Evaluation of Textile Materials
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Lecture-32
Evaluation of Yarn Evenness (contd…)

Hello everyone, so we will continue the topic evenness and what we have discussed last class in that the limit irregularity of different types of fibres ok.

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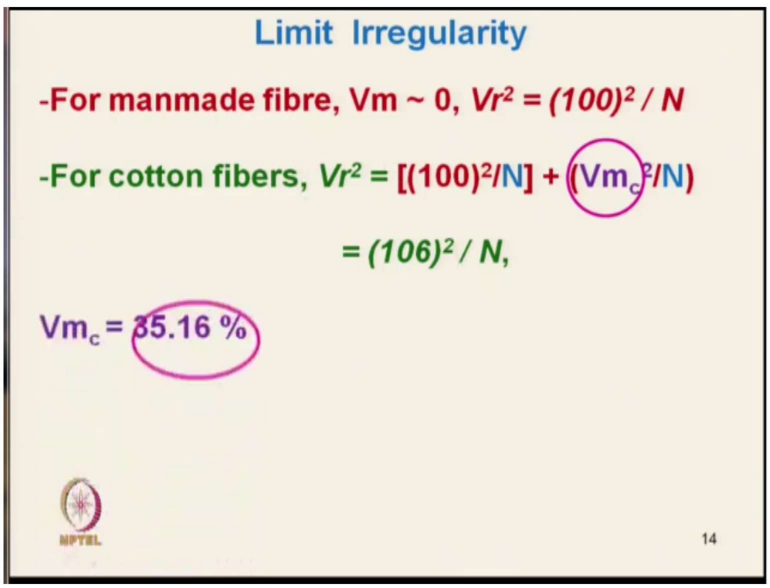

Now we have seen that for manmade fibres where the variability of fibre mass/unit length is 0 in that case the limit irregularity is of the form of 100 square/N ok and for cotton this is 106 square/N that is variance.

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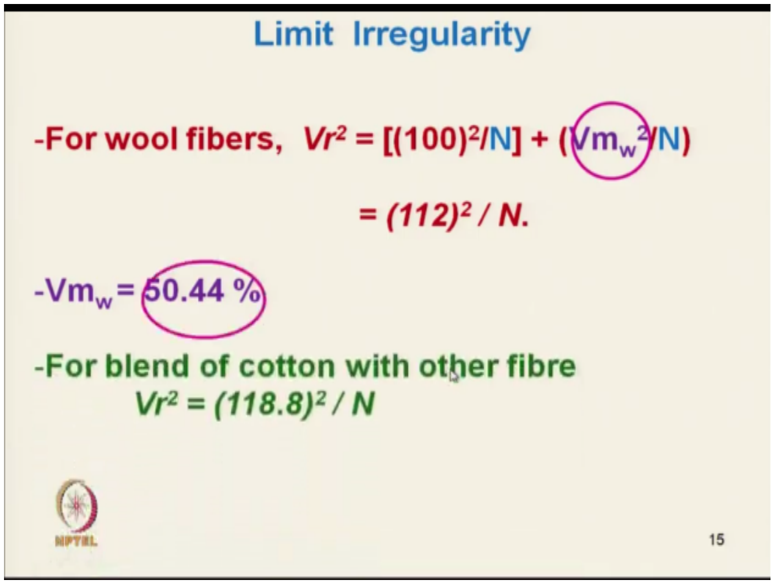

And for wool we have seen it is a typically 112 square/N and that this 112 we can achieve we can arrive at by 2 ways if we know the mass variation of wool which is typically around 50% then we achieve 112% and also if we consider the diameter variation.

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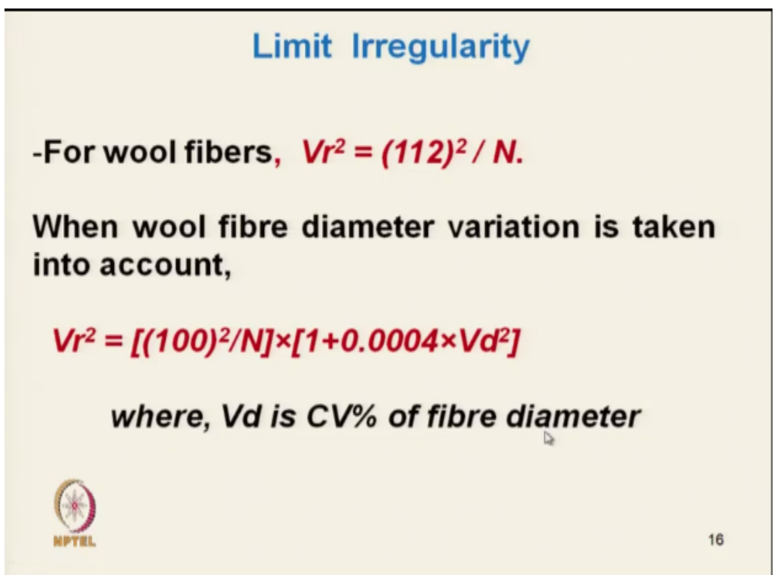

Diameter variation this is coming out to be around 25% for diameter variation we have to use this equation as we have seen which is 100 square/ N*1+0.0004*Vd square. So, this is actually empirical equation from there we can achieve the irregularity.

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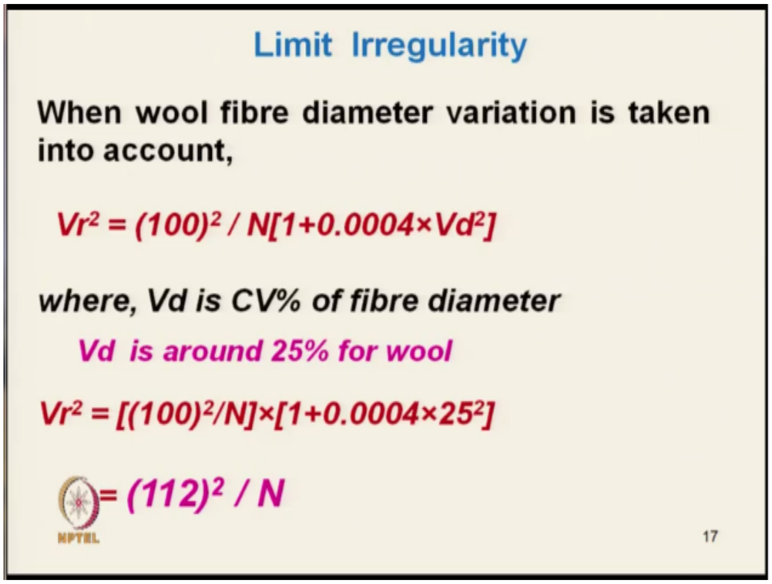

Limit irregularity of wool fibre which is around say 112 square/n where considering the diameter variation of wool as 25% ok.

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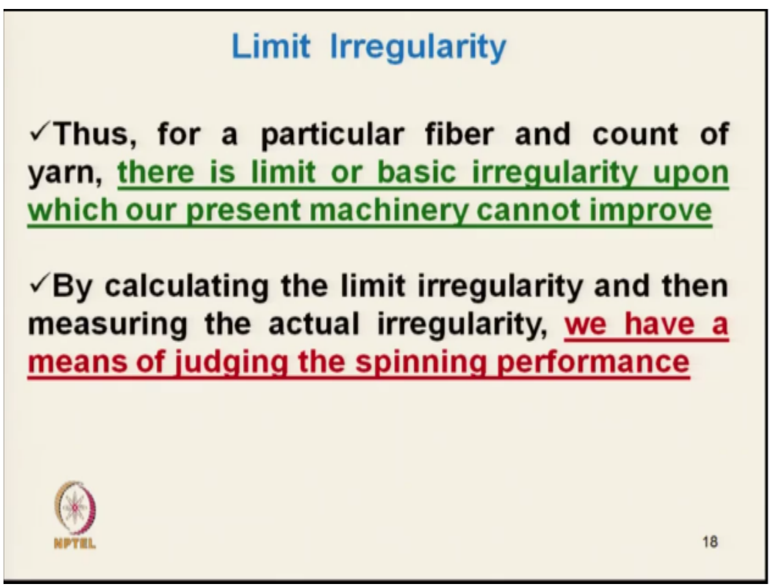

Now for thus for a particular fibre and count of yarn there is a basic irregularity, so often which beyond which we our machine cannot be improved. So, the machine there must be some irregularity some actually when the machine is running. So in textile process the staple fibre production process where the control of fibres are totally negative control.

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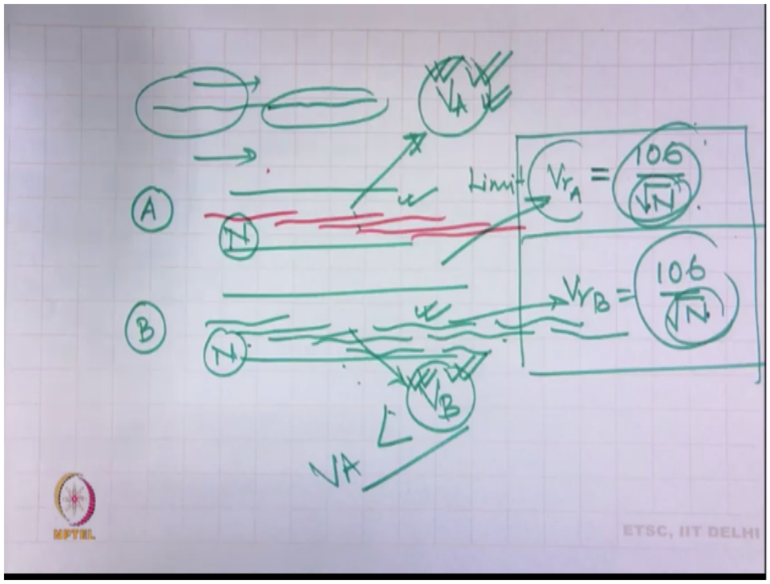

We cannot grip a fibre and lay just after another fibre it is not possible, this fibre move by either by air or by roller contact or by frictional contact. So, that due to this inherent limitations of the technology we cannot produce perfectly even material. So, for staple yarn, so that the minimum irregularity that is produced that is called limit irregularity and now suppose this machine A is producing is actually handling a fibre this fibre it is handling.

It is aligning the fibres in this fashion, now machine B is aligning fibre same fibre at definitely it will align at different zone, definitely it will not be exactly same. Now if we want to judge the performance of machine A or machine B, in that case what we know the limit irregularity, Vr machine A yeah this they are producing yarn of same linear density exactly same linear to say.

So, mean number of fibres will be N exactly for both the so limit irregularity is actually not the part of the machine. It is a it does not show the performance of machine it is a theoretical value which are waste possible machine can produce and that is the by say for cotton. If it is cotton 106/under root N and for this machine also machine B VrB will be exactly same as under root N.

So, this limit irregularity is not the performance of it does not show the performance of machine. Now to show to know the performance of machine we need something else, suppose this machine with the limit irregularity of VrA is 106/ machine A is getting is producing a yarn of say

VA, VA is the actual CV% of yarn. And this machine is producing VB now if all other parameter same this parameters are same exactly same.

So, number of fibres in the cross-section the count, the same fibre everything is remain same. In that case it is very easy to compare we can compare directly by using this value, if VA is less. So, VA is less than VB in that case we can say that machine B is performing poorly but this type of simplified situation is not there will not be there in most of the senses, in those cases what will be happen.

In those case the either number of fibres will be different or type of fibre will be different everything will change ok. So, that cannot be exactly same we can have different types of fibre, so different variety of fibre, cotton of different variety different lot or different count this will be there different number of fibres in the cross-section. So, in that case comparing this value of CV % produced by the machine will not help.

So, we need to have 1 parameter which will give the actual running performance of the machine. So, we have to have means of judging the spinning performance ok, so that in that way the if we take the ratio of actual irregularity and compare with the limit irregularity. In that case we can get on factor, that factor is known as index of irregularity.

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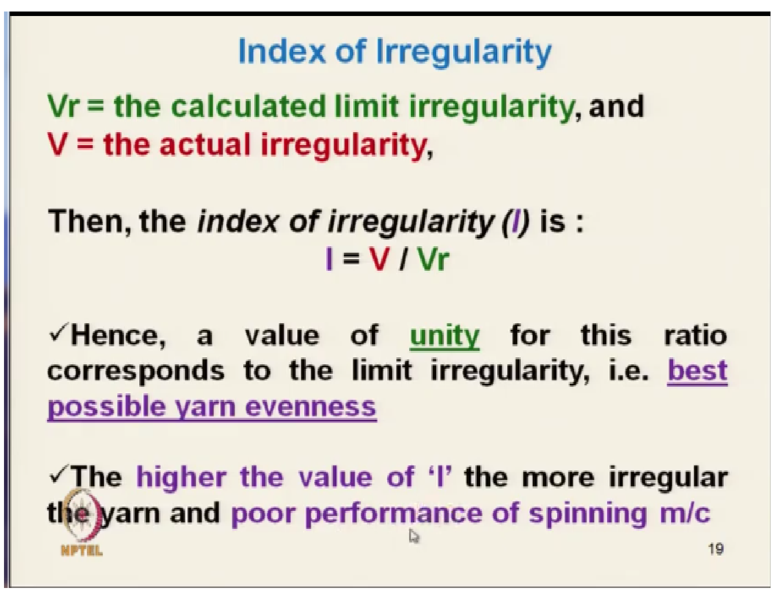

So, this is the index of irregularity which is nothing but the ratio of actual irregularity V of the yarn or fibre sylver or roving divided by the limit irregularity. So, the index of irregularity I is expressed as V/Vr ok and definitely Vr will be always less than V actual CV that means the index of irregularity will always be high. So, in which situation the index of irregularity is unit when V is equal to Vr that means the yarn the machine is running perfectly, totally, ideally it is running.

In that case only V will be=Vr that means machine is producing the minimum possible variability. That means index of irregularity 1 it is a minimum value and that is the best performing machine and in normal case it is always higher than 1. So, depending on the value irrespective of the type of fibre or linear density of yarn, number of fibres in the cross-section if we compare the I then we can get the value .

We can actually come to know the actual performance of the spinning machine ok. So, hence a value of unity for this ratio correspond to the limit irregularity the best possible yarn evenness ok. Yarn not only yarn maybe slyer or roving the higher the value of I the more irregular the **yarn** yarn will be or sliver or roving and poor performance of the spinning machine.

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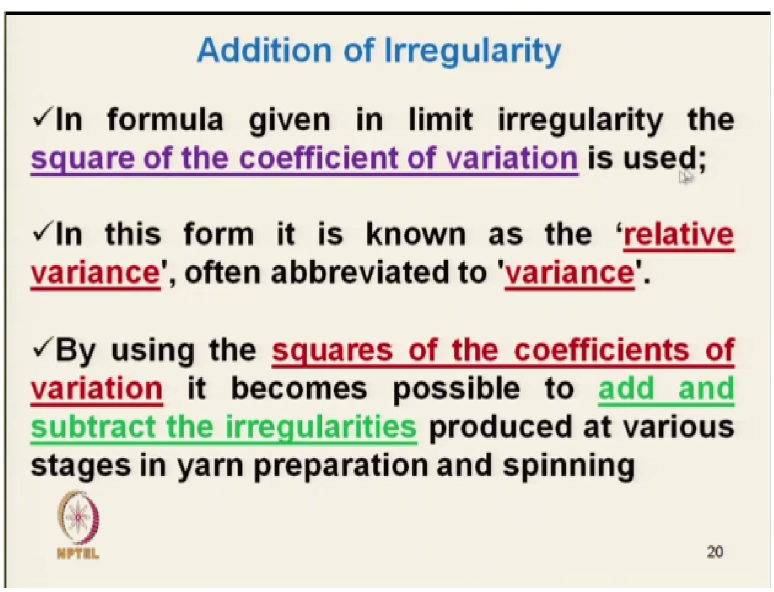

After this now we will discuss that addition and reduction of irregularity, now here in the formula given in the limit irregularity is the square of CV% that is the it is the. In this form it is known as the relative variance or it is a normal we can say it is a variance ok, variance is nothing but the CV% of square of the CV%.

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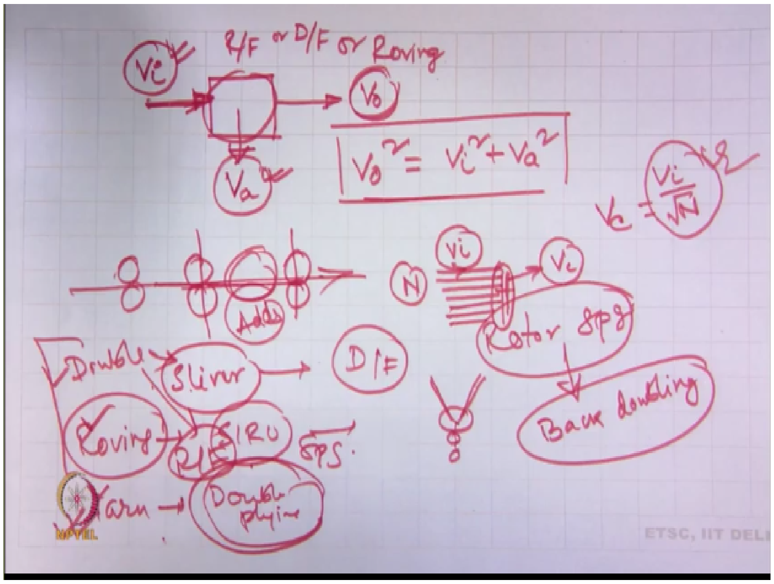

Suppose this is 1 machine it is maybe ring frame or draw frame or roving frame what we were doing we are feeding 1 material. This is the material here with the CV% is of say V input and here the after processing. Processing means it is actually maybe drafting maybe anything twisting after processing the output material it is a V output. This is the CV% of output material and CV% of input material and in this process this machine adds a CV of Va, Va is added.

And that means it is enhanced, so this Vo is more than Vi, so by addition of variance we can have the equation Vo square=Vi square+Va square. So, in this way the CV% gets added up that means this is called addition of irregularity. So, for any process spinning process we must remember it always adds that means in the spinning process when it draw frame, ring frame or roving frame the things the material gets stressed, typically it get stressed.

During stretching process it adds the irregularity during stretching process here it adds irregularity. So, this any process roving frame, ring frame or draw frame during the stretching in the drafting ruler the it adds the irregularity. But in addition to that we can also reduce the irregularity, so reduction of irregularity is only by in the spinning process is only by doubling.

The doubling maybe in the form of sliver in the form of roving, in the form of yarn or in the form of fibre. Now in the form of sliver if we double number of sliver it is done in drafting ok, in the form of roving this is done in it is called SIRO spinning ok. SIRO spinning where number of roving the 2 roving strands are fed in a ring frame ok, so this is the roving and this is 1 roving and then it is getting drafted here.

So, here it is a doubling in the form of yarn it is doubled in the doubling or plying, in the plying stage yarn is doubled. And fibre doubling takes place in various processes 1 example is that it is in rotor spinning, in rotor spinning fibre gets doubled at the rotor group. This is called back doubling and the beauty rotor spinning process is that it gets drafted at initial stage. And back doubling takes place at latest stage at the end after back doubling no drafting takes place.

So, that means that is the 1 reason that is the main reason for higher evenness in rotor span yarn, so that back doubling takes place at the later stage. But if you see the draw frame or roving frame here draw frame or roving frame here the in ring frame roving frame is normally a single stage, ending frame SIRO spinning. And draw frame there first doubling takes place which reduces the irregularity and then the drafting takes place which adds the irregularity.

Similarly for yarn doubling it actually there is no drafting only the doubling takes place, so reduction in irregularity is there. So, the basic formula is that if the say there are n number of strands of input sliver of irregularity say input material of irregularity V input. And the combined input, combined slive, combined material is V say combined, so V combined that means CV% of combined material will be V input/under root N.

This is the way the CV% decreases, so by using the squares of the coefficient of variation becomes possible to add and subtract the irregularities which is produced at various stages in yarn formation ok.

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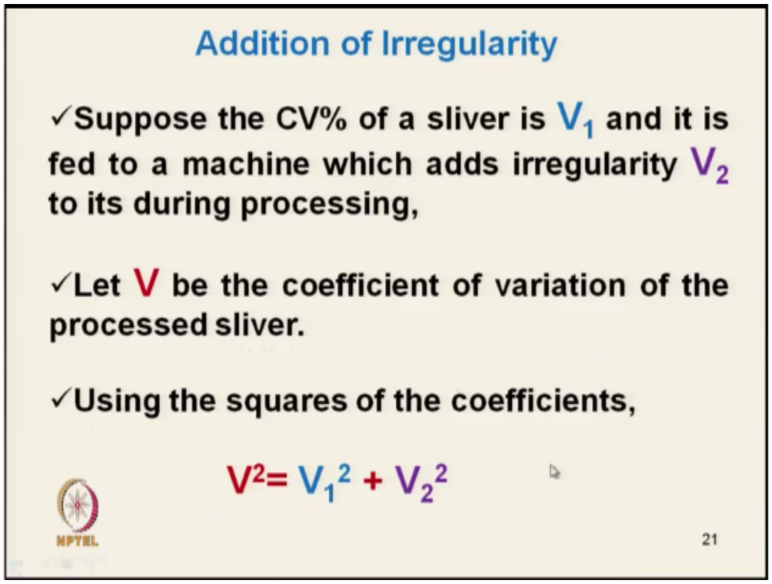

And as I have mentioned suppose a CV% of a sliver is V1 and it is fed to a machine which leads which adds irregularity V2 ok. So, **so** we can add this and V is the coefficient of variation of the output material say output sliver. So, then it will be the actually squares, so V square=V1 square+V2 square from there we can calculate ok.

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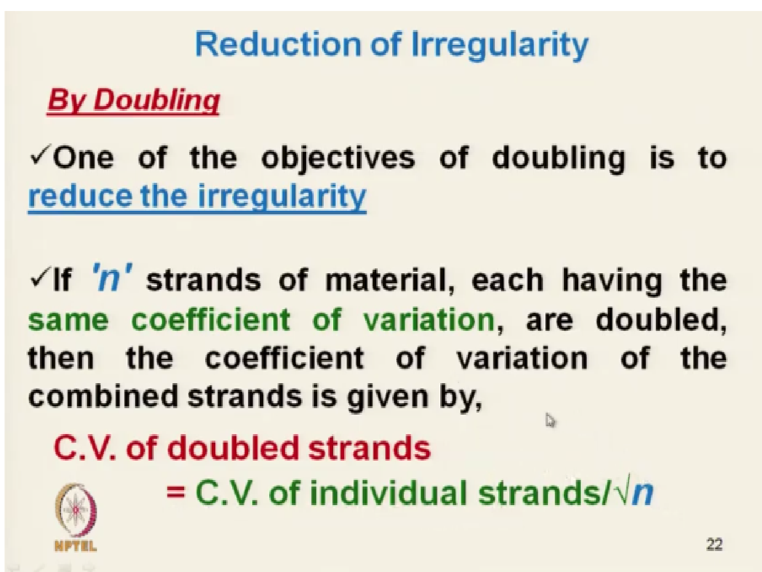

Similarly as I have mentioned reduction in irregularity can be achieved only by doubling. So, one of the objectives of doubling is to reduce the irregularity and if n strands of material each having same coefficient of variation are doubled. Then the coefficient of variation of combined strand it is not the output we must remember this is the CV% of the combined input material ok that is the CV of individual strand/under root n ok.

Now with this basic concepts, now we will start solving some of the practical problems ok.

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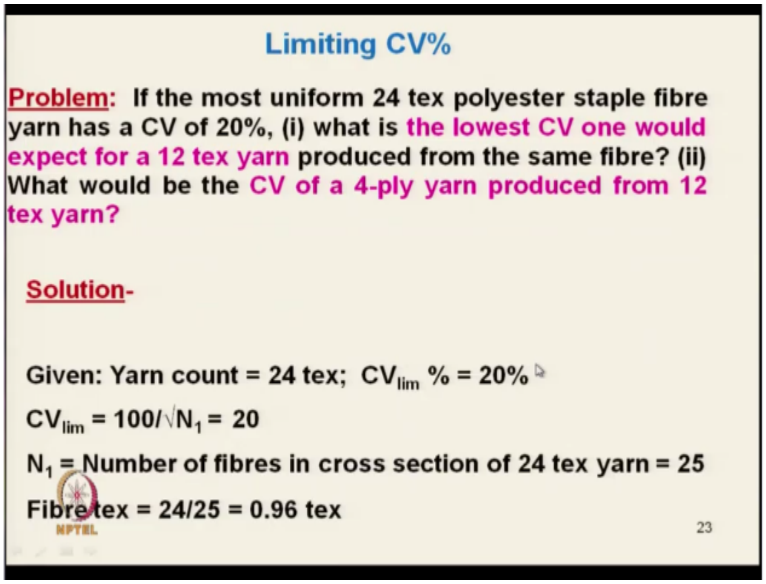

First problem let us see which is related to limiting CV, now if the most uniform 24 tex polyester staple fibre yarn as a CV% of 20. So, it has got 20 CV what is the lowest CV% 1 would expect for a 12 tex yarn produced from the same fibre ok. The same fibre it is there and limiting CV is asked, so actually what is the lowest CV% that is the limiting CV is asked.

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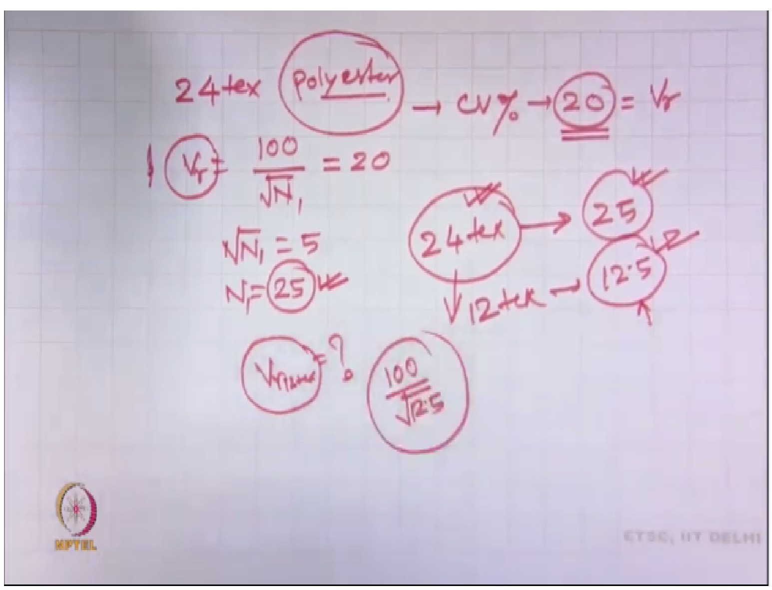

So, here the problem is very simple we get 24 tex polyester is given, so we do not have any other knowledge ok. So, we know that the this is the 24tex and it is producing CV of 20, so the lowest

CV, so this is and the fibre we do not know ok**.** So, that means index of limiting CV it is a **C** Vr limiting CV will be and as it is polyester fibre it will have so 100, 100 polyester is there.

Then by under root N, under root N is the now what is given here this CV value is given because it is **it is** given that it is a best possible yarn most uniform yarn. So, that means CV 20=it is a Vr, it is a limiting CV most when it is told that it is a most uniform yarn that means it is a limiting CV. So, that means it is a 20, 20 is given, so from there we can calculate under root N=5, so N=25, 25 is the N value.

So, N1 so number of fibre N1, so here it is given N1 say, N1 is the 25 ok, now so we know this for 24 tex the number of fibres in the cross-section is 25. Now the question is that what will be the limiting CV for yarn will with 12 tex, so Vr say 12 tex this is asked. So, for 24 tex number of fibre theoretically if it is 25. So, for 12 tex same fibre is used the theoretically the number of fibre will be 12.5 although number of fibre cannot be in fraction.

But for theoretically average mean number of fibres if we see it is 12.5, so if we know the number of fibre and if we know it is a polyester then we can calculate the limiting CV by using the formula 100/under root 12.5. So, this is the limiting CV for 12 tex yarn, so for and we can calculate the fibre tex also from there also we can calculate this is the number of fibre in the cross-section is 0.25 and then we can calculate the tex of the fibre for 24tex 25 fibres are there.

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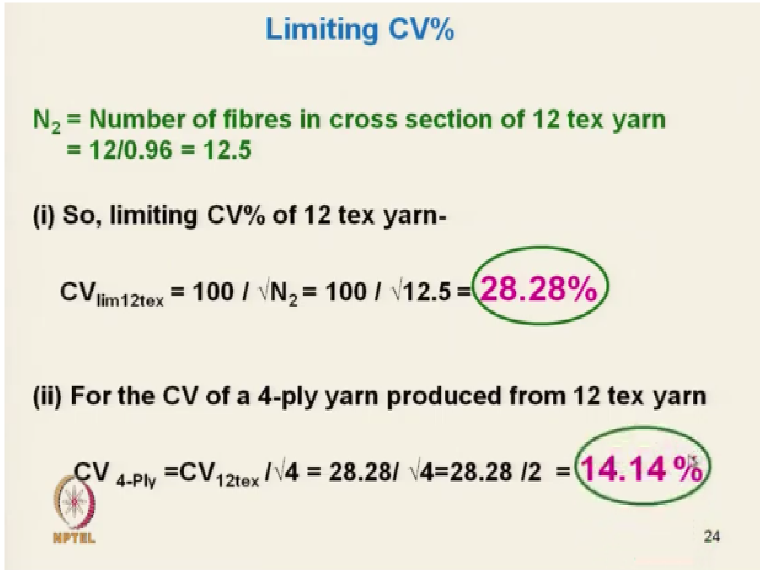

So, fibre tex is 0.96 and from there we can calculate also the number of fibre in the cross-section, so it is coming out to be 12.5. So, if we know the number of fibre in the cross-section then the limiting CV will be for 24 12.5 fibres will be 28.28%, what does it so. This problem shows that if we have less number of fibres, so if we draft more ok then we cannot control the fibre we cannot control the evenness, evenness has to go out it is a has to increase.

So, it if you are making ½ so that as it is from 20% to it has come out it is a 28.28% that is mainly due to the number of fibre in the cross-section. Now second part of this problem is that what would be the CV% of 4 ply yarn produced from 12 tex yarn, so 12 tex yarn is there. Now this is the limiting CV, so that minimum CV what would be the minimum CV produced by the this yarn.

So, now what will do we will use the reduction formula, reduction formula is that for 4 ply yarn produced from 12 tex fibre, 12 tex yarn will be it will be nothing but 28.28 under root 4 because it is 4 ply. So, this is come out to be 14.14, so this is the simple numerical but this from this numerical 1 can get clear idea, the how to use the limit irregularity ok, how to calculate the limit irregularity.

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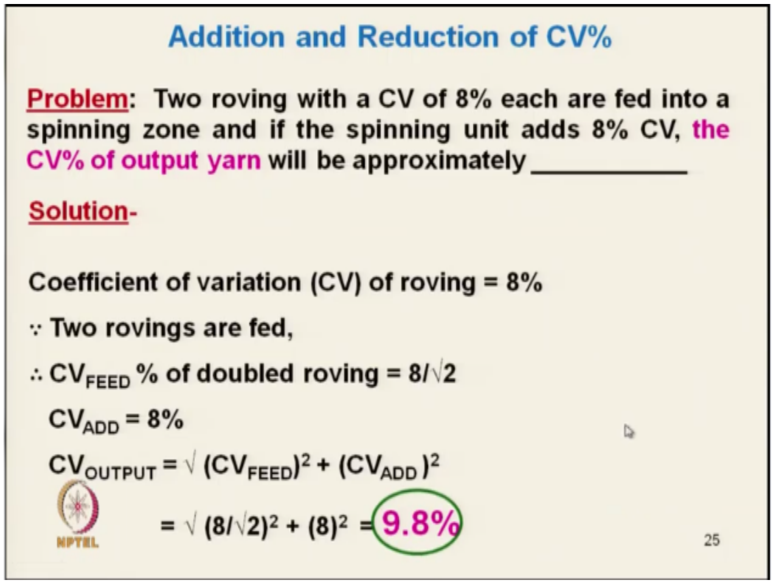

Our next numerical is that it is addition and reduction of CV% it is related to that 2 roving with CV% of 8% CV of fed into spinning zone that is hydro spinning. And if the spinning units adds additional 8% CV what will be the output yarn CV ok it is again simple because we have added 2 rovings of 8% CV. So, the addition formula will add, so 2 roving, so this will be reduction, so 2 rovings are doubled, so that means 8/under root 2.

And again we are adding 8%, so this here it is a reduction formula then addition formula will be CV feed square/CV add square under root ok. Because CV output, so it is a simple 8/under root 2 square+8 square, so it is coming out to be 9.8%. So, if we fed 2 rovings of 8% CV and then we add during drafting another 8%. So, effective CV of the yarn will be 9.8%, this example actually gives a simple example which shows the addition and reduction of irregularity.

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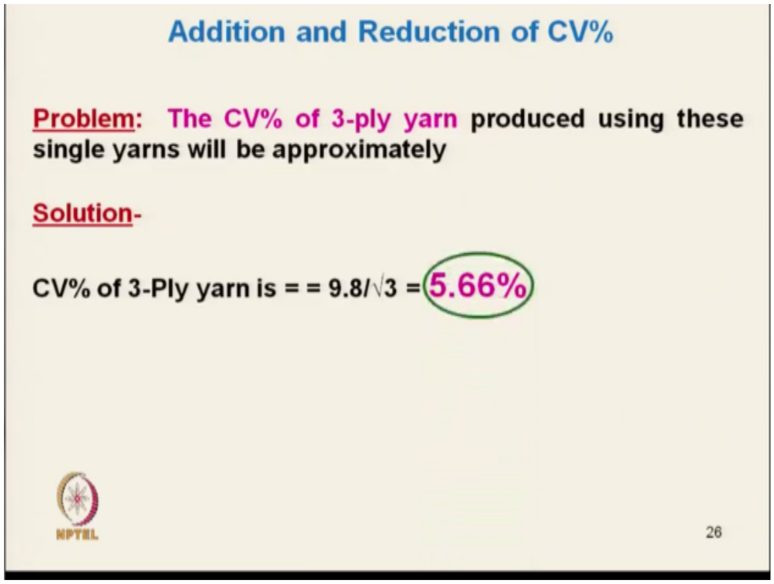

Next is that the same what we have got 9.8% CV of yarn, now in the next stage same yarn we are plying 3 times, 3-ply yarn produce using this single yarn will be approximately 9.8 under root 3. So, we can actually try different combinations but the concept is very simple straight forward concept it is coming out to be 5.66%.

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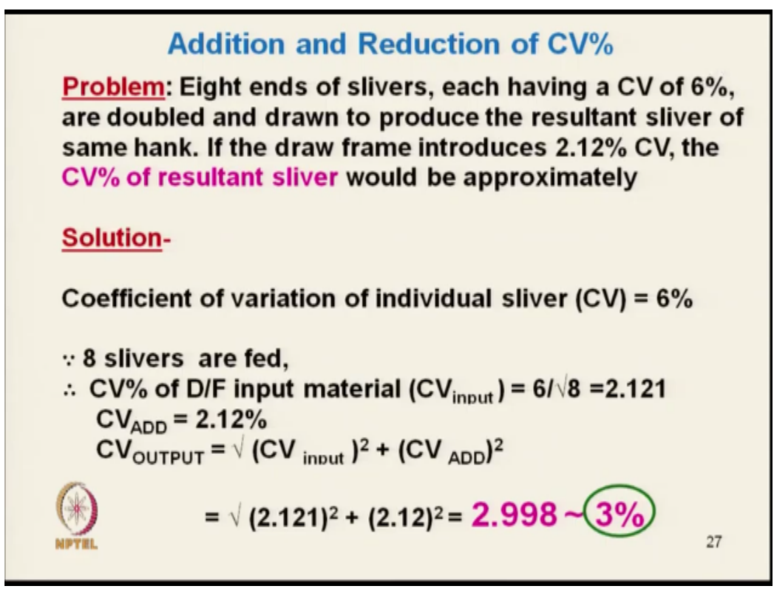

Next again it is a related to the addition and reduction of CV%, 8 ends of sliver each having CV % of 6% are doubled and draw frame add is actually it is and drawn to produce resultant sliver of same hank ok. So, it is a 6 it is actually 6, 8 slivers we are feding and typically we are giving 8 drafts, so theoretically. And during that it adds 2.12%, so if the draw frame produce introduce 2.12% CV, so during drafting it is actually introducing 2.12 CV.

The CV% of resultant sliver would be approximately like coefficient of variation of individual sliver, individual feed material then 8 slivers we are feding. So, it is coming out to be 2.121 this is the input material not the sliver, it 8 slivers together at the back of the draw frame just before the drafting ruler. So, after doubling it is coming out to be 1.121 this 1.121 thick material of 8 slivers are again drafted and drafting adds again 2.12 ok.

So, this it is adding 2.12 that means the formula input+CV addition and we are getting a CV of approximately 3%. So, output draw from sliver's CV is approximately 3% even after the addition of 2.12% it has actually almost ½ to that of individual draw frames like. So, this is the example where one can get clear idea how the CV% of slivers are reducing, the slivers are getting uniform.

We normally say draw frame actually makes the sliver uniformly but if people argue it also adds, so one can try to see whether actually it is a reducing or not. Now if we want to reduce it further in the same machine if it is adding 2.1, so only way is to increase the number of doubling ok. If we make it 10 it will be further reduce in that way, so here it shows draw from actually reduce the CV% of the material ok.

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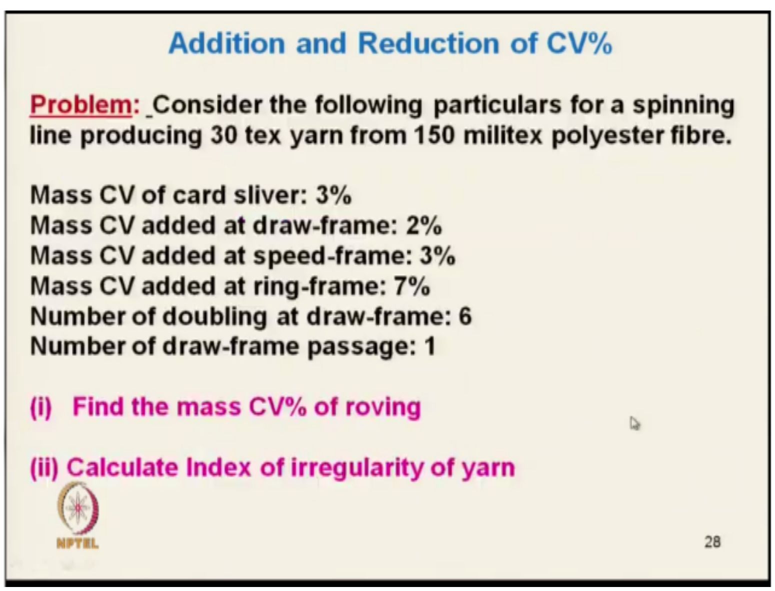

Now next problem here is again related to addition and reduction of CV, here just see consider the following particulars of a spinning line means it consist of roving, frame, card, draw-frame total spinning length, this is the process ok input line producing 30 tex yarn from 150 millitex polyester fibre. So, this is given and mass CV of card sliver, the card sliver if we take the CV% is coming out to be 3%, mass CV added at draw-frame 2%.

Mass CV added at speed-frame it is 3%, mass CV added at ring-frame it is 7%, number of doubling at draw-frame **6** 6 doubling and number of draw-frame passage is given 1. So, normally we give 2 draw-frame passages here in the specifically it is written it is a 1 passage. Now from this data we have to calculate the CV% of roving ad index of irregularity of yarn this is the actually our problem.

So, for calculating index of irregularity of yarn we have to calculate the CV% of yarn also, so ok. Now let us see how to wag out, so 30 tex of yarn from 150 millitex. So, from there what we can do we can calculate the number of fibres in the yarn cross-section.

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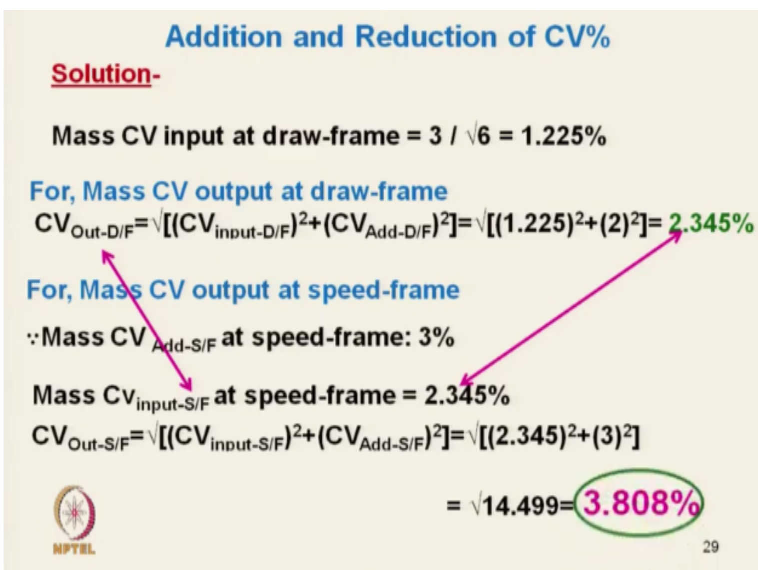

So, number of fibre in the yarn cross-section will be that will calculate so mass CV of input draw from material. So, what is the input, so 3% is the card-sliver, so this card-slivers, so such how many slivers will fed such a 6 slivers, 6 slivers of 3% card-slivers of 3% CV% we double at the draw-frame, so what will be the input material CV it will be 3/under root 6 it is coming out to be 1.225%, the mass V of input material at draw-frame ok.

And what will be the mass CV of output material we know how much draw-frame is adding, so what is the value here, value is draw-frame mass it is added it is 2% it is adding that means mass CV will be it is under root this 1.225 square+2 square, so under root 1.225 square+2 square it is coming out to be 2.345%. So, this is the mass CV of sliver draw-frame sliver, now then mass CV of roving at roving frame.

So, what is the mass CV of roving, so this is the draw-frame, so in roving in speed-frame we fed 1 sliver of 2.345 CV% and the CV% added in roving is it is 3% CV it is adding. So, this value will be the square of under root the square of 2.345+3 square, so 3% is added, so mass CV at speed frame ok is that is mass CV input of the speed-frame CV input of speed-frame is 2.345%. So, it if we add the square and take the under root it will come out to be the this is the CV output what is the CV output of draw-frame is equal to CV input of speed frame, so same value, now this value is 3.808%.

So, that means the after drafting from 2.345% it has come out to be 3.80 8 % that is added due to the addition at the rate at 3% ok.

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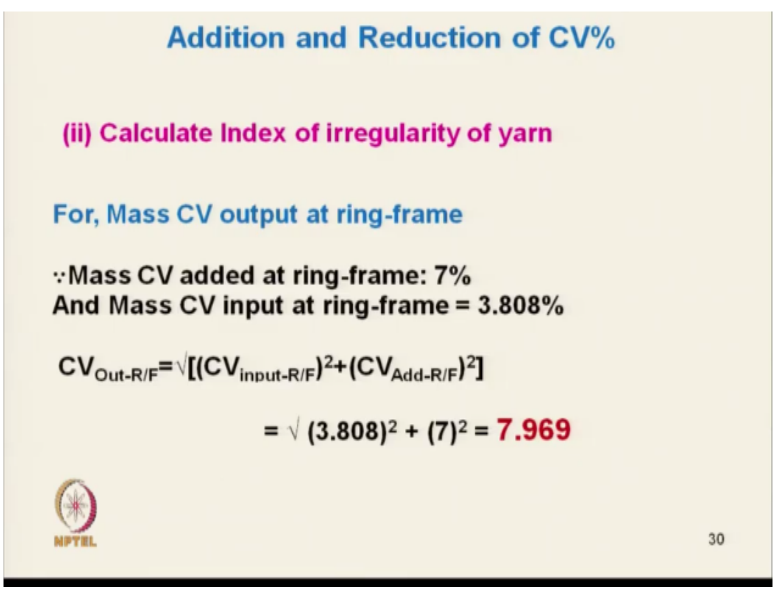

Next is that so what we have our problem our requirement of the mass CV of roving, so that is mass CV of roving is calculated, this is the mass CV of roving. Now index of irregularity we have to calculate index of irregularity of the yarn that mean ring-frame we have to calculate, so to calculate the index of irregularity of yarn mass CV output of ring frame what is the mass CV output of ring-frame.

We know the roving frame and we know the addition, so mass CV added at ring-frame is 7% we are adding and mass CV input of ring-frame that is the roving frame we have add roving mass CV was 3.808%. So, if we add these 2 the square of this 7% and square of 3.808%, so it is and take the under root it will be 7.969, so this is the mass CV actual CV of yarn, what we have produced.

Now to get the index of irregularity we must calculate the limit irregularity and to get to calculate limit irregularity we must know the number of fibers in yarn cross-section.

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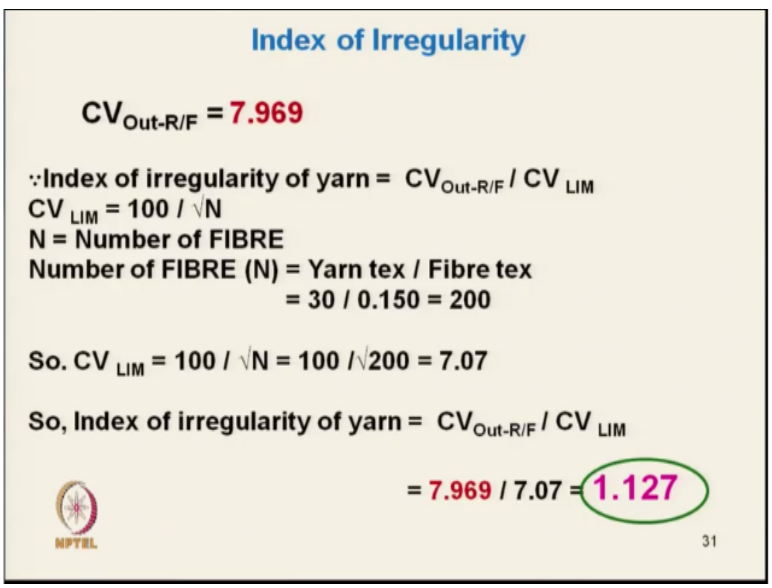

Now we know that CV this is the CV output of roving ring-frame that is yarn CV and index of irregularity is CV output of ring frame/limiting CV or at ring-frame at the yarn strength. So, what is the limiting CV, limiting CV is 100/under toot N because it is polyester fibre is given. If it is given the cotton because cotton we do not have to tell anything, we know the value 106 but and for wool it will be 112 but if we specify other fibres other than say then you have to specify this value ok.

This constant value you have to be it is a manmade fibre will take directly as 100, so the number of fibres we can calculate if we know the yarn tex. So, yarn tex is given here and fibre tex also is given, so yarn tex was 30 tex it was given and fibre millitex was given 150 millitex. So, it is coming out to be 0.150, so there will be 200 fibres in the yarn cross-section, so if you know the 200 fibres here we can calculate the CV limit.

So, what is CV limit is 100/under root 200 it is a 7.07 this is the CV limit and if we know the CV limit and we know the yarn CV actual CV. So, we can calculate the index of irregularity, so index of irregularity of yarn is CV output which is 7.969 and CV limiting CV which is 7.07 ok. So, the ratio will us the idea of 1.127, so if we know this value the range of production range of machines, so we can compare.

So, the higher the value of index of irregularity poorer will be the performance of the machine ok. This will be this will give direct indication of the actual performance of the machine ok.

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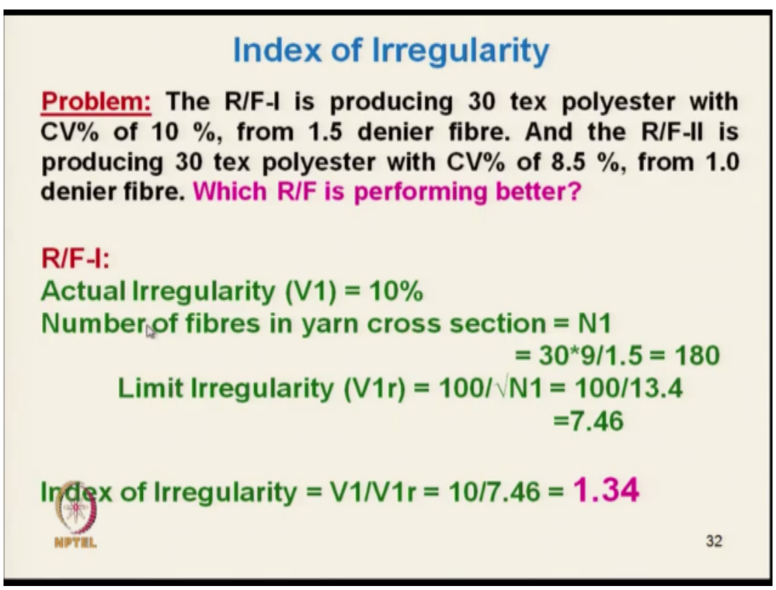

Next problem is that here we will try to calculate know the performance of a machine 2 ring-frames are there we want to calculate. Now ring-frame 1 is producing 30 tex polyester yarn with

CV of 10% from 1.5 denier fibre . Because this problem has been made very simple but we can give the problem with all previous data, so here it is a directly it is given.

But this CV% of 10% one can actually calculate from by knowing the addition CV of at different stages and the input slive input material CV. So, that way this CV is directly given and it is given the count of yarn that 30 tex and fibre denier is given 1.5 denier fibre and another ring-frame, ring-frame 2 which is producing again 30 tex polyester yarn, so same polyester yarn it is producing and it is producing a CV of 8.5% ok.

But in that case that ring frame 2 what we are doing we are using a different fibre at fibre of 1 denier fibre. Earlier we are using 1.5 denier and if we are happy with that ring-frame 2 is producing even here it is CV% is 8.5 whereas the ring-frame 1 is producing a Cv of 10% see if we are happy that with the fact that ring-frame 2 is producing better yarn then we are wrong because in ring-frame 2 we have given a different fibre, we have actually used a finer fibre.

So, in that case to compare this performance of these 2 ring-frames we have to get the index of the irregularity. So, index of irregularity the lower the index of irregularity better will be the performance of the machine, so we cannot judge the performance of machine by output CV. Output CV is the products quality, but performance of the machine we have to judge by the index of irregularity ok.

So, for ring-frame 1, so actual CV is given 10% ok V1 and number of fibres in the cross-section is N, so that we can calculate N1. So, N1 is nothing but 30 tex and 9 denier and it is a sorry individual fibre is 9 denier and we can first convert it to denier 30 tex is nothing but 270 denier 30*90 and divided by 1.5 pars fibre denier it is coming out to be 180 fibres in the cross-section.

Now if we know the number of fibre in the cross-section and as we know it is a polyester fibre we can get the value calculate the value of limit irregularity by using formula 100/under root N1 number of fibre in the cross-section. So, it is coming out 100/13.4 that is under root 180 is 13.4 and the limit irregularity of the machine 1 the yarn 1 it is a 7.46 and the actual irregularity it has producing 10%.

So, we can calculate the index of irregularity of machine 1 ring-frame 1 it will be 1.34, so the machine the ring-frame 1 which is producing 10% CV it is giving it is index of irregularity is 1.34, now let us see what happen to the ring-frame 2.

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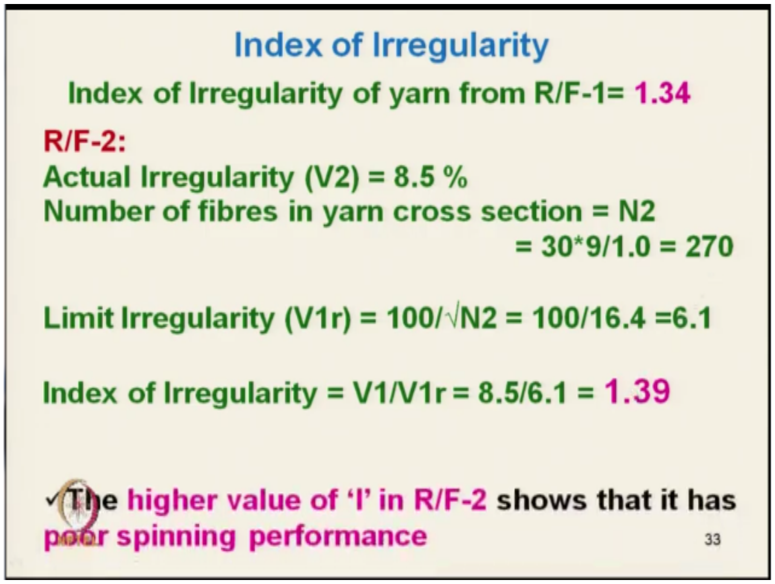

So, index of irregularity of yarn from ring-frame 1 is 1.34, now let us see for ring-frame 2 again in the same way actual irregularity is 8.5% that is V2 number of fibres in the yarn cross-section N2 in the same way will produce will get 30*9 that means 270 denier and it is using 1 denier fibre, so there will be 270 number of fibres. So, similarly we can calculate the limit irregularity of yarn it is a of this is this will be your 2 ring-frame 2 it will be 6.1 that will 100/under root 270 which is nothing but under root 270 means 16.4.

So, it is 6.1 is the limit irregularity and actual irregularity is s8.5% then we can actually calculate the index of irregularity is this one ok this is the index of sorry this should be V2 and this will be v2r not V1r. So, this is nothing but 8.5% by 8.5/6.1 and it is 1.39, so ring-frame 1 was producing yarn with higher irregularity higher CV% and ring-frame 2 was producing yarn with lower CV %.

But if we see the performance of machine the ring-frame 1 is having lower index of irregularity that means the performance of ring-frame 1 is much better than ring-frame 2. So, looking at the

CV% of yarn product we cannot judge the performance running performance of machine to actually for product final product CV% or U% is ok. But if we judge the want to judge the running performance of a particular machine we must go for the measurement of index of irregularity ok.

So, the higher value of index of irregularity in ring-frame 2 shows that it has poor spinning performance ok that is our conclusion.

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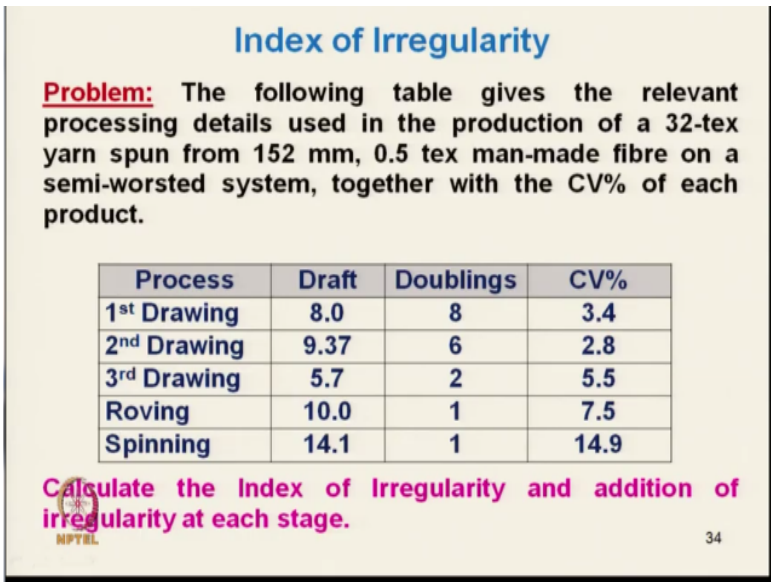

Now will see another a practical problem of calculating the index of irregularity at different spinning process this is actually this process is actually semi-worsted spinning system. In a semi-worsted spinning system where we use we can in worsted spinning we can use either wool blend 100% wool or even manmade fibre, what is worsted system, where we deal with the long stable fibre which normal ring cotton spinning system does not actually it cannot handle this long system, long fibre length.

So, in worsted system we use large number of draw-frame, so here you draw-frame 1, draw-frame 2, draw-frame 3 at different level of draw-frame we can see and different number of combers we can use. But here as we are using manmade fibre so comber is absent otherwise we can comber or say wool blade ok. So, the problem here it is given this is actually taken from a practical problem industry data.

The following table gives the relevant processing if we tell used in the production of 32 tex yarn span from 152 millimeter. So, this you can see the length of the fibre shows it is not the cotton system, cotton system can handle maximum up to 50 yarn or to some extend 54 or 60 minimum not more than that. Here we are dealing with 152 millimeter but the length of the fibre will not actually come into our calculation.

Because in index of irregularity calculation or CV% calculation we do not consider the length of the fibre ok. And 0.5 tex manmade fibre on a semi-worsted spinning system ok it is course manmade fibre it is a 0.5 tex ok together with the CV% at each product. Now this is the process first draw-frame we give draft 8 doubling 8 and CV% drawn-sliver is 3.4 second drawing draft is given 9.37, doubling is given 6.

And CV% of the product second draw-frame product is 2.8, third draw-frame draft is 5.7 doubling is 2, 2 slivers are process fed and the CV% we get it is 5.5%, roving 10 draft that is doubling. There is no doubling 1 strand 7.5 spinning the ring-frame we use 14.1 is the draft 1 doubling and it is a 14.9 is the CV. Now what we have to calculate, we have to calculate the index of irregularity and addition of irregularity at each stage. So, that at each stage we have to calculate, now we will go we will see the stages how to proceed.

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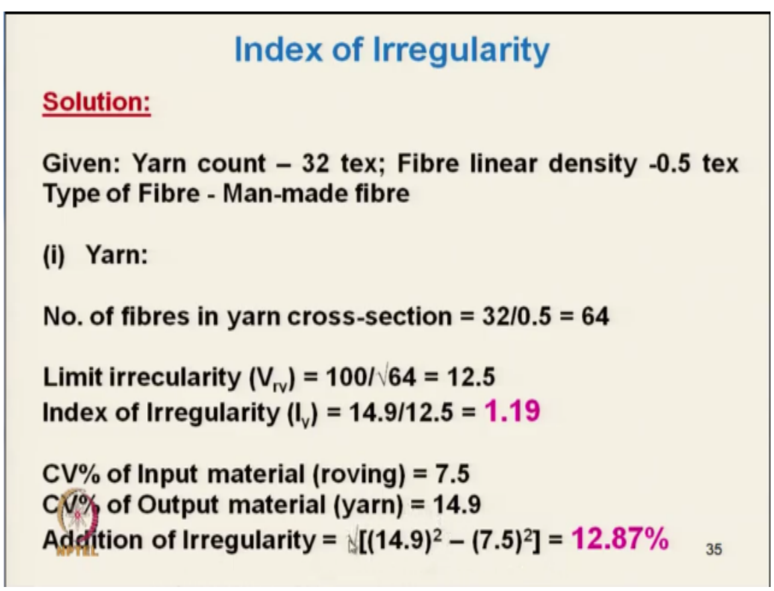

Now the solution is that given yarn count is 32 tex, we know the yarn count is given it is a 32 tex yarn count is given and fibre tex is also given. So, linear density of fibre is given 0.5 tex and type of fibre is given it is a manmade fibre. So, from here we can calculate the index of irregularity, so number of fibres in the yarn cross-section is 64 ok. Similarly we can calculate the limit irregularity it is a 100/64 it is coming out to be 100/8 means 12.5, 12.5 is the limit irregularity.

And also we know the CV% of yarn from the table we know the CV% of yarn was given 14.9, so the index of irregularity it is divided by 12.5 which is limit irregularity. Index of irregularity of ring-frame is 1.19 and CV of input material of roving is given it is a 7.5. So, CV of input material is given it is a 7.5 and CV of output material is also known it is a 14.9, 14.9 is the yarn CV and roving CV was supplied it is a 7.5.

So, addition of CV we can calculate CV of input material addition of CV is we can calculate using the earlier formula, it is a it is coming out to be 12.87. That means CV of output material=CV of input material+CV addition, so it will, so this-this will be the CV of addition. So, addition of CV is 12.87 and 1.19 is the index of irregularity, so we can use this data to feel the table gradually.

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Index of Irregularity

Process	Draft	Doub	Tex	CV%	Add	I
1st	8.0	8		3.4		
2nd	9.37	6		2.8		
3rd	5.7	2		5.5		
Rov	10.0	1		7.5		
Spg	14.1	1	32	14.9	12.87	1.19

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So, now we have added 2 columns 3 columns in fact we will have added 3 columns, column this column tex was not given and this 32 tex is given. The linear density of yarn was given and addition of CV in spinning is 12.87 and it is a 1.19 is the CV index of irregularity.

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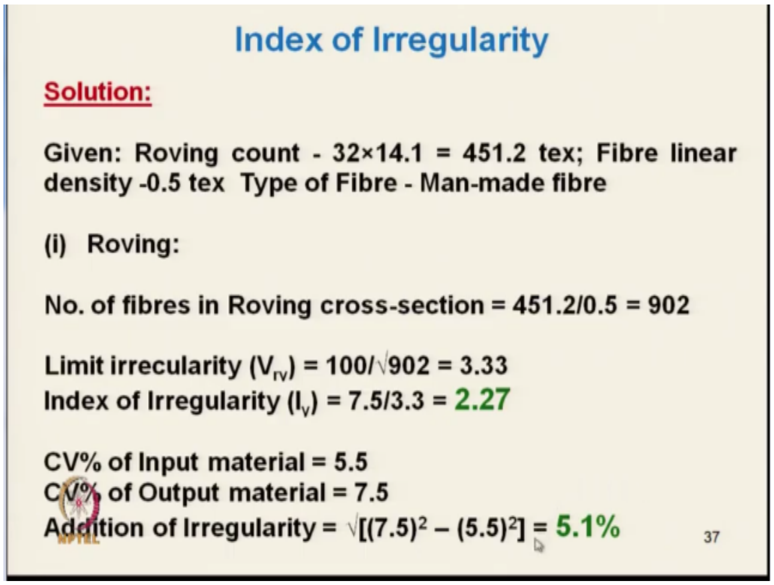

And now coming to the roving stages, in roving we can calculate the count of roving, if we know the draft. The draft what was given is in spinning draft is 14.1, 14.1 draft is given and count is given 32 tex. So, we can calculate the count of roving. So, count of roving is 32*14.1 it is a 451 tex fibre linear density is same, same fibre 0.5, so type of fibre manmade. So, for roving if we try to solve it is a number fibre in the cross-section in the same way we it is coming out to be 451.2/ 451 tex of roving/tex of fibre it is 902.

And limit irregularity is 100/9.2 of roving it is 3.3 and index of irregularity because roving irregularity value is given it is a 7.5% roving CV was given, so index of irregularity of roving is 2.27. And CV of output material, that is roving CV, so in this is the CV of input material of this the roving CV that is and CV of input material what is this, this is the CV of draw-fame sliver, third draw-frame sliver it is given which is the input material for roving.

And CV index of irregularity is given as CV of output material that is roving CV is 7.5, so output material roving CV is 7.5. So, from there we can calculate the addition of irregularity in roving process it is coming out to 5.1%.

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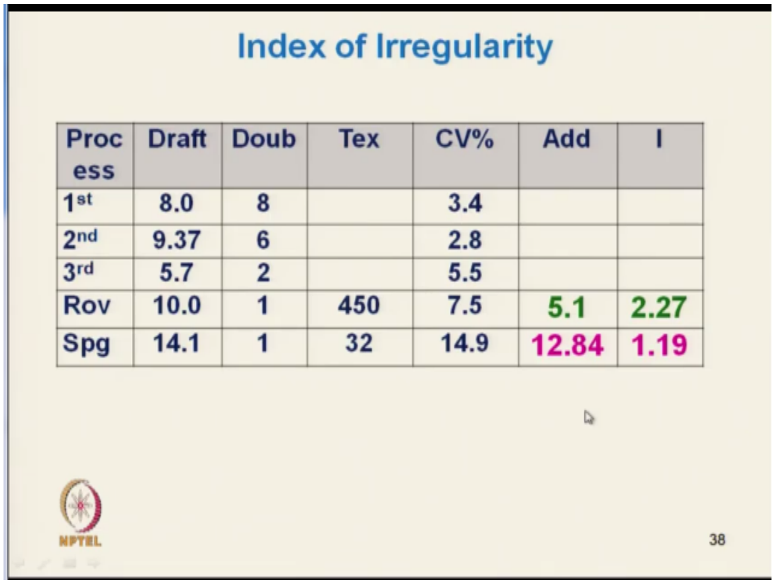

So, this we can add again to this table, so 450 tex 5.1% is added and index of irregularity is 2.27%, now we can go back to another process the next that will be last.

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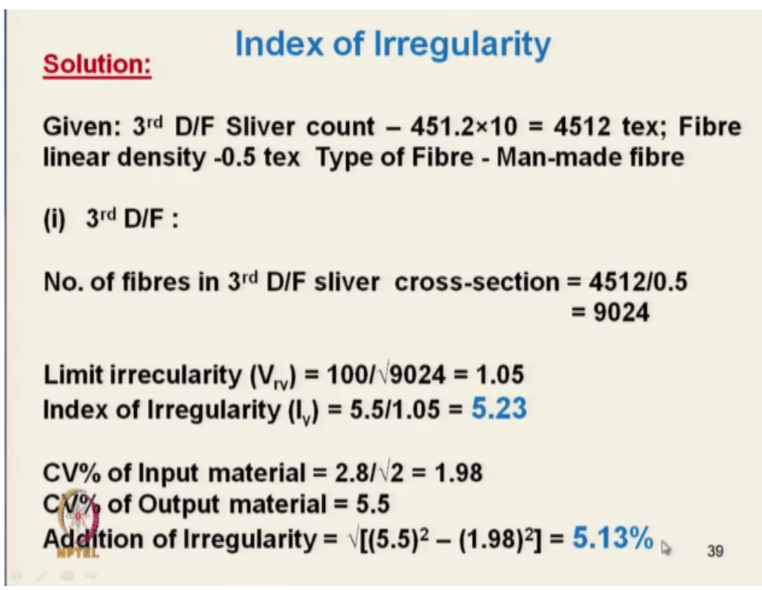

So, third draw-frame sliver similarly we know the draft we know this is the count, so 451 is 451.2*10 is the third draw-frame sliver count. Because the 451.2 this is approximately 450 this is actually 451.2 and if we multiply by 10 there is in the roving the draft is given this is the tex in roving, so if we draft if we multiply by 10 it will be actually 451.2.

In the table tex place as 450, so 451.2 tex is the sliver tex and 0.5 fibre density, so the number of fibres in the draw-frame sliver cross-section will be 9024 ok, 4512/0.5. So, we can calculate the index of irregularity of draw-frame sliver is 1.05, s0 100/under root **0.** 9.24 the number of fibres and index of irregularity is coming out to be 5.5/1.01 which is index, so limit irregularity.

And 5.5 is the irregularity of the third draw-frame sliver CV%, so and this is the limit CV, so index of irregularity is 5.23 and CV of output material which is why CV of output material is actually output material CV is 2.8. So, you can see it is a sorry 2.8 is the input material, so in third draw-frame sliver third draw-frame will fed input material of say second draw-frame sliver output material of second draw-frame sliver which is 2.8.

So, this is the index of irregularity and CV limit is known so CV limit of CV% of input material in draw-frame ok in third draw-frame, third draw-frame what is the drop number of doubling in third draw frame number of doubling is 2. But the sliver which we are feeding from the second draw-frame, second draw-frame sliver the CV% is 2.8 and it is under root divided by under root 2 number of doubling it is coming out to be 1.98 is the CV% of input material.

And CV% of output material which is nothing but 5.5 then we can calculate the addition of irregularity in the third draw-frame which is 5.13.

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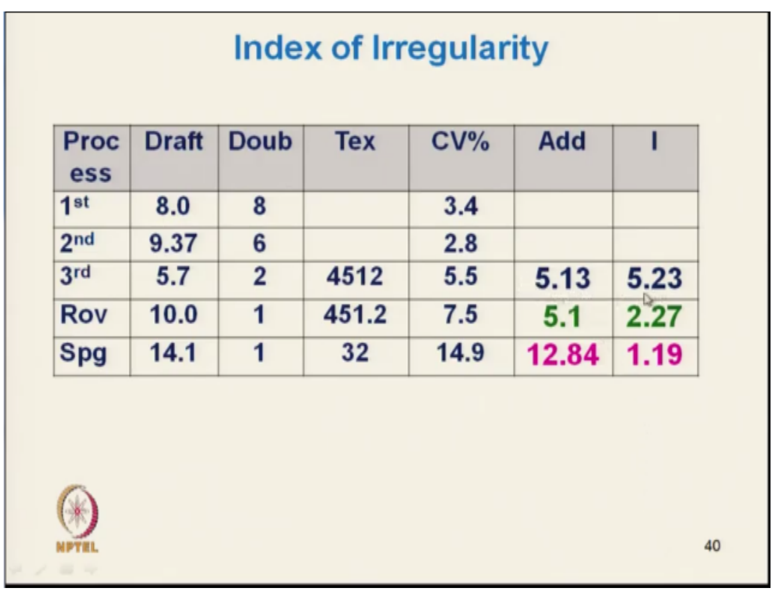

Process	Draft	Doub	Tex	CV%	Add	I
1st	8.0	8		3.4		
2nd	9.37	6		2.8		
3rd	5.7	2	4512	5.5	5.13	5.23
Rov	10.0	1	451.2	7.5	5.1	2.27
Spg	14.1	1	32	14.9	12.84	1.19

And we will put we will add this values in this table, so we will keep on adding this values we can feel this table ok. So, this numerical it keeps all the flavor where doubling is there, drafting is there we can calculate the index of irregularity, we can calculate the addition of irregularity from the number of fibres, so this if we can try to solve this type of numerical our total concept will be clear. And for fast and second draw-frame passage this will be your homework you can try and you can try to solve this problem ok till then we will stop here for the day, thank you.