New Spinning Technologies
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Lecture - 02
Sliver Feed Arrangement

Today we are going to discuss Sliver Feed Arrangement that is the feed unit of the machine.

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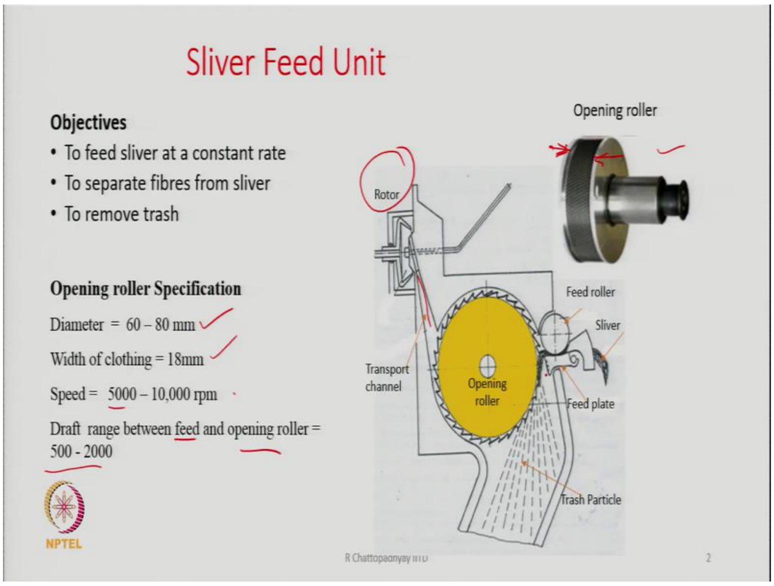

So, Sliver Feed Unit, what is, what are the objectives of sliver feeding? Number 1 is the unit should be capable to feed the sliver at a constant rate at a uniform rate the sliver should be feed. Number 2 is fibres finally, are to be separated from each other that is fibres should be arriving in the form of the sliver and we have to separate the fibres from the sliver and make them move.

And the third is we have to remove trash particles when we are processing cotton fibres, because we all know that the sliver still contains lot of trash particles. Though large amount of cleaning is done in the blow room and in the carding machine, but still some amount of trash will be left and these trash particle is a nuisance we will see that is a nuisance for the performance of the rotor spinning. They create lot of problem for us.

So, removal of trash is also an important aspect of sliver feed unit. Trash removal is not required if you process 100 percent polyester or 100 percent viscose rayon or such man-made fibres where trash does not exist. A unit is shown here feed roller, feed plate, this is the zone where trash particles are escaping, then we have the opening roller on this side, a real opening roller image is shown, then this is the transport channel through which the separated fibres will move and reach the rotor box the rotor is here.

So, this is a cross-sectional view of the sliver feed unit. If you look at the specification of the opening roller, this roller will be having a diameter between 60 to 80 mm which may know it differs depending upon the manufacturer. Then the width of the clothing the clothing that we see here, this width is around 18 mm it runs at the speed of 5000 to 10000 rpm. So, depending upon the kind of fibres I am processing we can set the speed in this within this range.

And the draft range between feed and opening rollers is 500 to 2000, again depends upon the type of material we are going to process what is the sliver count, what is the yarn count, what type of fibre, based on that we can decide, how much draft is there between the feed and the opening rollers. We can find it out easily if we know the surface speed of opening roller and if we know the feed rate in terms of its linear speed. So, that is this is the opening sliver feed unit, it goes up to this point transport channel.

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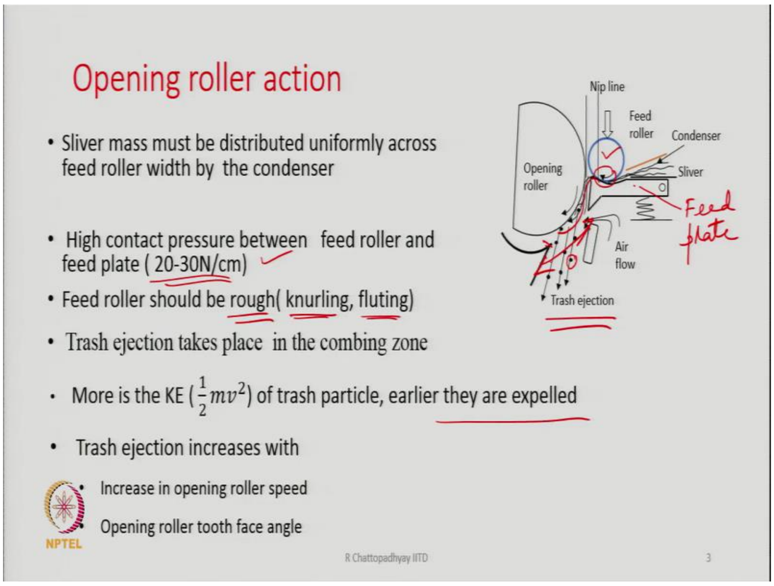

And opening roller action if we try to understand the feed unit will be able to feed the sliver at a constant rate and for that what we have, we basically have a feed plate which is this one this is basically feed plate spring loaded and then we have a feed roller which is here.

So, feed roller feed plate combination will be feeding the sliver, sliver is coming from a can. So, sliver is lifted because of the pull from the feed roller side and the feed roller is giving motion and the roller rotates at a constant speed. The speed can be set separately we can set the speed whatever speed we want and at that speed it will continuously run and pull the sliver from the can.

Now, once the sliver is fed and it comes into contact with the opening roller teeth, the opening roller is full of needles or saw tooth, a surface is full with saw tooth. The action between these two opening roller and the feed roller is similar to what happens in carding machine in the licker-in region of the carding machines there also we feed a lap or a matt of fibres and this matt of fibres is opened by the licker-in.

Here a similar thing is being done instead of lap we are feeding a sliver, and instead of licker-in we have a opening roller, but the action is same, only the size of the feed roller and the size of the opening roller they are much smaller in comparison to the size of licker-in and the size of the feed roller that we see on the carding machine ok.

There is a high contact pressure between feed roller and the feed plate this much contact pressure is required which is given by the spring. If the pressure is not there the feed roller will not be able to pull the sliver there is chance of slippage. So, there has to be sufficient force, at the same time if the force is there on the opening roller teeth will act on the fibres the fibres are going to be pulled out by the teeth of the opening rollers.

The teeths that opening roller teeths are coming at a high speed and it is then penetrating the front part of the sliver which is here, in front of the feed plate is penetrating this particular part of the sliver and pulling the fibres out, there is a huge difference in the speed, teeths are running at a much faster rate than the rate at which the fibres are being fed.

The feed roller should be rough; they have to be rough, Why? So that there is no chance of slippage, from here from this nip as the fibre end is coming over here and the opening roller tooth is trying to pull it out there has to be some amount of resistance from the feed roller, otherwise a chunk of fibres will be simply plucked from the feed roller, to avoid such kind of plucking action where a bunch of fibre is simply withdrawn from the nip.

That is something which is not desirable the friction has to be adequate enough between the feed roller, feed plate and on the fibres. So, in order to increase friction the feed roller surface is either knurled or that could be flutes on it. Trash ejection takes place, Where? here these black dots are actually trash particles, the trash trajectories are shown here by the arrow.

So, as soon as the fibres are teased from the sliver lot of trash particles also are trapped between the fibres all these trashed particles which are trapped will be combed out by the teeth of the opening roller. But because the trash particles once they are combed out they are free they are thrown away by the centrifugal force.

They attend the speed of the opening roller and they are thrown away and these particles there is opening over here from here to there, this opening is large enough and lot of trash particles are ejected as shown in the diagram and we are in a position to clean the fibres at this stage. The purpose of the opening roller is not really to clean, but in the case of cotton we take the opportunity of the separation of fibres by the opening roller to clean it again, this may not be required in the case of man-made fibres.

The trash ejections takes place in the combing zone which is from here to there this is the combing zone and more is the kinetic energy of the trash particle, more of more of them will be expelled quickly; that means, higher the speed the better it is. Trash ejection increases with increase in opening roller speed and opening roller tooth face angle like you have studied the licker-in teeth angles.

So, here also the angle of the opening roller tooth is important that is how much trash particle they will retain and how quickly they can be released from the teeth it all depends upon the geometry of the licker-in tooth.

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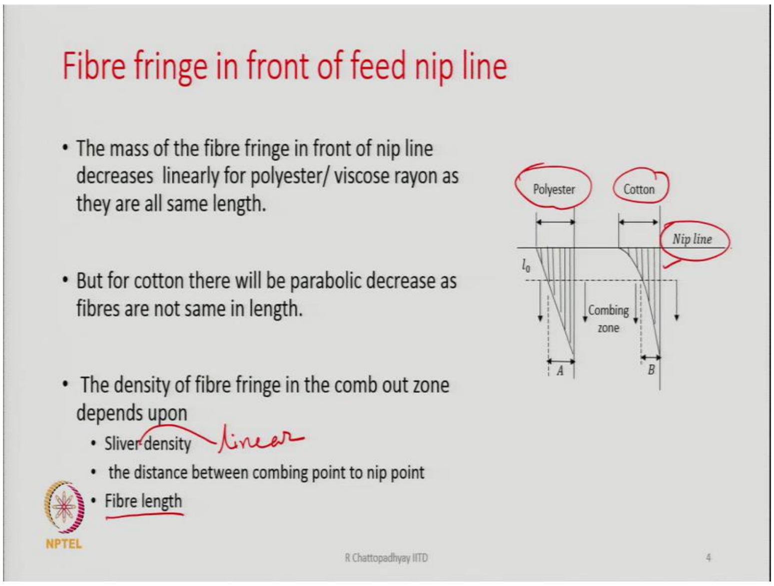

The next slide gives you while combing is going on how the fibre fringe looks, now here the two diagrams are here, on the right hand side it is meant for cotton, on the left hand side is meant for polyesters. If this is the nip line as shown it here, then in front of the nip line as the fringe of fibres are being combed continuously by the teeth of the opening roller, the fringe will look like this in the combing zone as it is shown.

For polyester it is something like a triangle because in case of polyester most of the fibres are of same length. In the case of cotton, it is not really a triangle because of the case of cotton we have fibres of different lengths. But this is the fringe which is continually getting combed or by the teeth of the opening roller. So, polyester viscose being same length it will have a shape as shown it here for comb for the cotton the shape is little different it is parabolic in nature.

The density of the fibre fringe in the combed out zone depends upon three important parameters, one is the sliver linear density how much is sliver linear density, it depends upon that. The other thing is the distance between the combing point to nip point, how much is the distance from the combing point to the nip point that is also; that means, the setting that we keep between the opening roller and the feed plate.

And the other thing also what matters is the fibre length, that is what is the length of fibre, how much is the length of the individual fibres. These three are important and you have to remember that in a dynamic state it is the fringe of this which is continually getting combed fibres are continually being fed and the fringe that exist in front of it looks like this as it is shown in this diagram.

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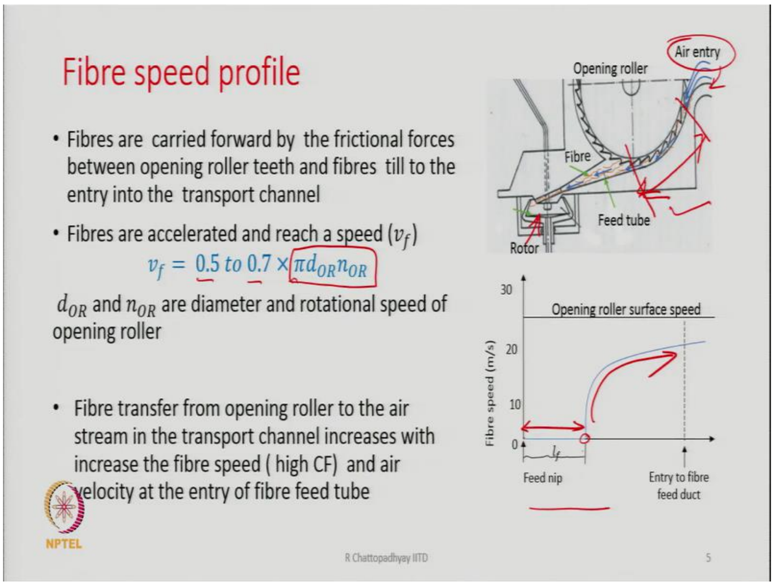

Fibre speed profile, here again this same unit is shown here and here we are showing you the speed profile of the fibre, feed nip is here, from here to there, the fibre speed is almost 0 almost nill; that means, it is close to the speed of the your feed roller. Then from there up to a certain point you see there is no change in the speed of the feed roll, the speed of th e fibre because fibre is still under the control of the feed roller a fibre may have a length of suppose 40 mm.

So, when the fibre appears at the nip of the feed rollers the leading end of the fibre appears now onwards it will be gradually fed so slowly and slowly it will move. So, it will move forward and as long as it is held or under the positive grip we can say of the feed roller it will continue to move at the speed of feed roller, there will be no change in its velocity that is from here to there.

From there as soon as the trailing end of the fibre is released the fibre is going to be anyway picked up immediately by the by any tooth of the opening roller and immediately its speed is going to increase. And this is how the speed will increase of the opening roller, fibres will be accelerated and suddenly speed will increase the velocity of the fibre has been shown to be 0.5 to 0.7 times the surface speed of the opening roller.

‘d_{OR}’ and ‘n_{OR}’ indicates the diameter and speed of the opening roller. ‘OR’ stands for opening roller.

So, fibres are on the picked up by the opening roller and from as soon as they go from here to there; they cover this distance they are about to be released, now from the teeth of the opening roller and they will enter a channel we call it transport channel, transport tube, doffing tube, there are different names. So, fibres will be released from the teeth they have to be released and now they will start moving through this channel and this channel is going where it is reaching the rotor.

The channel extends up to rotor, it starts on the opening roller housing and it goes on the opening roller cover, and it goes up to the rotor. Because we need to remove the separated fibres from the opening roller surface and want them to be within the rotor. So, because the fibres are held on the surface of the opening roller teeth they are experiencing a very high centrifugal force. So, wherever there is a gap available many of them will be thrown away, they should leave the teeth of the opening roller.

So, how many of them will be able to leave, how many of will be able to know continue to move all depends upon the tooth geometry. If the teeth is too acute in nature in that case many fibres may not be able to be stripped or they may not be released. So, there is an in the angle of inclination of the tooth of the opening roller is very important and the second thing is that the suction; how the fibres will move from the opening roller to the rotor, this journey the fibres are going to make is through the air.

So, there has to be a flow of air, this flow of air will be able to take the fibres along with them; that means, there has to be a suction system which will work through the rotor, the rotor is here is the rotor. So, rotor within the rotor we have to create a negative pressure and then only it will be able to draw air through the transport tube or feed tube whatever we say it and that air is actually entering here, you see here is the air entry.

So, this air is also trying to help in removing the fibres from the surface of the opening roller teeth. So, centrifugal force and the suction force both of them are responsible for removing fibres from the teeth of the opening roller. And higher speed is better higher speed of the opening roller is better because centrifugal force will be also be more, fibres will go towards the tip of the opening roller.

And therefore, they can be easily removed if they remain buried between the teeth if they go remain to as the base of the teeth, then there will be more friction when you try to remove them, but the centrifugal force will cause them to move towards the tip. And hence, the higher centrifugal force is beneficial or the removal of fibres from the teeth of the opening roller. So, many a times it has been found that in the case of actual processing the opening roller gets completely filled with fibres and it gets jammed.

So, jamming of opening roller is very common in the actual practice. So, one of the way to get rid of this jamming conditions on the opening roller is you increase the speed of the opening roller. That is one of the you know way to tackle the situations that is not the only way, but that is one of the way.

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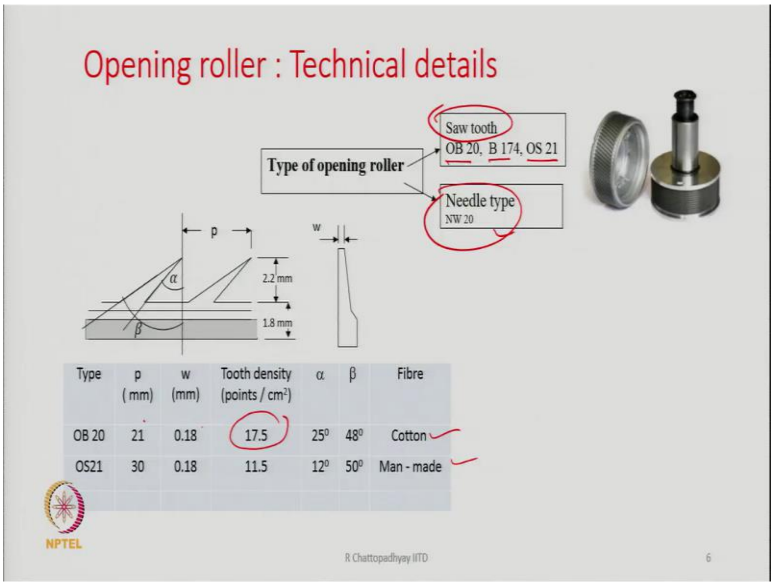

Type	p (mm)	w (mm)	Tooth density (points / cm²)	α	β	Fibre
OB 20	21	0.18	17.5	25⁰	48⁰	Cotton
OS21	30	0.18	11.5	12⁰	50⁰	Man - made

If we look at the opening roller technical details opening rollers are available in two types one is saw tooth type, another one is needle type, saw tooth also has its own variety OB 20, B 174 OS 21. So, these are the no, type of opening roller, tooth and typical tooth geometry is also shown here.

So, what is important is, what is the pitch, what is the width, tooth density points per cm^2, what is the angle ‘α’ and angle ‘β’. So, typical values for cotton and man-made fibres are given and the saw tooth is more, no you can say it is more suitable for processing cotton and synthetic fibres as well, you can see a change in the value of ‘α’ and ‘α’ especially when we try to process synthetic fibres man-made fibres which are long.

The needle type of tooth is also used when you want to process very delicate fibres; we call needles puts less stress on the fibres. So, they do not damage the fibres whereas, saw tooth can damage the fibres, they can break the fibres also, they are very very strong. So, in some cases where fibres are weak and; that means, they are delicate we can use needle type of teeth on the opening roller.

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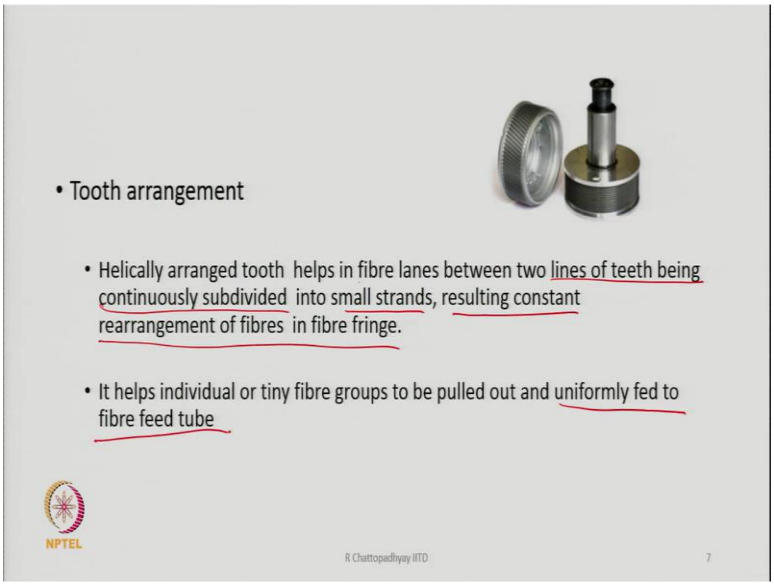

Tooth arrangement if we see they are helically arranged; Why? because it helps in fibre lanes between two lines of teeth being continuously subdivided into small strands, resulting constant rearrangement of fibres in the fibre fringe, that is the reason why they are helically arranged, you should look at this teeth here they are actually helically arranged so that these fibres in the slivers can get subdivided easily.

It helps individual tiny fibre groups to be pulled out and uniformly fed to the fibre feed tube, that is the reason that the tooths are helically arranged, otherwise they will form fibre channels. So, you have to break the formation of fibre channels, fibres will wrap around the they will occupy the space between the between the teeth.

So, we have to break that, so that they do not occupy their space. So, otherwise if the space is available between a series of tooth and they are all aligned together then lot of fibres will go and settle there and it will get filled up easily and it will lead to choking. So, if you want to avoid choking therefore, we have to see that channel formation how it can be avoided and it is the way we actually you know arrange the teeth on the surface of the opening roller that really matters. That is how the tooths is helically arranged.

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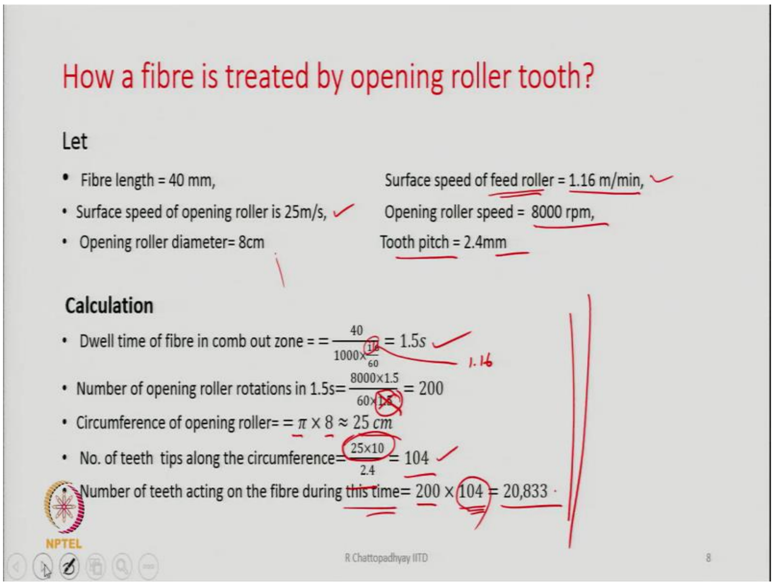

How a fibre is treated by the opening roller tooth? Let fibre length be 40 mm, surface speed to the feed roller is typically let us say 1.16 m/min it could be 0.5, 1, 1.2, 2 m/min also depends, surface speed of opening roller is 25 m/s and opening roller speed is let us say 8000 rpm, opening roller diameter is 8 cm and pitch of the tooth is 2.4 mm.

If you do a calculation just to know how a fibres, what a fibre is going to experience as they are fed by the feed roller? So, dwell time of fibre in the comb out zone what is the dwell time, how much time they will spend? If 40 mm is the length of the fibre and 1.16 is the surface speed. So, it will be 1.6. So, 40 mm we divided it by 1000 to make it meter.

So, that is the fibre length in meter and the delivery fibre surface speed of the feed roller or delivery speed of the feed roller is 1.6 m/min. So, 1.6 by 60 and if we do this calculation probably we will get a figure 1.5 second. So, this value so, only 1.5 second it spends, number of opening rotations in 1.5 second.

How many times the opening roller is going to rotate we can also calculate, that is if the speed of the opening door is 8000 rpm. So, per second is 8000 by 60 and in 1.5 second it is going to rotate by how many times? (8000/60)×1.5, what is this value? 200. So, that value will be 200. So, the opening rollers rotation is going to be 200.

Next is circumference of opening roller is how much? (πd), (π×8) centimeter is the diameter it is became almost close to 25 cm that is the diameter the circumference of the opening roller. So, number of teeth tips or tooth tips along the circumference is going to be how many? (25×10)/2.4, that is 104.

So, number of teeth acting on a fibre during this time assuming that all the fibres are there all the teeths are there on the which are there on the surface of the opening roller all of them are actually acting on them. So, in that case (200×104), that is 20833. So, 25 cm converted into mm, no sorry how much it is? 25 m/s, yeah it is ok.

I think 25 cm converted into millimeter 250 mm and if the pitch is 2.4, the total number of teeth is going to be 104 and number of teeth acting on the fibre therefore, will be (104×200) because it will every revolution means 104 teeth will act on it. So, in 200 revolution 200 and 104 so many teeth is going to so many teeths are going to act on a fibre. So, roughly we can say that when a 40 mm fibre is being fed at the speed of 1.6 m/min almost 21000 teeth are working on it.

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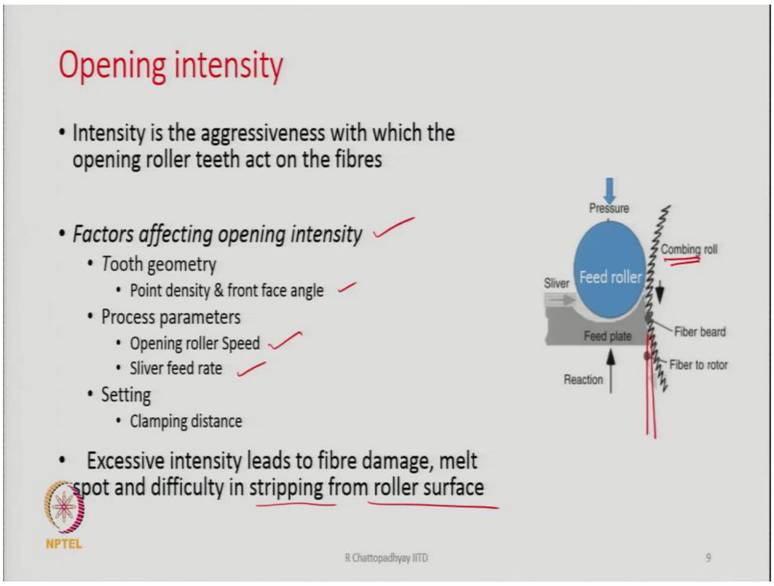

So, opening intensity we can also find out and we can say the intensity of the opening basically means the aggressiveness with which the opening roller teeth act on the fibre.

So, factors that will affect the intensity, one is tooth geometry that is point density and front face angle. How many tooth are there per unit area? And what is the angle of inclination of the teeth front face of the teeth?

Second thing is process parameters where opening roller speed and sliver feed rate both are will have a influence on opening intensity. And the third thing is the setting, that is the clamping distance, that is the distance between the feed plate and the opening roller or also known as combing roller.

We can call it opening roller or we can also call it combing roller, how much gap is existing between these two that will also affect the opening intensity, actually this gap is very very important, to close a gap may call lot of fibres to break opening intensity will be too much. So, it is very important that how much gap we should maintain. The other parameters are to geometry and generally once this setting is made is not disturbed; we generally change the process parameters in order to increase or decrease the opening intensity.

Excessive intensity leads to fibre damage, fibre melting and difficulty in stripping from the roller surface everything is possible that it can lead to damage of fibres, it can lead to melt spot in the case of thermoplastic fibres mostly polyester fibres this problem could be there and difficulty in stripping from roller surface also could be sometimes there.

As I said there is a possibility of better stripping at a higher speed of the opening roller that also is possible because of the higher centrifugal force and at the same time there sometimes may be difficult in stripping from the roller surface at a higher speed because it may lead to fibres getting no going towards the base of the tooth because of very high force that will be acting between the when the fibres are pulled by the teeth of the opening roller.

So, it can be sometimes it can create difficulty also especially with synthetic fibres whereas, in the case of cotton it may be beneficial from the point of view of stripping. So, stripping could be advent could be beneficial sometimes, sometimes it may not be as you go for higher speed of the opening roller.

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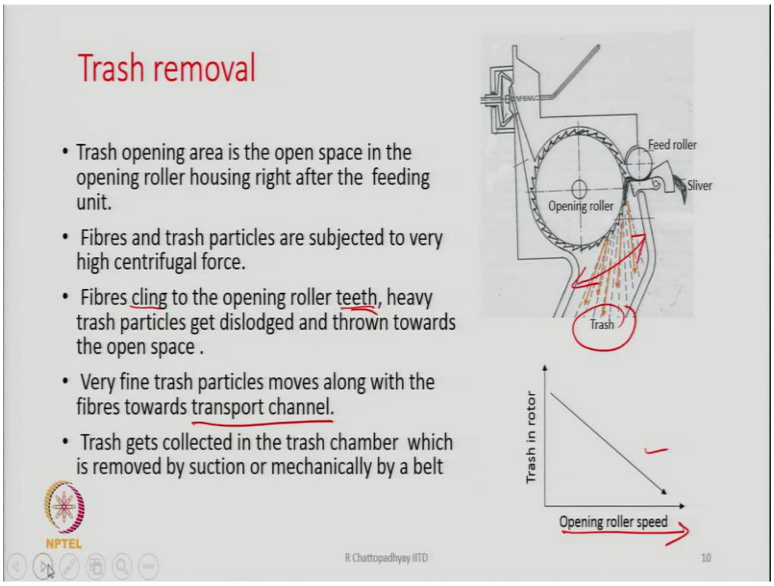

Trash removal is very important and with the opening rollers speed as we increase, the trash quantity within the rotor keeps on declining. So, if we have two trashy cotton that we have to process we have to increase the opening roller speed or we have to keep the speed at a higher level. Both the fibres and the trash particles are subjected to very high centrifugal force fibres can cling to the opening roller teeth because they have a they are generally lighter and they have a long length.

So, their contact area between the teeth and the fibre surface is always more in comparison to the trash particles which are very dense and therefore they may not cling so well as the fibres clings to the teeth of the opening rollers. So, trash particles are easily released from the surface of the opening roller and they all fall down.

So, we have a very big opening over here, the whole purpose of this opening is to allow this trash particles to get ejected and rush towards a chamber where there is a mild suction that we keep on sucking the trash particles. What happens whatever we do some fine trash particle still moves along with the fibres and they will finally, reach the rotor that is they will move towards the transport channel and from there some trash particles will ultimately reach the rotor.

In the rotor this trash particles some of them will get deposited and there is no way to get rid of them, we can only reduce the you know you can clean the fibres very well, but very very fine dust particles cannot be removed by these means and they go directly within the rotor and they are keep on accumulating within the rotor groove and as a result they create disturbance in this spinning operation. They also can affect the quality of the yarn.

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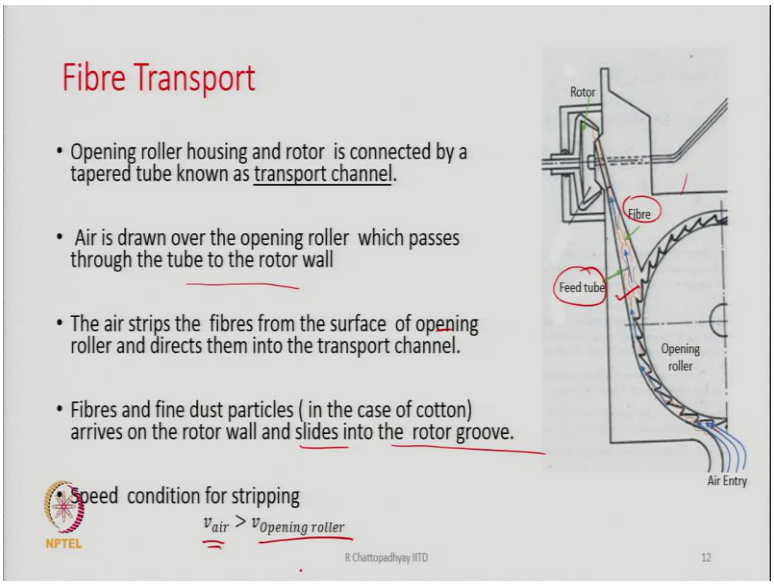

Fibre transport part if we try to understand from the opening roller through this transport channel or fibre tube these are the fibres as shown here they are transported and what is the air is drawn over the opening roller which passes through the tube to the rotor wall and this entire rotor chamber is actually connected to a suction unit.

And we suck the air through the rotor chamber this air helps in stripping the fibres from the surface of the opening roller and then direct them towards the transport channel. Fibres and fine dust particles arrive on the rotor wall and then they slide into the rotor groove finally, they all reach the rotor groove, fibres will also reach the rotor wall, dust also will reach the rotor wall from the wall they will go towards the rotor groove and they will accumulate there.

The velocity of the air has to be more than the velocity of the opening roller; that means, the velocity at this point must be more than the velocity of the opening roller, surface speed of the opening roller has to be less, then only fibres can be easily removed from the surface of the opening roller. These are very important conditions therefore, if we keep raising the you know speed of the opening roller then the differential speed that we have between the air velocity and the opening roller that will gradually reduce.

And therefore, transport of fibres or stripping of the opening roller surface will be difficult, unless we change the suction rate, the suction rate remains as a previous level what we do is keep on raising the opening roller speed hoping that this is going to improve the stripping; it may not, because the velocity of the air has remained at the previous level in such situation we have to increase the suction rate in order to increase the velocity of the air which is we are drawing over the surface of the opening roller.

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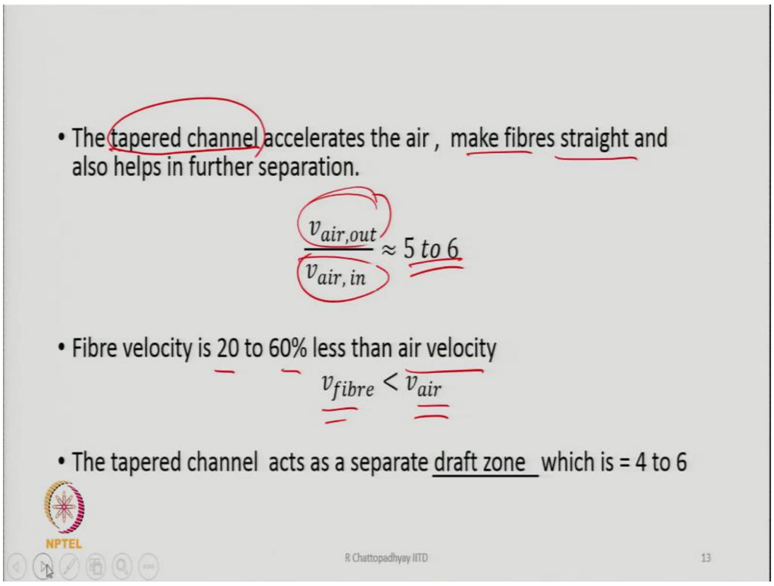

The channel we called it transport channel, we called it fibre feed tube, we may call it doffing tube whatever it is, this is tapered a geometries is important that it is a tapered channel and this tapering has a beneficial effect and that is that it makes the fibres straight, why? Because velocity of air in and velocity of air at the output of the channel, this ratio is 5 to 6.

So, the channel geometry such that it is tapering gradually at the exit end the velocity is 5 times more than the velocity at the entry end, that way the channel geometry is made. The fibre velocity is 20 to 60 percent less than the air velocity in general. So, velocity of fibre is always less than velocity of the air which is carrying the fibres, because fibres actually travels a very short distance.

The taper channel acts as a dropped zone which is 4 to 6. So, transport channel itself is acting as a drafting zone because at the entry to the channel whatever is the velocity of the air at the exit of the channel which is near the rotor groove, velocity is much more and it is 5 to 6 times more therefore, there is a continuous increase in velocity; that means, there is acceleration that the fibres get and fibres are separated out.

So, whatever is the draft between feed roller and opening roller that draft is now multiplied by 4 to 6 times before they arrive at the rotor that becomes my total draft. So, if the draft suppose at the feed point of the feed roller is between is 500; let us say and some figure we assume and the draft suppose there in the feed tube could be 4 to 6 let us say it is 5. So, total draft will be (5×500), 2500 that is the draft which is going to act here.

So, such a high draft will not be able to achieve by having normal roller drafting system the roller drafting system we are not capable to give such a very high level of draft to the order of 500, 600 like that is not possible.

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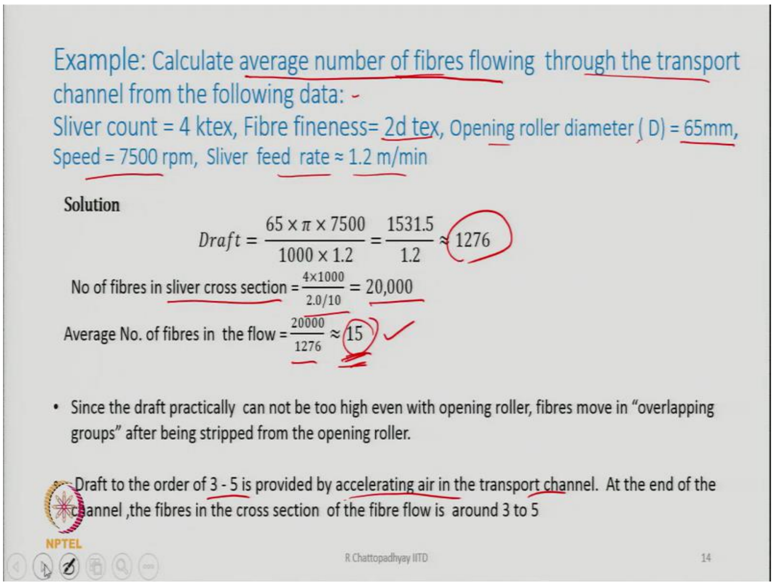

Now, we will take an example; let us say calculate the average number of fibres flowing through the transport channel from the following data. Data what is given here sliver count, fibre fineness, opening roller diameter which is 65 mm, speed, sliver feed rate, these are the parameters which are given, we have to calculate average number of fibres flowing through the transport channel, how to go about it, solution is given here, first we will calculate how much is the draft between opening roller and feed roller.

So, the draft calculation is simple. Surface speed of the opening roller divided by surface speed of the feed roller and if we do that we will get a figure 1276. So, the draft between opening roller and feed rollar is 1276. The next is if that is the draft now how many fibres are there in the sliver cross section, sliver ktex value is given fibre fineness value is given.

So, we convert both of them to tex and take the ratio, we get a figure 20000. So, the sliver is having 20000 fibres in the cross section. Therefore, average number of fibres in the flow will be how much because of the draft of 1276 will get a figure 15; that means, on the opening roller surface itself there will be 15 fibres in the cross section of the fibre flow.

Since, the draft practically cannot be too high even when opening roller fibres move in overlapping groups. Now, we can say that I told you earlier that we have to separate the fibres to almost single fibres whereas, in practical situation we see there are 15 fibres in the cross section, does it mean that it is not following the principle of opening end spinning or not.

Actually it is not necessary that we have to have just one fibres in the cross section in the fibre flow even if we have groups of 3, 4, 5 fibres to still work. Therefore, here we get like 15 fibres where on the surface of the your opening roller, because the draft between them is to the order of 1276, now rest of the draft is there in the transport channel. So, the 15 fibres which are being fed at the entry point of the transport channel by the time they land in the rotor they will not be 15 cross section of in the cross section, you can say in that fibre flow or the fibre flux is going to be much less now.

It will be reduced suppose the if the draft in the channel as we said earlier can vary between 4 to 6, if you take a figure 3 or if you take a figure 5, then we will have 3 fibres in the cross sections and with this many fibres also the system is going to work that is the false twist will not be generated; otherwise the next as we have said earlier as I have you know discussed earlier that there is a chance that the twister will act as a false twister and we put twist on both the sides.

If there is a continuity in the fibre supply and there is overlapping action between the fibres then this possibility is there, but if the ends are free to rotate then this will not be there. So, here there is almost a break because there is some more drafts still available in the transport channel.

Draft to the order of 3 to 5 is provided by the accelerating air in the transport channel as I said so, which can vary between 3 to 5 some somewhere you may find 4 to 6. So, it all depends upon the actual geometry of the transport channel that will decide what is the tapering and taper ratio we can say, from there one can calculate how much could be the draft.

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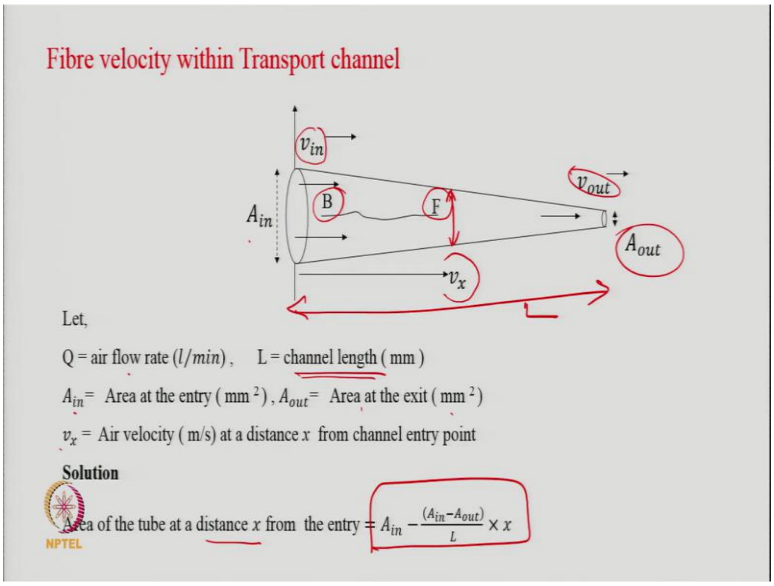

And here we are doing one more analysis of the fibre velocity within the transport channel. So, here a transport channel is shown a simplistic diagram, the area at the entry is 'A_{in}', area at the exit is 'A_{out}' velocity of air is 'v_{in}' velocity of the air out is 'v_{out}' and 'BF' is a typical fibre.

This is the forward end, this is the back end and this is direction in which the fibres are moving. So, air flow rate is given, channel length is given, area stated, velocity at a distance 'x' suppose we want to calculate, as the fibre is traveling through this zone transport channel what is the velocity at a point 'x' on the fibre?

Actually in the actual case the velocity at F and velocity of B will be different, F will move faster than B, but because there is this same fibre the fibre will be under tension and this is in a way helpful this tension will actually straighten out the fibre, because of this fibre itself is accelerating, but because it has a length dimension and the two ends may have a you know they may differ in terms of 30 mm distance between them or 40 mm between them it is.

We can assume that the front end will move faster than the back end and if that happens the fibre will be straightening out in in the transport channel. So, this possibility exists in the transport channel that some fibres may get straightened out. Now, how much will be this velocity of the fibre or the air, now area of the tube at a distance 'x' can be found out if we know the area here and the area at the output and if we know what is the total length which is ‘L’.

So, what is ‘L’ total channel length, from here to there this is what is not shown here in the diagram this is what is ‘L’. So, we can find out what is the you know area added at a distance ‘x’ how much is this area, let us say here which is at a distance ‘x’ this can be found out from this simple equation.

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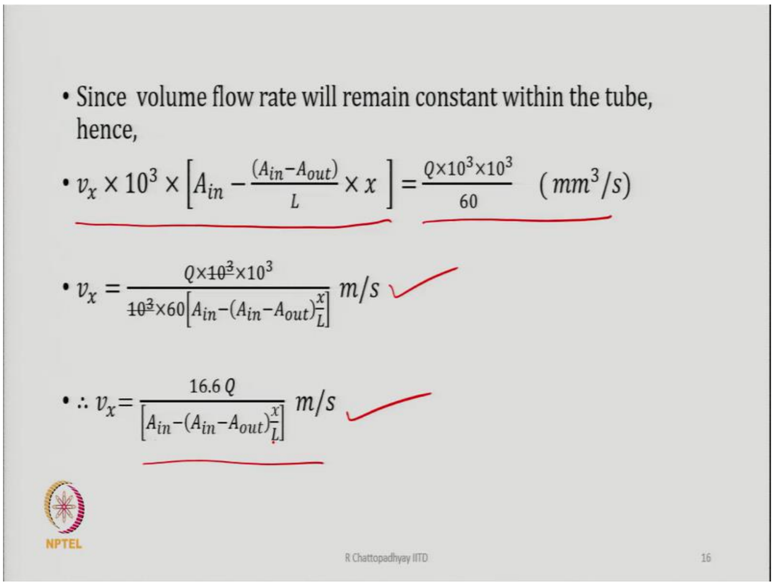

Since volume flow rate will remain constant within the tube, hence the volume flow rate at a distance ‘x’ is going to be whatever is the area multiplied by the velocity of air at that point that is ‘$v_x \times 10^3 \times$Area’ will give you the volume of air which is transported.

It should be equal to the this value in mm^3/s, ‘Q’ as you have seen in the previous case is the volume flow rate that we have. We have to see that the units are matching on both left and right hand side accordingly you have to multiply by 10^3 to make sure that the units are same in on the both sides they should match they should tally.

From there we can calculate what is ‘v_x’ now. So, the v_x is given here, you see we have we can cancel 10^3 both in numerator and denominator and we will be left out with this formula that is

$$v_x = \frac{16.6Q}{\left[A_{in} - (A_{in} - A_{out})\frac{x}{L}\right]} \; m/sec$$

So, this is the velocity that you will get, If we know the air velocity the fibre velocity we can will be little less as we have seen it earlier. We will have some idea that the velocity of air from the entry to the exit, how it is changing and how much it changes, provided the geometry is given to us; that means, we must know the value of 'A_{in}' the value of 'A_{out}' that is what is the area at the entry side, what is the area at the exit side.

If we know these two and if it is length 'L' is also given; that means, the geometry of the channel is known, once the geometry of the channel is known so geometry decided by three parameters area in the two places and the length of the channel. We will be able to calculate what is the velocity of air at any point in a distance 'x', 'x' will depend vary between '0' to 'L'. So, that is the end of this session.

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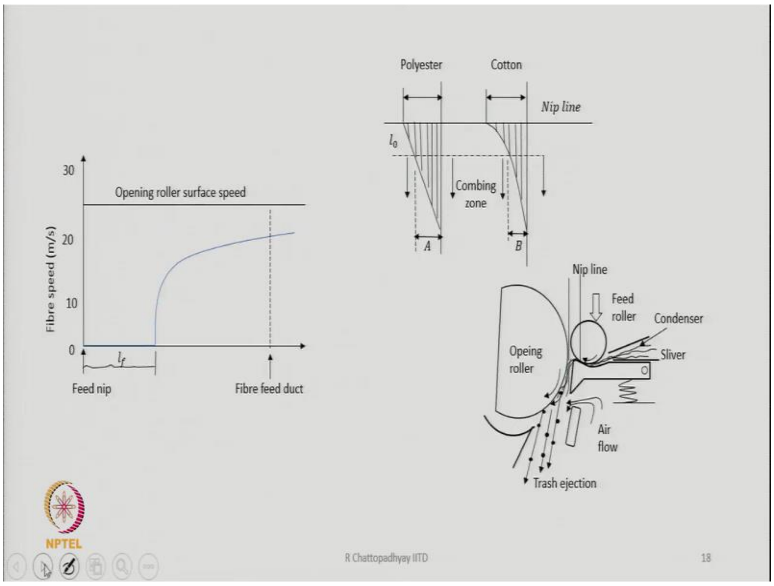

Thank you, we will meet again in the next class.