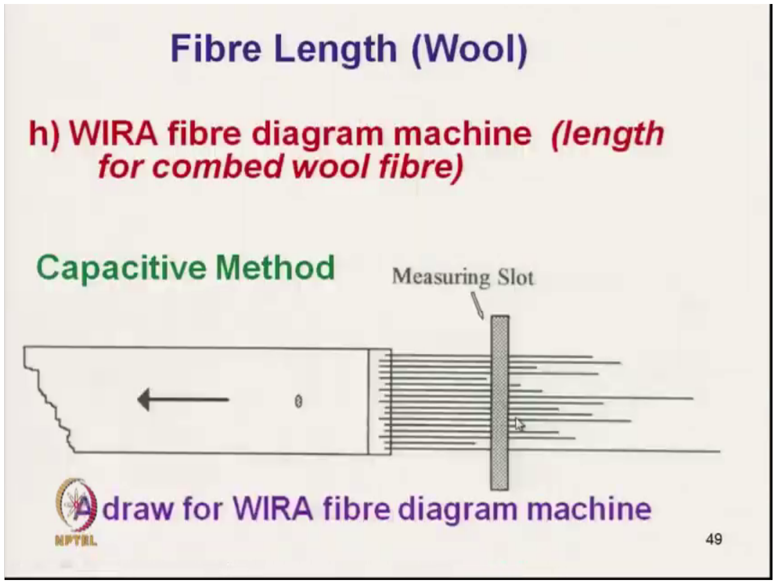

Now we will discuss methods of measurement of fibre length of wool fibre. In wool fibre there are totally it is different from cotton. We cannot test the wool fibre the way we test cotton. We cannot test wool fibre in fibrogram. Fibre graph we cannot use because of the reason the wool fibre is a length. Wool fibre length of wool fibre is much longer than cotton fibre. So, the way we test cotton fibre length it will not be applicable for wool fibre.

Wool fibre length is measured in two different ways one is WIRA fibre diagram machine and it works in capacity principle ok. And the length is measured here after the removal of grease content ok. Ok it is measured for combed wool fibre. Wool fibre is then we receive we have to thoroughly remove all the grease fibre. Otherwise we cannot take out the fibre it is very sticky. After recovering the whole even in that case also it is very difficult to measure it is at cream condition it at entangle condition it cannot take out the fibre.

So, we can normally test just after the combing. The combed wool fibre is taken also one can try with the carded fibre also but for combed fibre, fibres are parallel in nature. So this is the; this one is the draw it is called one draw means this is the polythene plastic sheet and it is marked and there is a hole is there. This is to be fitted on the machine there is a projection and this projection in that this slot the hole is fitted to the machine so that instrument can be started. This will show the when it is fitted on the projection.

This will show the starting point of the measurement and there is a measuring slot which measures the capacitance of the material ok. Now as the material is changing it proportional to the quantity of materials here ok it is the draw for WIRA fibre diagram machine. This is called one draw, so the draw is actually to obtain from the combed sliver and at the end of this plastic sheet it is a transparent normally it is a gum there is a sticking gum and the fibres are actually gripped.

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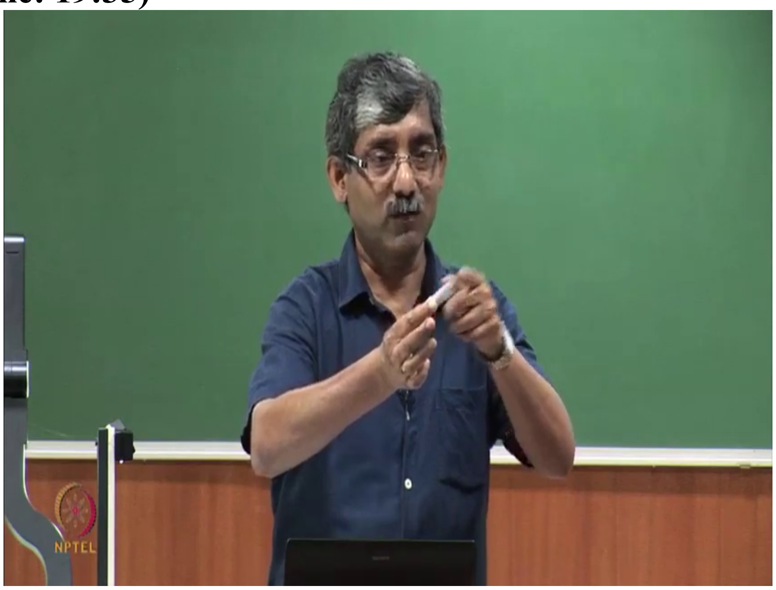

So, suppose this is the comb sliver, there is; this one is the draw polythene plastic draw and at the end it is been gripped at the point and then we are taking. This is the draw one draw which contains short fibre long fibre and all. Now this draw is placed in the mission this draw is now placed in the machine where it is actually and it starts from this point. Now let us let me draw once again.

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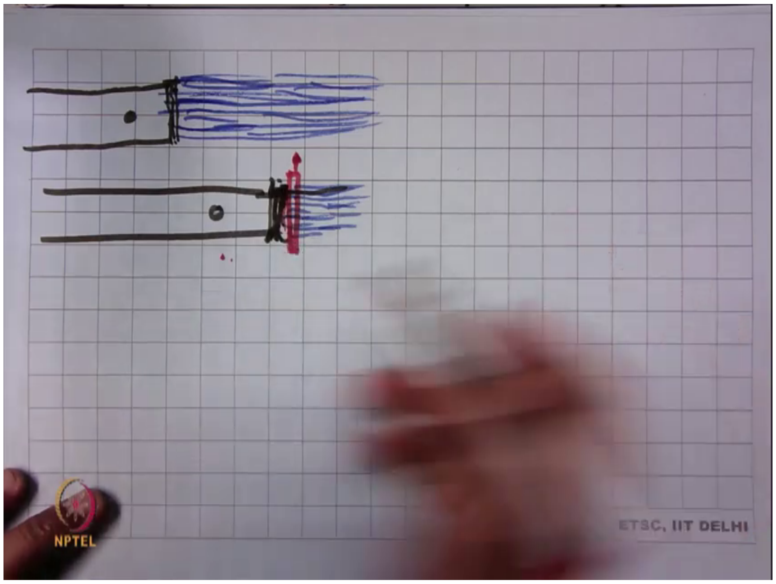

These is suppose the sliver this the combed sliver now the polythene plastic sheet that is drawn it is like this. Here it is the slot is there at the end; at the endpoint you have one that is gum, sticking gum. It is divided into two parts ok top part and the bottom part it is a double ok. At the end it is the little bit opening, now this is placed here at the tip point the fibres are gripped. And then it is been pulled after pulling what we are getting. The fibres are gripped few fibres are gripped.

This is draw ok, this is 1 draw, now you have a measuring slot which measures the capacitance of the wool and it is manual it is not automatic. Manually this position is fixed at the starting point maximum number of fibres are there the capacitance will be different gradually it is drawn. This is with the slot this is it is moved next time it will be here. And it is done in 10 different stages steps ok now gradually it is moved.

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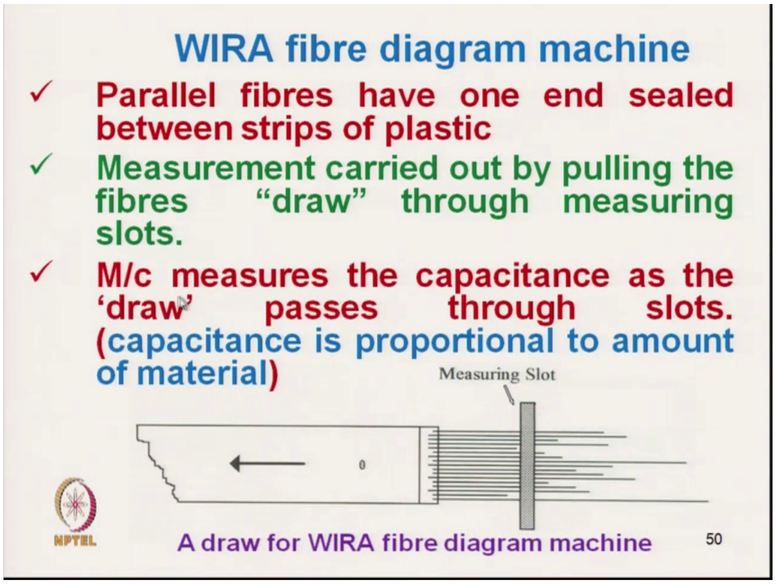

We will try to see parallel fibres and one and shield between the strips of plastics. So, one end is sealed ideally it is assumed that almost same length. Measurement carried out by pulling the fibre draw, fibre draw this is called 1 draw ok. Through the measuring slot, this is the measure slot. The machine measures the capacitance as the draw passes through the slots. Gradually the draw is passing through the slot and machine measures the capacitance. Capacitance is proportional to the amount of material. Initially the capacitance will be high and then gradually material will be less and less depending on length ok.

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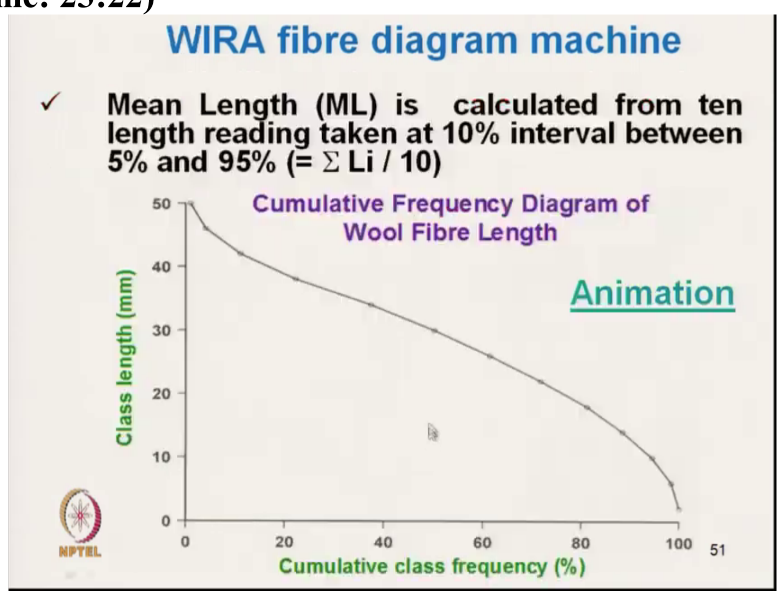

This is the way it is measured the mean length so first draw is this one it is the maximum ok this is 100%. That is hundred percent fibres are there this is the first one is the maximum one, 100% cumulative classes of frequency that is maximum capacitance. This 100% we discard we do not take for calculation. We gradually; there is a data, there is a value 100% value is there some capacitance value it is giving and we know the length ok. That length is zero length. Now gradually we move, move the draw, we draw that sheet.

Till the, 95% of the capacitance reached, 95% of that initial value is reached. Y axis is showing the movement of the draw the X-axis is showing the proportional. So at 95% we have noted down the length ok, so it is actually the moved manually until it is 95% of the initial value is reached. That value that in the card, graph sheet we are plotting putting that point is called 95%. Next value will be again 10%, 85%, 95% points is this one then you move further you will get the 85% of the fibres then 75, 65, 55, 45, 35, 25, 15, 5% so this is 100% that is up to 5%.

There will be 10 readings starting from 95 to 5, so it goes in opposite direction. So, it starts with 95 interval of 10% it goes up to 5%. So this way we get cumulative frequency diagram of wool fibre length. This is the cumulative frequency diagram directly we will measure the capacitance.
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And in fibrogram we have seen it is measured by the intensity of light and capacitance is proportional to mass of material it measures the weight at end. Now try to see it is being drawn through the slot 95, 85, 75, 65, 55, 45%, 35, 25, 15 and 5. So, this is drawn and the mean length is calculated in the way has been explained. And this is the way we will get the plot that is that is the cumulative frequency diagram although it appears it same as the fibrogram but it is different.

Because this is giving almost clear idea, it is equivalent to the shorter diagram. Here it is equivalent to shorter diagram but this fibrogram is different only as we have explained it is due to the way of selecting the clamp.

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This gives this is typically this gives the shorter diagram ok and its length, addition of length divided by 10 so we get the mean length.

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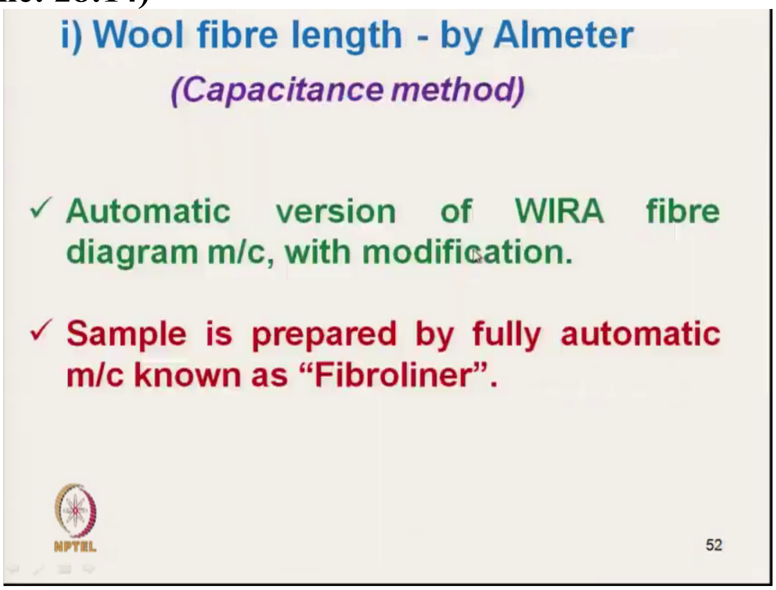

And another version is there, it is basically the automatic version of the WIRA fibre diagram machine is that it is called the Almeter where the principal are exactly same but there is little bit variation. In WIRA fibre diagram machine the draw is prepared by hand and it is drawn by manually ok. And you have to plot manually but advantage of WIRA is it gives a clear idea of actual length of the fibre. Why we cannot use the similar technique in case of cotton.

Because cotton fibres length is very small and the variability is very high that is why if you want to prepare draw it is very, very difficult, we have to take large quantity of fibre but in that case it would not work because of the variability to take care of the smaller fibre also we have to have the thicker material and it would not work. But for wool it is long fibre, variability is relatively smaller. So, we can have few fibres and then we can prepare the draw. And it is automatic version of WIRA fibre diagram machine with little bit modification.

What is the modification? The modification is basically the preparation of the draw. Here we do not prepare draw we prepare sample which is known as the fibroliner. By using the fibro liner sample is prepared automatically ok and this machine is known as fibroliner.

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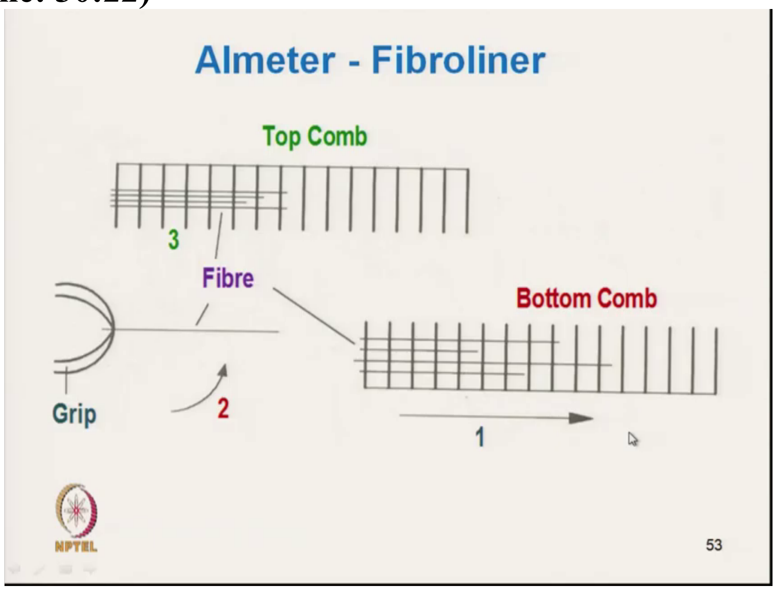

Now this is the Fibroliner try to see here it is your bottom comb ok and fibres in the form of sliver are placed on the bottom comb. It is a comb is different type of comb it is a grilled box type it is a grilled type ok.

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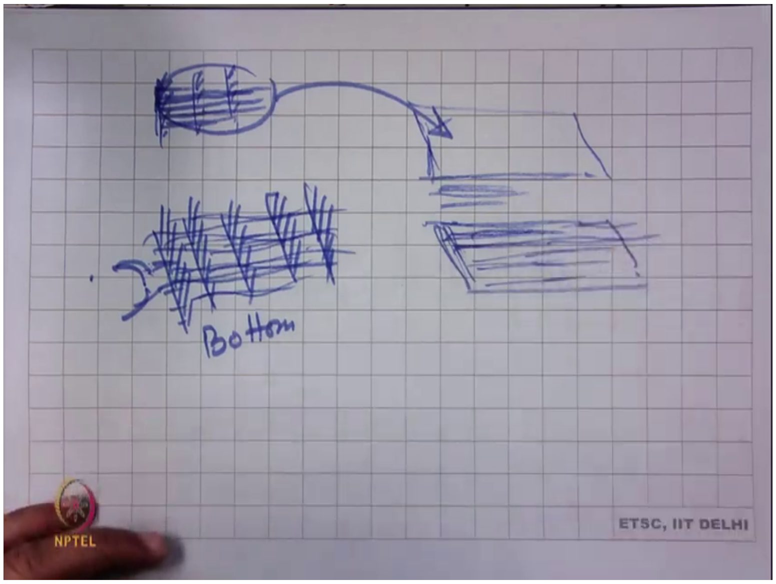

If you see here this is the bottom comb ok now the slivers are placed here of different length ok. Now there are few projected fibres, now what fibroliner clamps are doing it is gripping the fibres from this points ok from these points. I can show here you try to see here this is the fibre.

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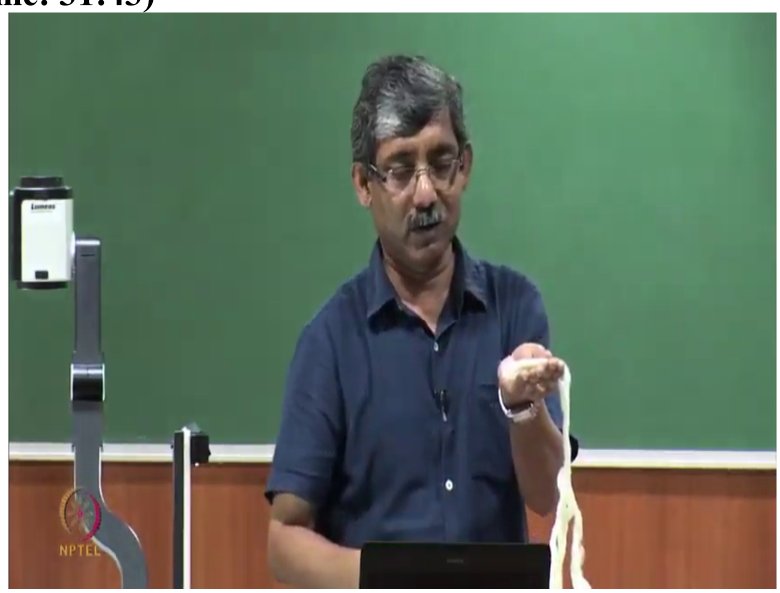

This like this the fibre ok, these are the fibres and the bottom comb is like this and here it is the fibroliner the grip that is clamping repeatedly and it is clamping and placing the fibre on the top comb again clamping gripping and again placing the; for a particular setting it is repeating say several times till all the fibres projected from the last comb is gripped is taken away and placed here.

The difference between the top comb arrangement and the bottom comb arrangement is that here the fibres are arranged in random like sliver. Fibres can start at any point. The grip it is gripping the fibre it is taking the fibre which is very, very small length maybe few millimetre 1 millimetre or 2 millimetres distance whatever projected fibres are there are gripping fibre and placing. That means whatever fibres are placing in that top comb and it exactly the end is at the point.

Now as soon as all the fibres at the bottom comb is exhausted here, then this comb will fall down projecting the remaining fibres here, other fibres. The same thing will repeat.

And it will be again it will, gradually it will move take away the fibre and it is there and it will take away the fibre it will place there so fibre 1 then it is gripping the fibre is gripped and the fibre is placed here. So, in this way continue placing till a thick material is actually prepared this material this is the top comb again I am coming this is the bottom comb. And now it is placing the fibre in the top comp again similar top comb.

And now the fibres are gripped here hand placed. So in this way it will place the fibre all the fibre of exactly same edge. Here the starting point will be same; after the bulk of fibres are placed here then this will be transferred to in between 2 polythene sheets. These total fibres will be transferred here in between 2 say this is the polythene sheet this is the top sheet and this is the bottom sheet. Transparent very thin polythene sheet this will be; the fibres will be transferred here having edge perfect edge at one end.

And the fibres will be; suppose we have prepared this is the exact edge at the end exact edge and then it will be placed in between the polythene sheet.

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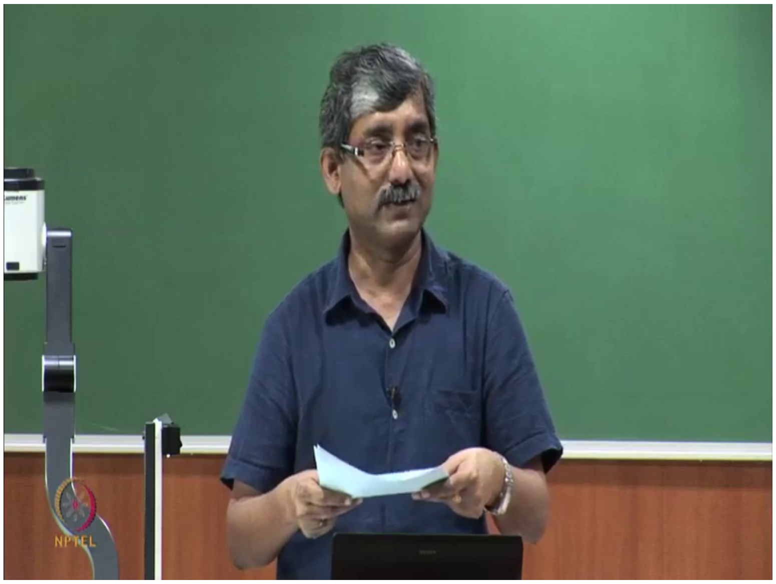

It is been placed here after that what is that at the edge. The even edge is at the midpoint the inner side and this is the longest fibre. So this polythene sheet top and bottom allow me the fibre, will be placed inside the machine it will be scanned and then we will get;

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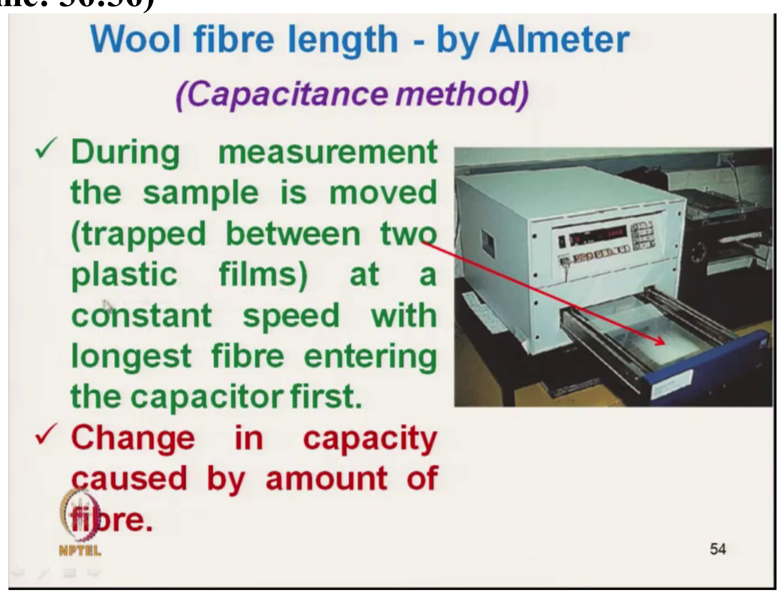

We can see the picture from the here this fibre draw which is trapped between to polythene thin plastic films which is transparent we can see the fibre this is the total draw during measurement the sample is moved trapped between to plastic films at a constant speed which is the longest fibre longest fibre very penetrates inside the capacitance zone first. So, the longest fibre enters the capacitor first. So, in this way it will measure the capacitance of the total system, the total fibres as it is moving.

And it will be exactly in the same way as we have done in case of WIRA fibre diagram but it is in the opposite direction. In WIRA that is from the maximum capacitance zones to minimum zone. But here it is minimum to maximum ok, but the principal is the capacitive principle but another thing is that they are age is exactly same at the end point we grip the fibre at endpoint it is aligned. The change in capacitance caused by the amount of fibre so the length is actually measured gradually so we get all the length related data.

This is actually nowadays in the industries they are using because WIRA fibre diagram machine is a little bit slower it is time consuming and this is very fast ok. I think now we have completed the fibre length measurement techniques we have seen the fibre length techniques for different methods for cotton and there are two special methods for wool fibre in the next segment will discuss the fibre finest measurements till then thank you.