Evaluation of Textile Materials

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Lecture-35
Evaluation of Yarn Evenness (contd…)

We will continue with the yarn evenness ok. Now so we will discuss another ways of expressing the yarn evenness it is a imperfection.

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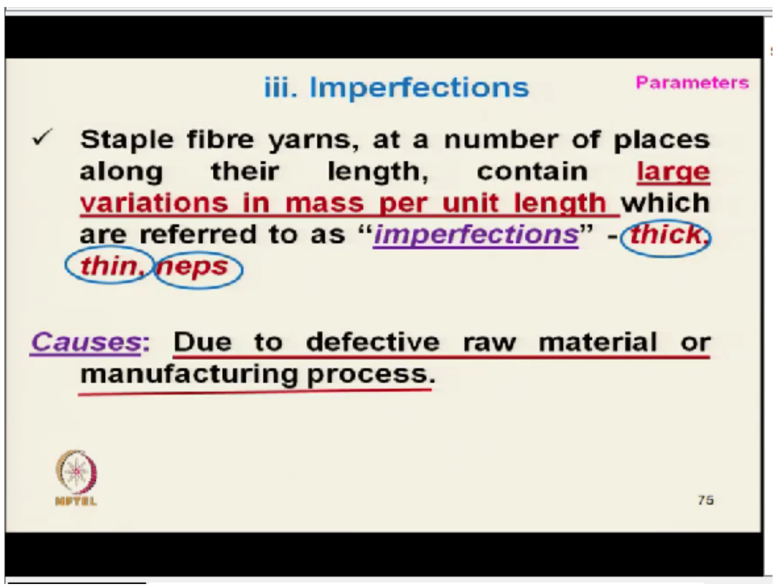

Imperfections are basically are the stable yarns at a number of places along with their length contains large variation in mass per unit area. So any staple yarn if we produce, so there will be inherent defect in that yarn which is actually inherent part of the yarn ok.

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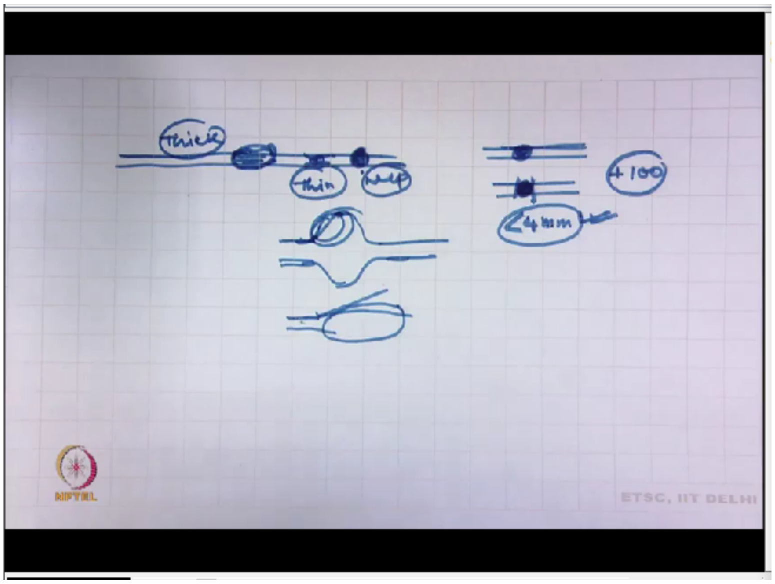

So, that it is due to the problem in the technology ok problem in machine ok the we cannot have yarn staple yarn without any imperfection, only thing we can reduce the intensity reduce the number of imperfection. There will be definitely some thick places, thin places or names, so thick places there will be little bit more number of fibres and average. There will be number of less number of fibres in the cross-section than average or there will be some node type.

So the difference between thick place, thin place or napes are classified based on the diameter or mass/unit length proportion of increase or decrease as compared to the with reference to the mean value. Now this imperfections are inherent nature of the staple yarn I am emphasizing this inherent nature, nature means this has to be there. We cannot have any yarn practically theoretically it is possible in practically without any thick, thin or neps.

There has to be there because this is the nature of the production line and this causes are due to defective raw material or manufacturing process. So, this will be there but we can reduce the level.

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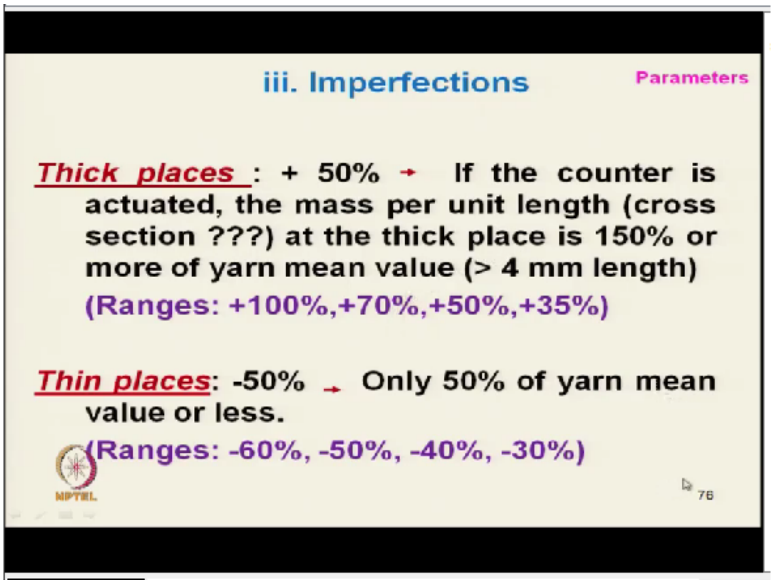

And the thick places example for say 50% thick place 50% level. So, what we calculate?, we calculate the number of thick places number of places where the mean value is +50% it is actually thick place thin places are expressed in terms of + or -, +50% means the mean value if we talk about the 100. And then + that means 150% that means 50% more than mean, if the counter is actuated the mass/unit length that is cross it is proportional to cross section.

If we assume the packing density same at a thick place is 150% or more of the yarn value yarn means value. So, it should be 150% or more value then we will call it at as thick place. But in thick place there is another condition the length should be more than 4 millimeter length. So if it less than 4 millimeter it will be considered as the neps. Now the neps in the capacitance principle the neps are counted based on mass ok.

If even if there is no change in diameter if the mass/unit length is higher by say 100%. So, double if it is double and if it is length is less than 4 millimeter. Then it will be called as the neps but in diameter type measurement where it says that rate of increase in diameter. If the rate of increase in diameter of yarn this is the yarn. Then if it is high then it will be called as the nape, if the rate of increase in diameter is low this angle if it is less.

Then it will be called as the thickness but the length is always there the neps will be less than 4 millimeter. If it is longer than it will be called as other type of parameter that is it will be called as faults that it will be called as faults that we will discuss later. So, neps thick place is more than 4 millimeter and typical range is 100%, 70%, 50%, +% it is typical ranges. But one can have 60% also, in any range one can have if we have data.

It is matter of only software ok, thin place-50%. So, only 50% of yarn mean value or less, so any value less than or more 50% or more. Then it will be called as thin place the different ranges are there 60, 50 30 and -30%. So, this are the different ranges and this will be actually cumulative value, so means that +35% or say +100%. It takes care of all the values rest other values also.

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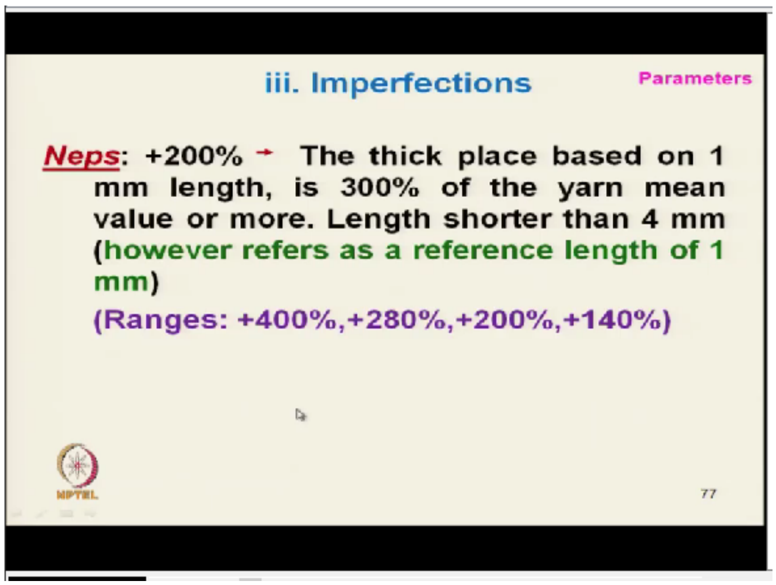

Neps+200% neps +200%neps means it is the total mass/unit length will be 300% of the mean value that one mass we will very careful like 280% neps means the mass/unit length is 380% ok that means +200 280%. And it is a reference length is 1 millimeter shorter length that is less than 4 millimeter. But it is actually specified as 1 millimeter length.

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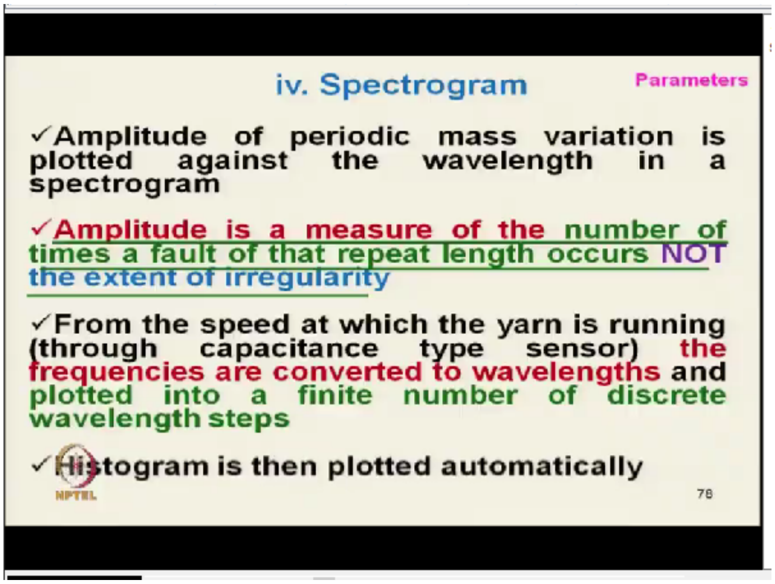

Now coming to one of the most important diagram or most important actually method of measuring the technique of measure in the periodic fault the spectrogram. The spectrogram only talks about the periodic fault if the yarn if the material does not have any periodic fault. Then spectrogram will not show anything ok, so the amplitude of this periodic mass variation is plotted against the wave length in the spectrogram ok.

In x-axis there will be the wavelength of the only the periodic fault that is I am just repeating. It is only talks about the periodic fault not any other fault ok. Now the amplitude it is not the amplitude which we have discussed the variability. It is the amplitude means here the number of times of fault of that repeat length occurs. It does not talk about the extent of irregularity ok. It actually the spectrogram does not talk about the extent of irregularity ok.

From the speed at which the yarn is run through the capacitance type tester. The frequencies are converted to wavelength ok that wavelength is it is converted and plotted into a finite number of discrete wavelength steps ok.

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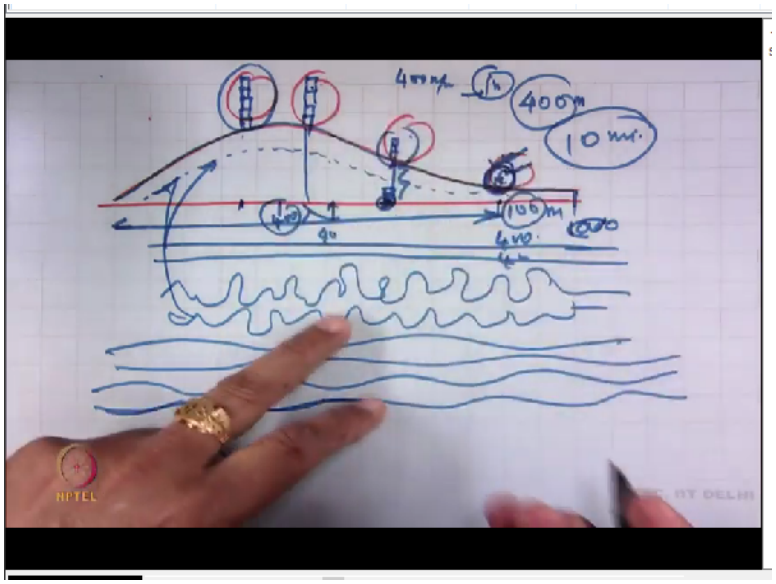

Now suppose typical wavelength of cotton, so spectrogram that this is the typical wavelength of and it is a very uniform yarn, so this is the very uniform yarn. Now if we have a yarn with high in percent very high in percent suppose this is the yarn very evenly fine very even here and another yarn it very high uneven. Then how the spectrogram will look like the nature of spectrogram will be exactly same spectrogram does not take care of any random variation ok.

Now suppose there is a yarn with the very nice. So now here what will do? from the data capacitance value data it will immediately it will get the value of the wavelength, from the speed and capacitance that from the speed it will immediately identify this is the wavelength it is taking place. Here every periodic fault it will start plotting this is the base line**.**

It will start plotting the number of times the periodic this one. Now if the periodic that length is smaller shorter variation is there with shorter length that means it will immediately shipped this here some. And here number of times it will start from this point there are some adjustments are there. But one will always we can see the larger wavelength, so if that the wavelength is say further high, the number of times it will occur.

It will show with the small but meaning here is the almost same. Here the height of (()) (13:56) will be chimney will be little bit high. Because here we have more number of data more here although less number of repetition. So, if we got if we get this value with small chimney that shows that there is a periodicity at that wavelength. This is wavelength ok at that wavelength that is the periodicity.

But although as our test length is say 400 meter and this may be say 100 meter, within that test length only 4 times it would happen. Now whether this is significant or not whether it is a by chance it is taking place that you can judge by comparing this height and this ratio of this site. The shows whether it is a significant or not if you have any doubt the ratio is ok because as you are going higher site the ratio will all remain almost same.

But still if we have any doubt what one can do? Instead of 400 meter speed meter per minute speed for 1 minute you run the same yarn for 10 minutes. So, you have got, so say 4000 then this periodicity this and this total length will be instead of say it is a say 1000 meter. Here we are getting something so let us say 400 meter it is 4000 meter. Now this will be shifted somewhere else the web this will be re-adjusted.

Then here somewhere else say it is say 400 meter or here somewhere else it will be 400 meter. Then you will have number of data and then for this as it is shifted yarn it will give you certain chimney. And this chimney then you will say it is a significant now you are sure that the problem is somewhere else the same thing. Now this is showing the periodic fault but what about this base, base is nothing. Base is actually it is a equation it is nothing but equation it is a if you run of filament yarn perfectly uniform will get something this one that is basic base.

It is does not talk about the variation only the chimney only this any periodicity for occurs. Then only it will calculate the wavelength and number of times it is occurring then it will keep on enhanced it is actually above that curve that is the spectrogram. So, basic spectrogram the equation just nothing but equation and it is a histogram which is plotted automatically ok. And the plotted into finite number of discrete wavelength steps ok.

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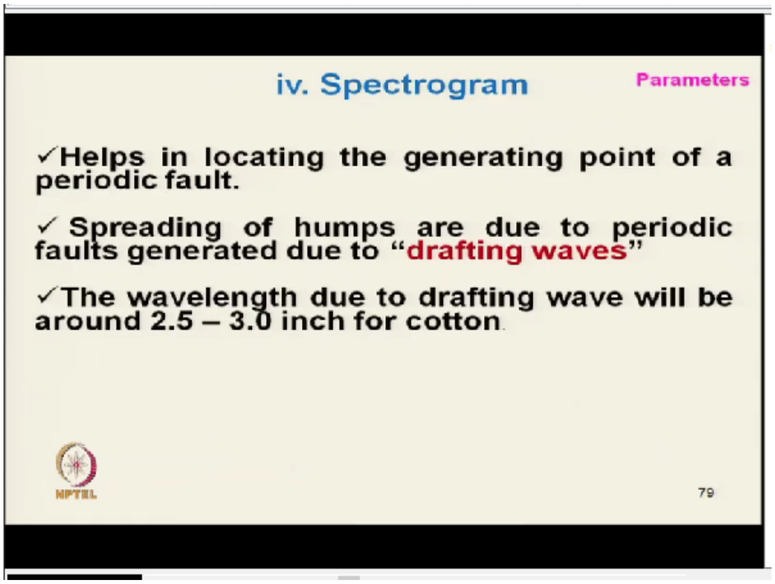

And that is that we have discussed if we have any doubt if we have identified in any small peak and you are not very sure always it is done you increase the test length. And try to test it if at all it is there is any variation any periodicity it will come out it will show up. So, it helps in locating the generating point of a periodic fault it will never tell any other fault if the machine is generating periodic fault then spectrogram is useful.

Otherwise it will it will not give anything, spreading of hump is also there. Now this you we may sometime in addition to this suppose it is nothing is there ok. And no clear chimney is visible it is there and what we are getting? We are getting clustered of chimneys small chimneys this are basically due to the drafting, drafting wave to some extent although it is a random in nature. But draft it has been absorbed the problem in drafting zone mainly in main drafting zone it actually generates periodic fault.

And that it is shows up in the spectrogram thus as I have mentioned spectrogram only shows the periodic fault. So, in drafting zone drafting wave it is spreading of humps are due to periodic faults generated due to drafting wave. And it has got certain wavelength which is typically for cotton 2.5-3.0 inch So, if we think that cotton mean length it is a 2.5 to 3 times of mean length that is for cotton.

So, within 2.5 to 3 inch we will see if there is a clusture of humps ok. Spreading of humps are there then we must be careful that there is some problem in drafting waves. So, either we have to reset the that draft zone setting or we have to see that whether the there are short fibres are there or not or something else or may be the (()) (20:52) there is a problem. So, drafting wave is mainly due to the this short fibre and that we can identify by the spreading of humps.

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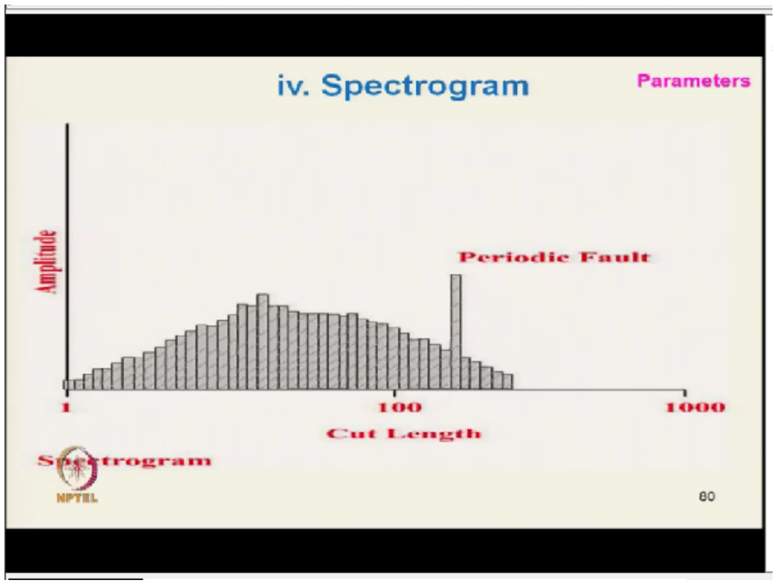

Now this is the periodic fault this is the normal cotton ok normal, for normal cotton yarn without any periodic fault it is there ok. And it does not show it is very clear it does not show any it is level of uniformity level of it never shows the level of uniformity. It shows only periodic fault and periodic it is important because we can actually the periodic fault as we have seen it creates measure problem in appearance.

And we can it is basically due to some periodic defect which occurs an particular machine ok. And this are mainly due to the eccentricity of roller or some broken teeth like this.

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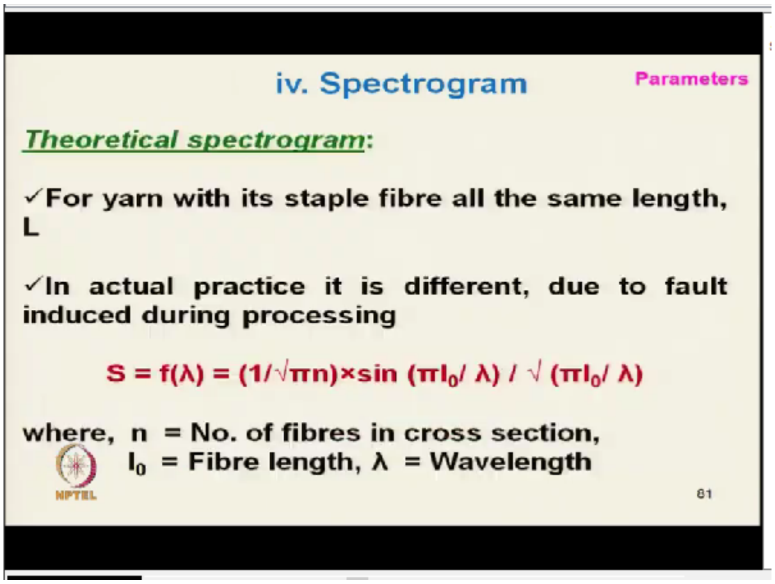

And this here this is the zone initial zone 2.5 to 3 inch zone. Here if it is there it is shows there is no such hump that means there is no problem of the this yarn with the wavelength drafting your problem is not there. But there is definitely there is a periodic fault is there at this wavelength, so what is the wavelength? If it is basically it is a 100 centimeter may be say 1.5 meter or 2 meter say logarithmic skills sometime.

So, at that length it is a periodic fault is there now theoretical spectrogram as I have mentioned it is a curve this is the curve. This is the curve this is the function of the this is the lamda which is wavelength and this is the equation the which shows the n is the number of fibres in the cross section. L is the fibre length and lamda is the wavelength.

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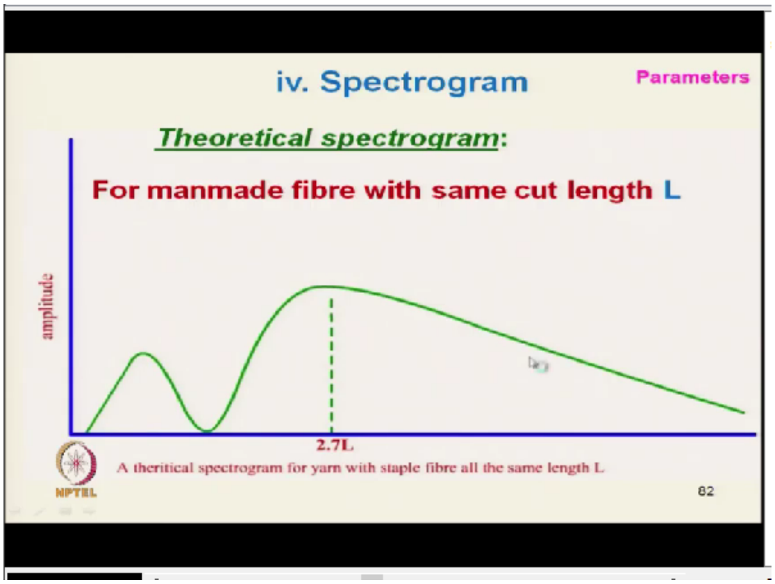

So, if we plot this will get this type of curve this is the if we simply plot this equation this is the type of curve and for manmade fibre where the length number of fibres and length of the fibres are fixed for constant length l0 fibre length will get this type of one. And this is the 2.5l which is actually shows the position of the drafting wavelength ok. But for cotton where the variability is there variability in the fibre length is there.

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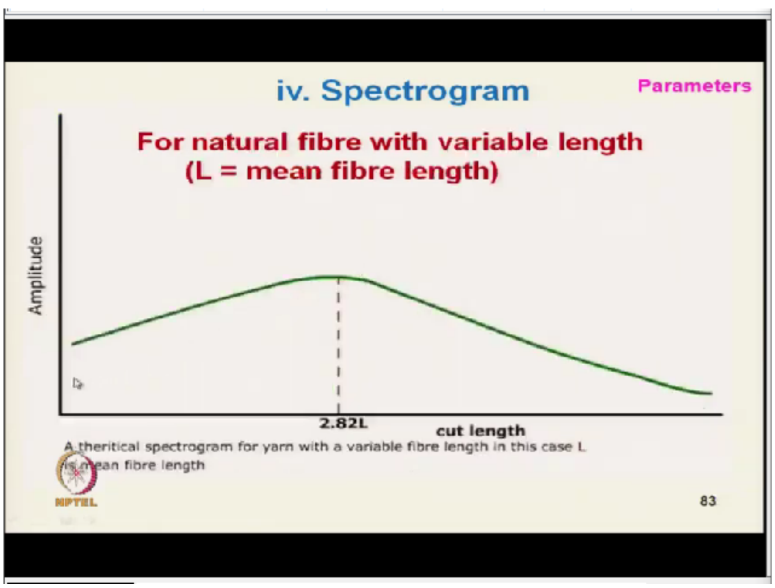

The typical curve is like this, this is for natural fibre like cotton we have this type of length. And here this is if at this point we get the this is due to the variation of that periodic variation of the drafting wave. So, 2.5 to 3 ok 2.82 length this is the at where automatically it will give the highest hump ok.

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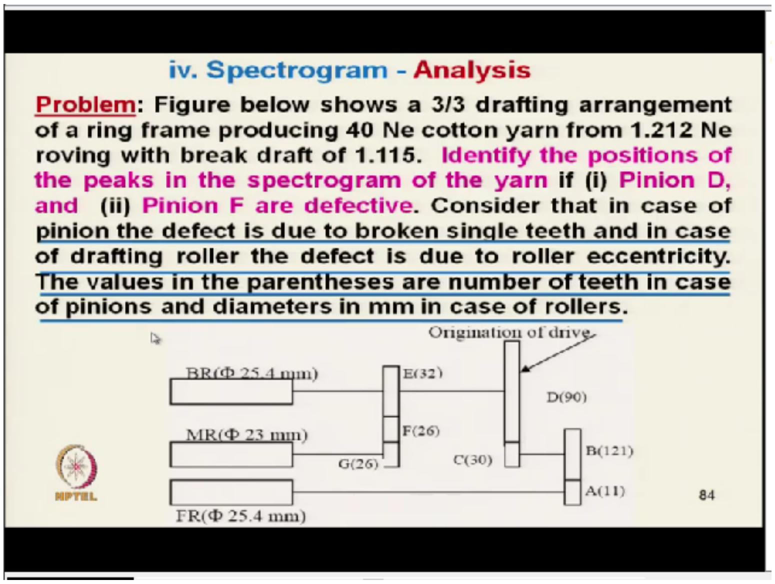

Now we will try to see few practical problems and what is the implication of how to use the spectrogram? What is the use of spectrogram? Now figure here it shows 3 over 3 drafting system and it is producing 40 Ne cotton yarn from 1.211Ne roving with the break draft of 1.115. So, break draft here between back roller and middle roller 1.115 break draft identify the position of peak in the spectrogram.

So, what will be the position of the spectrogram if the pinion D which is actually driver. It has got one broken teeth pinion D and pinion F are defective here actually consider the case, in the case of pinion the defect is due to single teeth broken ok. And in case of drafting roller it is defected due to the eccentricity of the drafting roller. The values in the parentheses this are either diameter or number of teeth ok. Now we have to calculate now try to see.

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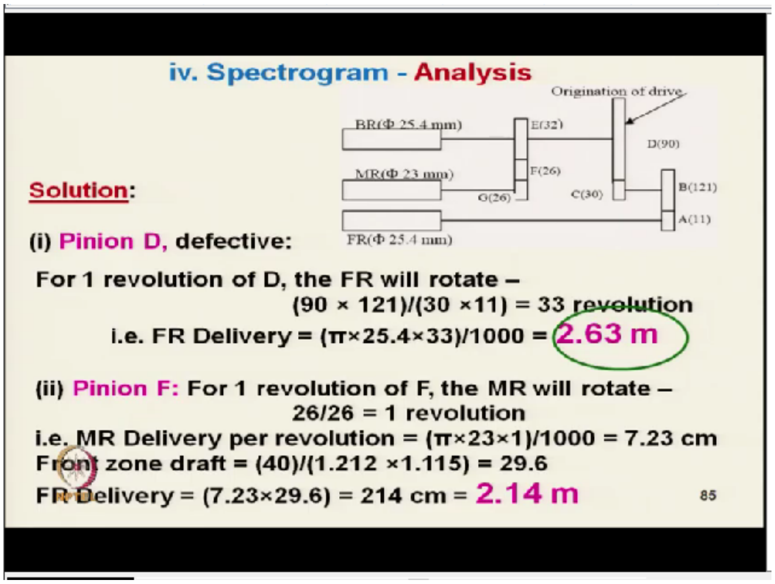

This is the situation now first condition is that the pinion D is defective. So, this is the pinion D now let us see the pinion D is rotating it is driven. So, once and it is got one defect when one teeth actually broken, here as it is driver, so this will give drive to the back roller and middle roller. But this teeth will not affect broken teeth will not affect the motion of the back roller and middle roller. Because they are rotating ok they are basically it is getting drive.

It is getting drive from somewhere else but the roller which will get affected which will get jerky motion is that it is a C roller. The roller C which is actually driven by D, so that means one rotation of roller D will give one jerky motion of C. And C and then it will get the jerk will get transmitted to roller B and then roller A and from roller A only to front roller. So, that after certain interval the front roller will rotate **sit** little bit in will give some jerky motion.

But once the defective teeth is coming then only it will get jerky motion otherwise there will not be any such it will be smooth rotation. So, what we have to calculate for one rotation of this roller D what is the delivery by the front roller? And that will be the effective wavelength, so for one revolution of D, the front roller will rotate 90 is the this is the teeth number of teeth. And by 121 90 by 121 this is the driven driver all the drivers are 90.

And 121 the driver and driven is 30 and 11. So, this is the 33 revolution will be there, for one revolution of D the front roller will rotate 33 revolution and the front roller delivery will be the if we know the diameter, diameter is 25.4 millimeter. It is 2.63 meter, so we will see if it the roller the D is defective the pinion D is defective then it will create it will generate one periodic fault in the spectrogram will show up one actually defect at 2.3 meter that we can calculate this is.

And if the roller F there is any defect in F then one revolution of F the middle roller will rotate by one revolution again. Because it is a 26 and 26 F and G are same if, so the middle roller will rotate by one revolution and then it is it will generate one defect of the value which is equal to the wavelength will be equal to the circumference of the middle roller. So, that at the middle roller stage it will create one defect, which is actually the periodic defect which with the periodicity that wavelength will be pie.

And the circumference of the multiplied by 23 in terms of millimeter now once it is generated here at the middle roller. Then at this is the break draft zone and the main draft zone after generating this will get stressed because it will get drafted. And that draft will stress the wavelength and will get final wavelength. So, middle roller revolution is that middle roller delivery per revolution, so this is pie D that means it is a circumference is 7.23, for one revolution it is a giving this much material to a 7.23 centimeter material.

And it is basically in front draft is we can calculate the front draft if we know the we have the data this is the yarn count and sliver count is known this is and the back zone drafting is known. So, we can calculate this is eh front zone draft, so 29.6 is the front zone draft and if we multiply because it will be stressed by 29.6 times. So, if we multiply the 7.23*29.6, so it is coming out to be 2.14 meter.

So, if there is any problem in front zone, so if roller F it will create one periodic fault of that wavelength 2.14 meter. So, in this way we can calculate if we can go in the backward also if we know the from the spectrogram if we know this the wavelength of the periodic fault. Then what we can do we can go stepwise backward and accordingly we identify the faulty roller ok. Our next problem is like this we know the defect length of defect periodicity of the defect. And we will try to identify the defective portion ok.

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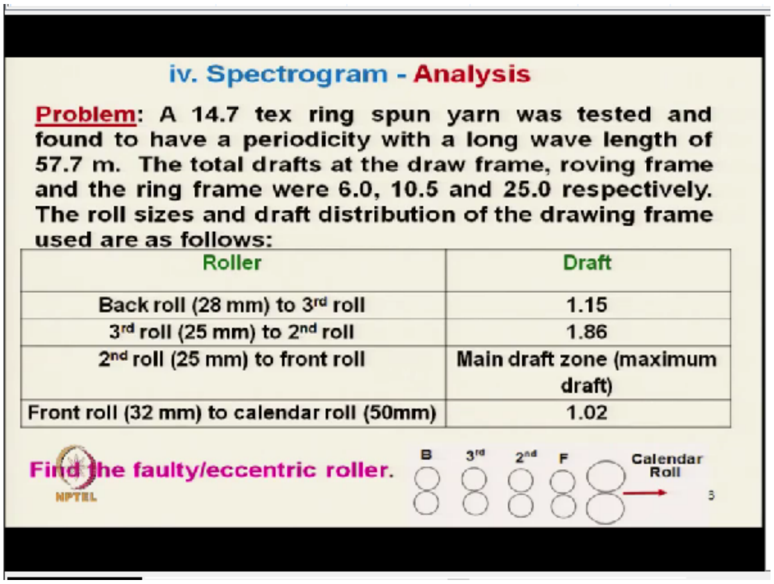

And here this is the situation in this numerical what it is given? It is a yarn is given yarn is tested or yarn of 14.7 tex ring spun yarn was tested. And found that we have the periodic fault of length 57.7 meter, so that in the spectrogram it shows that at 57.7 meter there is a hump ok chimney is formed. So, that identify and it has been actually identified that it is a real fault real periodic fault and the system is that total draft in the draw frame, roving frame and ring frame.

So, the system is the draft draw frame, roving frame and ring frame it is known 6, 0.5 and 25, 25 draft is given in the ring frame respectively and the roller size and draft distribution in the draw frame are giving lines. So, it is a back roller, third roller and this it is actually four over four drafting system. So, back roller, third roller, second roller, front roller and after that calendar roller. Now the fault can occur at any point may be in ring frame may be in roving frame or may be in draw frame. So, first we have to identify the which machine is responsible ok we will go step by step.

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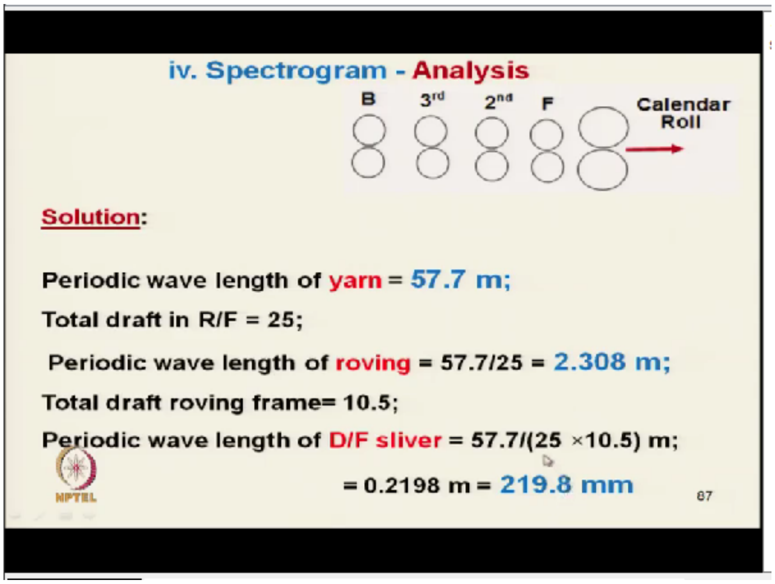

Now the periodic length is it is length of the yarn is the 57.7 meter that it is given and total draft in ring frame is 25. Now 57.7 meter length in ring frame it cannot occur because ring frame if we see the total draft and total circumference of the rollers it cannot match. Because if it is will be much in less than that in ring frame much less than that it will be below 1 meter sometime. But that we can always check and but few meter but it will not be definitely 57 meter ok.

Now then we have to take care of the we have to see the backward portion. So, in backward next portion next machine was that it is a roving frame. If the roving frame has got it is a problem then the what will be the in the what was the periodicity? In roving frame, in roving the periodicity was 57.7meter/25 because 25 times it is stressed. So, periodic wavelength of roving will be 2.308 meter that is also very long for roving.

Because roving we keep draft only up to maximum 10 draft, so that it is a basically that has been we can always check with the roving frame the diameter of rollers and the distribution of the draft. And it is not there, so then we will go further backwards. So, when we have to see the draw frame now if we see the draw frame if we want to see the that means the output of the draw frame that is draw frames sliver.

We will have the periodicity of length will be the total draft in roving is 10.5. So, draw frames sliver we will have periodicity is 57/25 that is 308/10.5 it is coming out to be 0.2198 millimeter

0.2198 millimeter sorry meter means it is 219.8 millimeter. Now we have to actually match this wavelength, so this sliver, sliver has got wavelength of wave periodic wavelength 219 millimeter ok.

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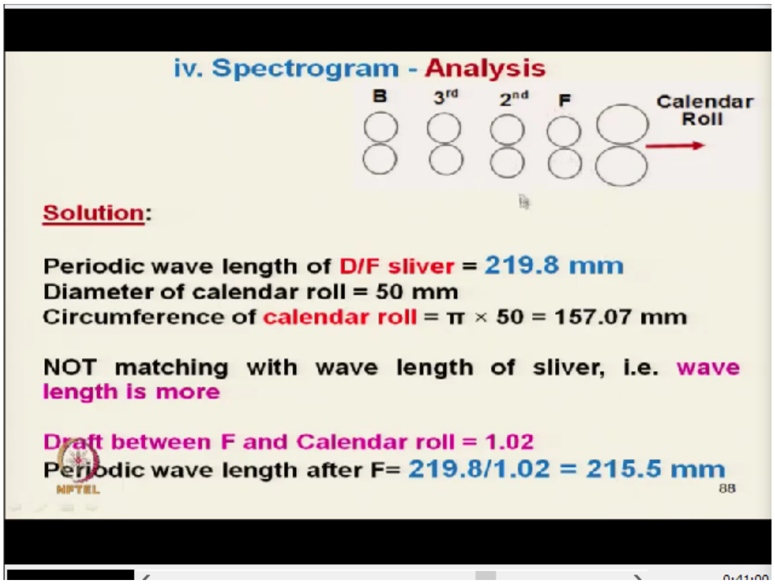

The periodic wave length of draw frame sliver is 219.8 millimeter and diameter of calendar roller as it is given it is a 50 millimeter. This calendar roller has got 50 millimeter suppose we assume the calendar is now defective. Now it has being now we are identified that the ring frame is not culprit the roving frame is not the culprit. The draw frame where it the periodicity has generated now we have to identify among all this rollers 1, 2, 3, 4, 5 sets of rollers which roller is problematic.

And if there is any problem in the calendar roller then the this distance now let us see assume that there is a problem in calendar roller, calendar roller is eccentric or it is moving erratically. In that case the diameter of calendar is given and it is circumference will be pie50 it will be 157.06 millimeter. So, that means the wavelength is more than this circumference that means the calendar roller is not generating the defect ok.

So, not matching with the wavelength of the sliver ok the wavelength is more than that if once the wavelength is more than the particular portion particular location. Then we have to that technique is we have to go back, so now let us go the next backward component which is the front roller if draft between now draft between front roller and calendar roller that is given it is a 1.01 it is the draft between that.

So, this wavelength we now divide by 1.02 to get the wavelength generated by the front roller the material which is coming out from front roller will have wavelength of 215.5 millimeter. So, periodicity periodic wavelength after F will be 215.5 millimeter. So, now again will now check whether the front roller there is any problem or not.

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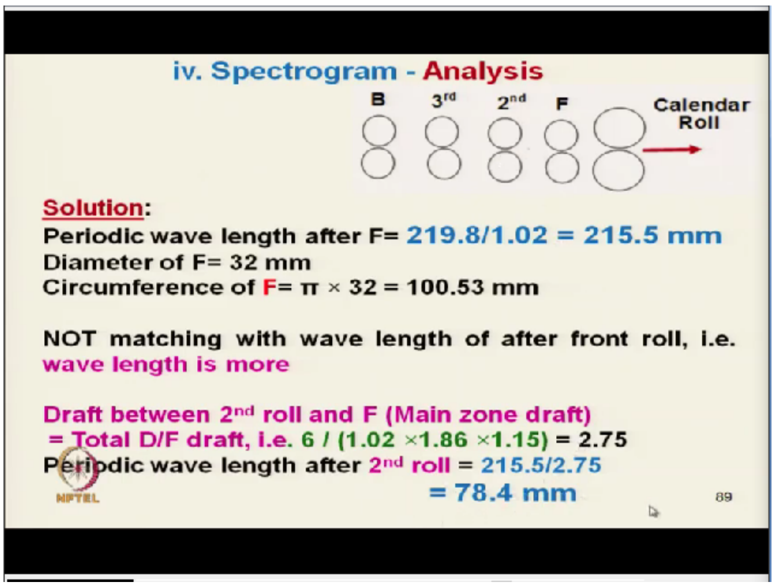

So, wavelength of the after front roller is 215 millimeter and diameter of front roller is given it is a 32 millimeter diameter is given. And then circumference of front roller we can calculates 100.53 ok still the wavelength is more than the circumference of that front roller F. So, that means front roller is not actually generating the fault, so not matching with the wavelength after front roller that is wavelength is more.

Then what we have to do we have to go back to the next roller which is second roller. So, draft between second roller and front roller which is main zone draft that we can calculate by knowing other thing other draft. So, 6 is the total draft in the system and back zone draft, middle zone draft and then the calendar zone draft if we divide. Then we will get 2.75, so 2.75 is the draft between second roller and front roller which is front zone draft that we have calculated 1.02 is the draft which is given in the table.

Here 1.86 draft is given here and 1.15 draft is given in the front. This was not given but total draft was given as 6, so we have to calculated this draft as 2.75 draft. Now we can just divide this 215.5/**27** 2.75 which is actually the which will give the periodicity of wavelength after second roller. After second roller the periodicity will be 78.4 millimeter the periodicity of **sec** after the second roller it is a 78.4 millimeter.

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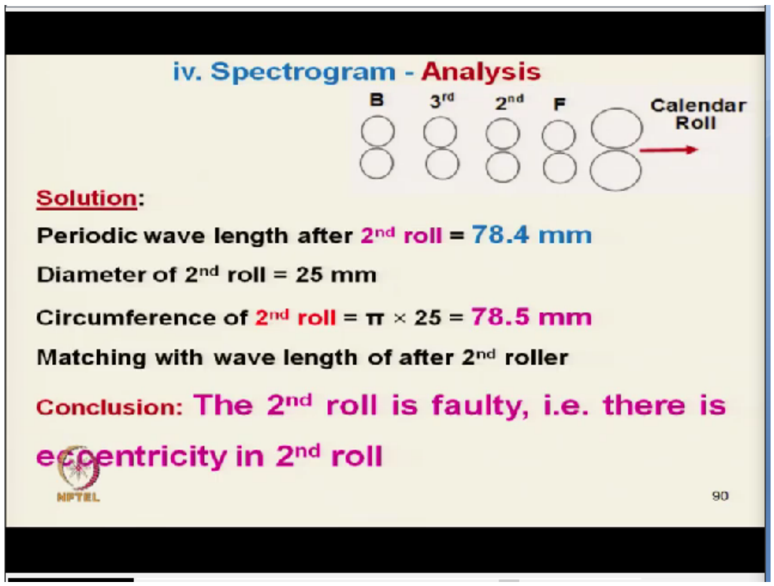

And if we see the circumference of second roller with the diameter of 25 millimeter it comes exactly same as 78.5 millimeter. It is matching with this value that means the fault is generated by the second bottom roller. This roller is defective ok matching with the wavelength after second roller and conclusion is that second roller is faulty that is there is eccentricity in second roller.

Now in industry what they do they have they create charts of different roller different gear. And accordingly what will be if the yarn is there. Yarn spectrogram shows particular defect say at defects 57.7 meter this particular will be responsible. So, they have the total chart and immediate they do not need to calculate in this way. But once they have to calculate and but the new modern machinery manufacturer they show they have the total data.

They show they give all the data that the for a particular defective machine component machine component what will be the effective wavelength of periodicity that one can immediately locate ok. Now we must know this system then we can actually solve the problem. Because in industry we impart different types of drafts, so for different draft we know the basics of how to analyze the spectrogram ok. Now we will discuss another important which is called variance length curve ok.

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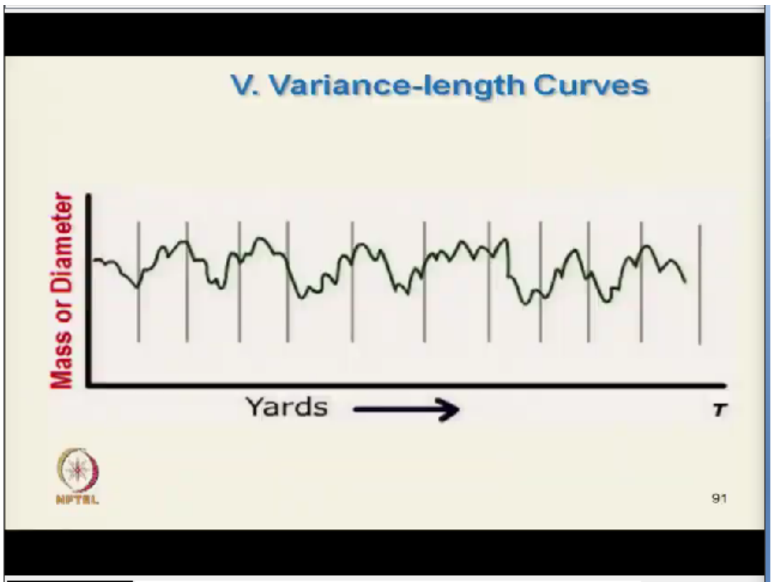

Variance length is it is very important it has got 2 types of variance length curves.

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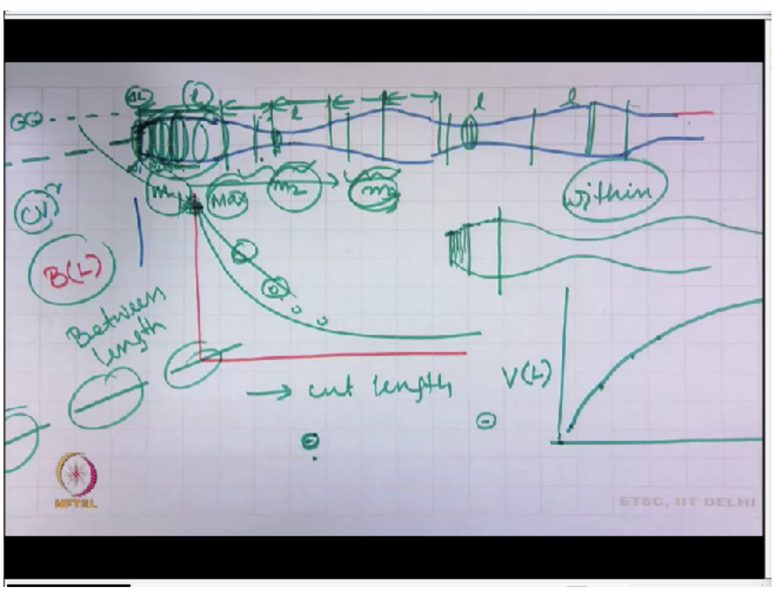

Now this is our yarn ok with the certain variation. Now it has got 2 types of curves one is called between length between length variation. Now between length means the yarn is there as we have seen in capacitance type tester we have the data of in each and individual point ok. Now if we cut the length suppose we are cutting the length of certain this is the length we can cut this length this is l or we can reduce the length.

Now if we say start with the least length ideally we see it is a zero length or very small length. Here cutting the yarn with the very small length this is the cut length. Now if we test if we take the mass, so imagine we are taking a mass of say very very say delta l length very small length. So, it will give a mass of w1, w2, w3, w4, so it will take care of mass why variation of mass. So, here it is a w something, so lowest mass to maximum mass because here our cut length.

So, the **the** material say this yarn is there this yarn we are cutting with the very very small length say in a micro level cutting that length. And we have taking the mass physically we have taking the mass, in that case if we see the variation we which what will get the CV% and square of CV % if we measure. It is a variance, variance if we measure it will be maximum with the this is the cut length at smallest cut length the variance will be maximum.

Now suppose what we do we increase the cut length we are increasing the cut length this is the cut length again we are taking another cut length another same cut length. We are cutting and owing mass taking the mass if we once we increase the cut length what will happen? This internal variation in the mass/unit length we will get average doubt. We will get a value m1, here we will get value m2, here we will get value m3 like this.

This m1 takes care of all this variation it is a average of and then if we take the CV% and the variance we will get certain variance which will be much less than this variance. And if we increase the cut length further we will get the lower and lower value of variance. So, that means if our cut length is small then we are actually and then we are measuring the CV% between this length between the this masses that is why it is called the CV between length or variance between length.

And which reduces logarithmically with the increase in cut length. Here x-axis is cut length now considering another situation this is called between length means between small length. This is one was this length which was giving highest value **o** another was this cut length longer cut length. It was giving this value another was between this cut length mass longer. This was giving this values.

So you take mass and then calculate CV calculate variance you are getting this value take mass calculate CV calculate variance and plot this. So, if we keep on increasing the cut length will get the lower and lower variance value, another type of curve which is known as within, within variation. Within variation means see what we are doing? We are taking the cut length of very small length very very small length.

Now imagine if we are taking very small cut length, in that case the variation will not be there. If we are taking very small piece of yarn and imagine we are trying to measure the variation within that if I have very small yarn and I do not have anything I am not comparing with anything I am only measuring this portion variation of this portion only by some imaginary mean. I am measuring the variance of this portion rest yarns are not there.

So, variance within that yarn if the cut length is very small the variance will be almost 0. There is no imaginary if the cut length is 0 the variance would not be there. If we increase the cut length little bit variance will get little high because what we are talking? We are talking the variance within that length suppose we are we have taken cut length of up to this point. So, it is taking care of by variance of within this this this this this this up to this point to this point variance.

So, the variance will increase little bit if we take cut length of this it will take variance from this point to this point also the variance will increase. This is called V(L) curve, so variance within length ok.

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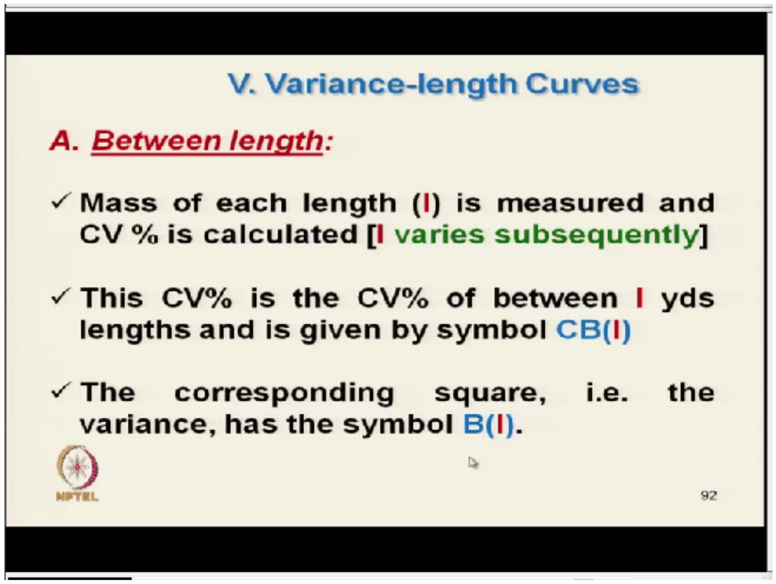

So, variance between length mass of each length l is measured and CV is calculated ok l varies subsequently. And then the CV is the CV between the l length and giving the CB(l) and if we take the square of that variance it is a B(l) curve ok.

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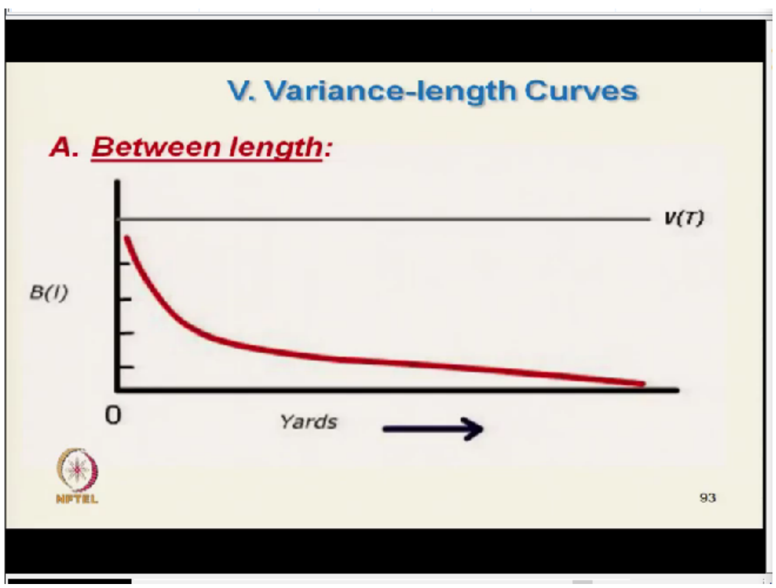

The nature is the logarithmic nature it is the that this is the nature ok. Now the next curve is that it is a within as I have already mentioned, with the increase in cut length the within length variation will increase. And the nature of curve is again curve this is the curve.

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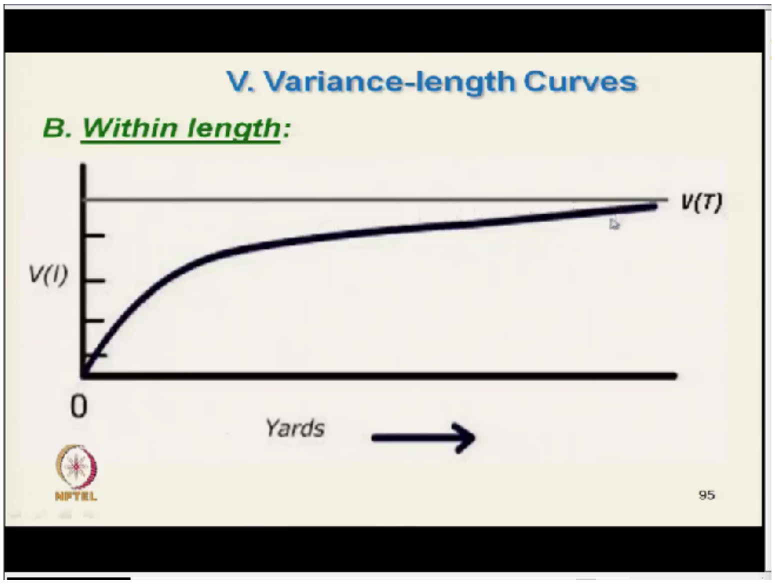

Now the total variation total variance is the summation of B(L) and V(L).

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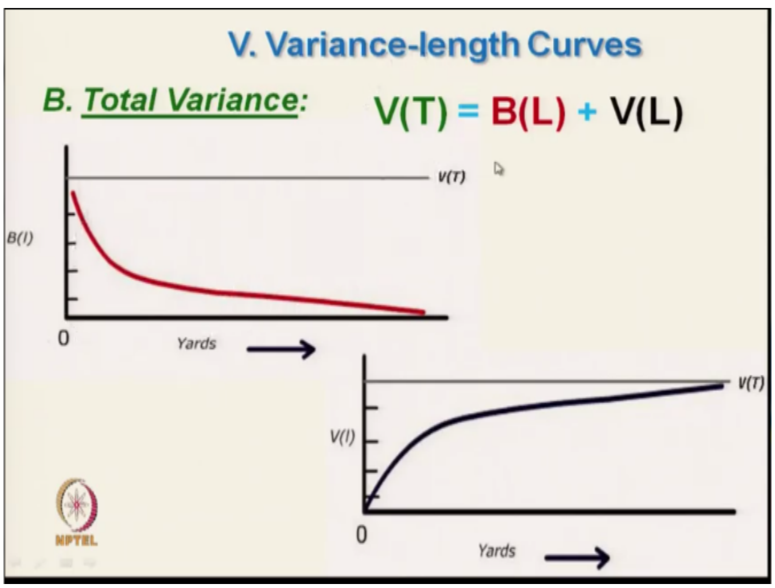

It is a just it is opposite, so if we one to take the variance total variance it is the summation of B(L) and V(L). So, in this B(L) or V(L) it give it shows a nature of the variation. And also from B(L) curve we can get the idea about periodic variation at which portion suddenly there is a increase suppose the curve in this B(L) curve in this portion there is certain increase in variance ideally this curve should be like this ok logarithmic curve.

Suppose it is not that smooth suddenly we have found there is certain increase in variance here at this zone that means that is the zone where periodicity is occurring. And it is it gives higher values of that evenness ok unevenness CV%. And this also in if we do not have the spectrogram the variance length curve also give idea about the periodicity the where the periodic faults are occurring ok.

And based on this we will try to solve a numerical which is simple by but we will try to solve but that we will do in the next class ok thank you.