New Spinning Technologies
Prof. R. Chattopadhyay
Department of Textile and Fibre Engineering
Indian Institute of Technology, Delhi

Lecture - 13
High Draft System

So, today we are going to discuss the Drafting System of the air jet spinning machine.

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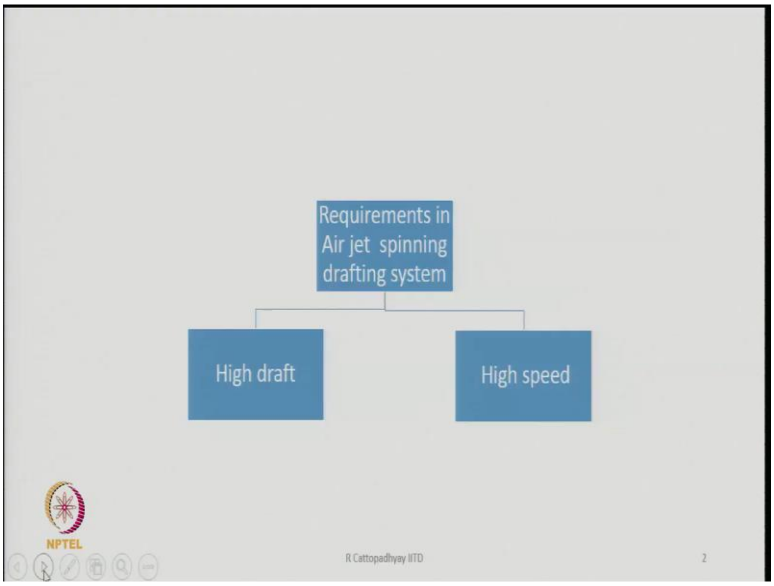

Now, what are the requirements in the drafting system of air jet spinning machines? There are two important requirements are there, one is it should be capable of giving very high draft because we have to spin from a sliver. So, it is a sliver to yarn conversion process. So, sliver is quite thick and the yarn is quite thin and we are directly converting from sliver to yarn and hence the drafting system should be capable to provide very high draft, much much higher than what we find in the case of ring spinning.

The other thing is high speed; the machine produces at a very very high speed and therefore, the drafting system must have a capability to run at a very high speed in comparison to ring spinning. So, we have to have a drafting system which is capable to provide high draft as well as high speed. Both are important requirement of the drafting system that is used on air jet spinning machines also on vortex spinning machines.

And, also, we will find that this may be required even in the case of friction spinning machines. Because roller drafting systems are used and generally, we feed a sliver and therefore, the requirement is of high draft as well at high speed whereas, in the case of ring spinning the requirements are low draft and low speed. So, these are the important differences.

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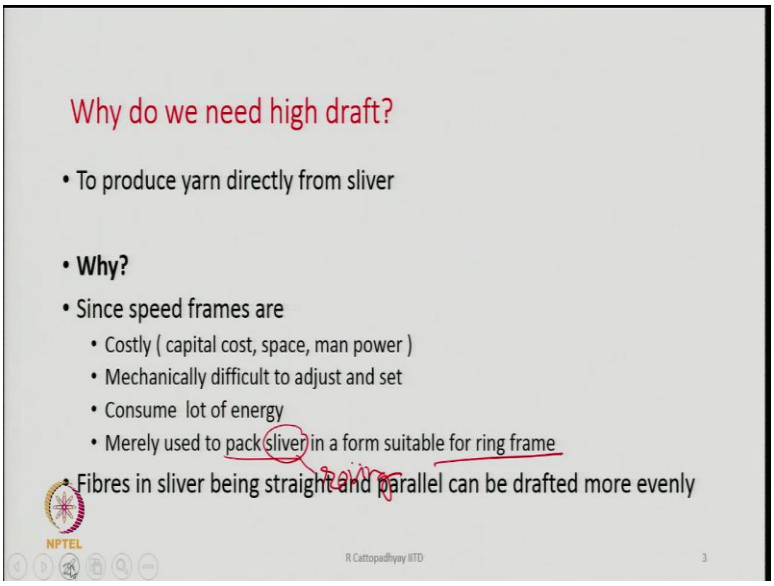

Now, question is why do you need very high draft because to produce yarn directly from sliver that is why we need very high draft. And this is the requirement since speed frame or roving frame which are normally used in the case of ring spinning process where in between the sliver and the ring spinning we have an intermediate machine called roving frame or sometimes called also speed frame that machine has been eliminated here.

And, why it has been eliminated? Because it is costly there is a capital cost in purchasing those machines, we need space and manpower. Then there are mechanical difficulty to adjust the machine and to set it so that we can produce an intermediate product on roving frame which is known as roving. Then it also consumes lot of energy and merely used to pack sliver in the form of the suitable for ring spinning.

That is the purpose of the roving frame was that it is used mainly to pack the roving in the form which is suitable for ring frame. Now, this is what we do not need now. So, for all purposes we need to eliminate this particular machine and if we can produce directly from sliver then there is a going to we have to we will be able to save lot of space, lot of capital cost and lot of labour energy everything. So, like lot of advantage.

That is why we try to go for high draft in order to eliminate the process of conversion from sliver to an intermediate product called roving, that is the reason. So, therefore, machine manufacturers are always thinking of developing a machines so that we can directly you know spin a yarn from sliver.

The other thing is fibres in slivers are very very they are straight and therefore, and parallel. They can be drafted more evenly and more easily, but when we convert the sliver into roving, we twist it and therefore, that the straight parallel arrangement of the fibre is transformed into a helical element of fibres in the roving.

So, we can avoid that if we do not make roving at all and if we have a system where we can directly spin from sliver because in slivers fibres are perfectly straight and parallel free from any twist and therefore, they are very very easy to draft also. So, these are the reasons.

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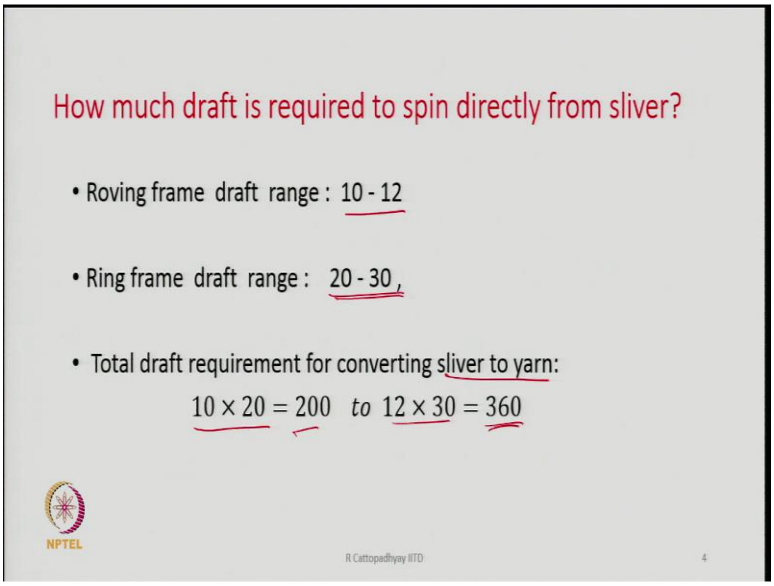

The question will come that how much draft we really require to spin directly from sliver. Now, roving frame draft rise in the range of 10 to 12, ring frame draft if we think it rise it is lying in the range of 20 to 30, and therefore, total draft requirement from sliver to yarn is could be to the order of ‘10×20’ on the lower side, 200 or it could be to the to the extent of 360 and an example I am showing it.

So, it means that if I want to convert a sliver into a yarn, the drafting system should be capable to provide a draft in the range of 200 to 360 that is the kind of draft that we require or at least 150 or more than 100, that sort of draft is what is required.

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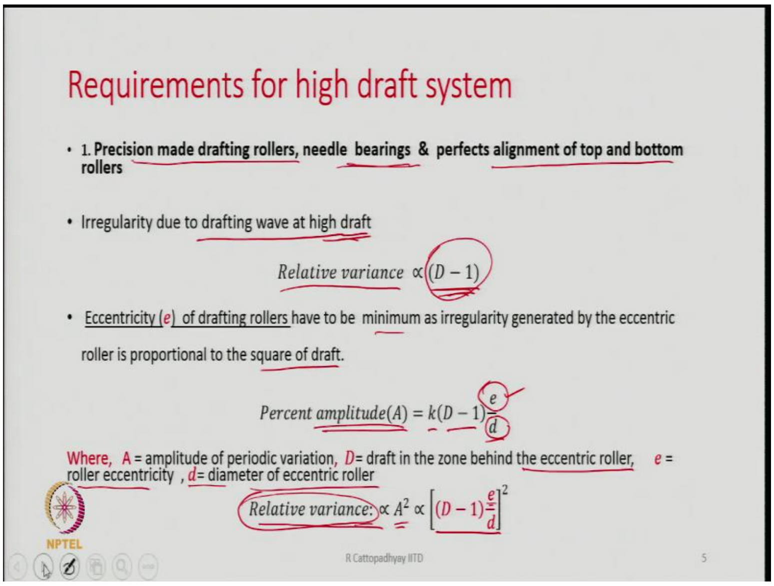

The other requirements for the high drafting systems are listed here. One is precision made drafting rollers, needle bearing and perfect alignment of top and bottom rollers. This is what is required our drafting rollers has to be much more precision made; that means, they should be the eccentricity should be minimum. Then the bearing has to be much better because the roller has to run at a very very high speed and the alignment of top and bottom roller has to be perfect.

Now, we will discuss this now why the rollers have to be you know so perfect in terms of the manufacturing precision. First of all, the irregularity that is generated due to drafting wave is proportional to ‘*D*-1’; relative variance that is the irregularity is expressed in terms of relative variance that is CV^2 will be proportional to the draft.

So, if the draft is high, the relative variance is going to be high and it is linearly related. So, if we think of going for high draft, we have to remember it will give a very high regularity irregularity also. So, we have to try to suppress the formation of drafting wave.

The other thing is the eccentricity of the drafting rollers have to be minimum as irregularity generated by the eccentric roller is proportional to the square of draft.

The rollers are eccentric; the percent amplitude in the mass per unit length because of eccentricity is,

$$= k(D-1)\frac{e}{d}$$

And, what are these parameters? ‘A’ is the amplitude of the periodic variations, ‘D’ is the draft in the zone behind the eccentric roller, ‘e’ is the roller eccentricity and ‘d’ is diameter of the eccentric roller.

So, the amplitude of variation which is generated because of the roller being eccentric is proportional to the draft in the zone behind the eccentric roller is proportional to the eccentricity of the roller itself and the diameter of the roller which is eccentric. And, therefore, relative variance here is going to be proportional to ‘A^2’ percent amplitude square and,

$$A^2 \propto \left[(D-1)\frac{e}{d}\right]^2$$

What does it mean? It means that if the roller is eccentric, the increasing the relative variance is going to be very very high. So, a small change increasing eccentricity will make a big difference in the irregularity of the drafted you know sliver. After the sliver is drafted whatever fleece we generate out of it that will be highly regular because it will be proportional to the draft and is proportional to the square of proportional to the square of draft, $(D\text{-}1)^2$ and also proportional to the e^2.

So, therefore, eccentric roller means too much generation of irregularity. And, therefore, if in the high draft system, we have to go for high draft there we have no we cannot reduce the draft in order to reduce the irregularity generation because of drafting wave. Therefore, that option is not there. But what is there in our hand that any other mechanical fault that can give that can generate irregularity, we can we reduce that or not.

And, there the option that we have in with us is the value of ‘e’ that is the roller should not be eccentric or eccentricity of the roller should be much less in comparison to the kind of roller that we can have on the ring spinning drafting system or roving frame drafting system. And, hence we write that we need precision made drafting rollers and the needle bearing; needle bearing will also consume much less energy.

And, the alignment is another important requirement between top and bottom rollers. So, all these are therefore, they become very important for high drafting system to be successful.

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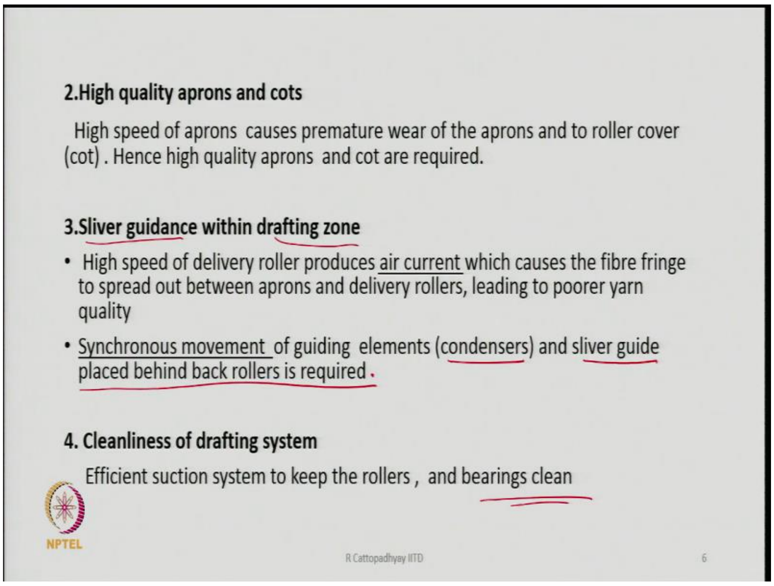

The other requirements are high quality aprons and cots. High speed of apron causes premature wear of the aprons and to the roller cover that is the cot because the speeds are much higher in this case. And, as a result the aprons will be wearing out faster the top roller cots also will wear out faster. Hence, we need high quality aprons and cot both, so that they do not wear out so fast.

The other thing is sliver guidance within the drafting zone. High speed of the delivery rollers can produce air current which causes the fibre fringe to spread out between the apron and delivery rollers leading to poorer yarn quality. With the high speed because of the air current gets generated with speed, the air current is powerful enough to disturb the array of fibres which are you know basically moving within the drafting zone.

And, if they are displaced from the original position because of the air turbulence, then it will actually be seen in the yarn in the form of lot of faults. So, the quality of the yarn will be downgraded. And, hence to avoid that what we can do that we can have sliver guidance within the drafting zone.

So, that the synchronous movement of the guiding elements like condensers and sliver guide placed behind the back roller is what is required. So, that we try to ensure that the spreading is restricted by having a sliver guide at the feed point and then also guiding element or condenser in the drafting zone. So, we do not allow the drafted material to be spread out too much that is what will be required.

Other thing is the cleanliness of the drafting system. Efficient suction system to keep the rollers, and the bearing clean. So, we get the speed are more. So, whatever suppose dust is there in the fibres, so, that dust is going to accumulate on the different parts of the drafting system and they can actually the create problem with the normal processing of the fibres.

So, we have to keep the entire system clean and for that we need the efficient suction systems, so that the rollers are clean and the bearings are also clean. So, efficient suction system, suction system is also required in this case.

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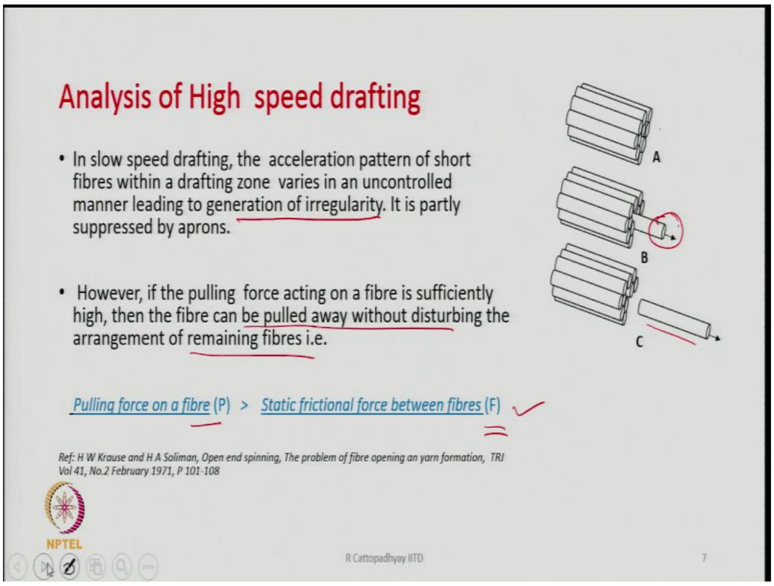

So, these are the important requirement. So, you will find that the high speed drafting systems which we have on air jet spinning machines. They are superior in these aspects otherwise this is also a basically now few pair of rollers are there, other three pair of rollers or four pair of rollers are there. So, to a layman a drafting system of air jet spinning machine or drafting system of ring spinning machine will appears to be similar.

But the difference exist in terms of quality of the rollers, the guidance system that we have and the kind of you know cleanliness that we require. Then only the drafting system will be successful. These are the requirements accordingly the all the drafting elements are manufactured.

Now, we will come to the analysis of high speed drafting. We all know that now the any drafting especially with cotton, where the short fibres are present leads to drafting, drafting generation of drafting waves or a kind of irregularity which we cannot avoid because the short fibres are there.

Now, we will study something here we will try to analyze the high speed drafting system where the fibres are withdrawal at a very high speed from the slower moving fibres. So, ultimately drafting is a basically change of speed of the fibres. So, there is a two groups of fibres - some fibres are moving at slow speed, some fibres are moving at high speed.

So, there is a transition where the speed is changing from slow to high. Now, this transition is a place where there is a possibilities of creation or generation of you can say some kind of disturbance in the motion of the fibres. Now, what happens in the case of high speed drafting we will try to analyze that.

In slow speed drafting the acceleration pattern of short fibres within a drafting zone varies in an uncontrolled manner as the acceleration pattern is changing continuously and there is no control on that and that leads to generation of irregularity. It is partly suppressed by apron.

So, the very purpose of the aprons is that the acceleration pattern is changed that we will allow the fibres to accelerate when they reach the nip of the front rollers and therefore, some guidance is given in the you know with the help of aprons. Aprons will physically grip the fibres and will actually guide them through the drafting zone and make sure that they get accelerated only when their front end is nipped by the roller of the front rollers. Otherwise, this will not accelerate out of turn.

The other thing is if the pulling force acting on a fibre is sufficiently high, then the fibre can be pulled away without disturbing the arrangement of the remaining fibres. So, if there is a bunch of fibre like here one fibre which is this one, we if we take pull it out at a very high speed. Then the arrangement of the fibres left behind is not going to be disturbed because of the inertia.

So, everything depends upon the speed with which one fibre is withdrawal from the rest of the fibres and for that what we need is the pulling force on a fibre must be much greater than the static frictional force between fibres. So, '*P*' is the pulling force and static frictional force between fibre is '*F*'. So, '*P*' if it is much more than the static frictional force '*F*' then the fibre will be drawn without disturbing the arrangement of the fibres which are left behind.

Now, this is what is important and we will try to understand this now that what is the value of pulling force and how can I find out the value of the static frictional force.

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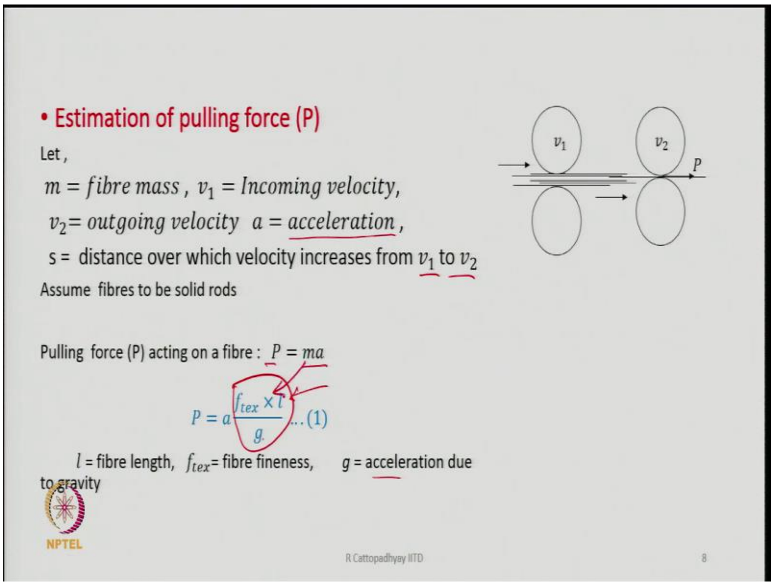

Now, estimation of the pulling force first of all. Let the mass of a fibre be '*m*' and 'v_1' is the incoming velocity of the fibre, 'v_2' is the outgoing velocity of the fibre, '*a*' is the acceleration that is as the fibre changes its velocity from 'v_1' to 'v_2' that has to be some acceleration. So, that acceleration is '*a*' and 's' is the distance over which the velocity increases from 'v_1' to 'v_2'.

Assume the fibres to be solid rods. So, the pulling force acting on a fibre is going to be 'mass × acceleration', 'P' is going to be 'ma', 'm' is the mass of fibre and what is the fibre mass? Fibre mass is basically this one. If 'l' is the length of fibre, 'f_{tex}' is the fibre fineness in tex, and 'g' is the acceleration due to gravity. So, '$f_{tex} \times l$' will give you the weight of the fibre and that divided by 'g' will give you the mass of fibre.

We have to make sure that the units are compatible, then we will directly get the value of we will get 'm' from the values of the 'tex' value of the fibre and the length of fibre. So, length and 'tex' value of fibre from there if you multiply will get the weight and the weight divided by the gravitational acceleration will give you the mass. So, 'm' is this, 'P' becomes 'ma'. So, 'm' is basically this one.

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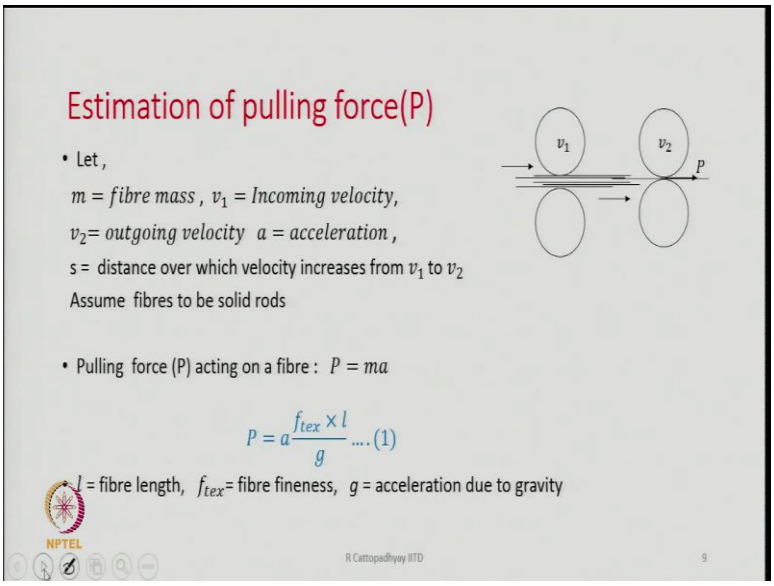

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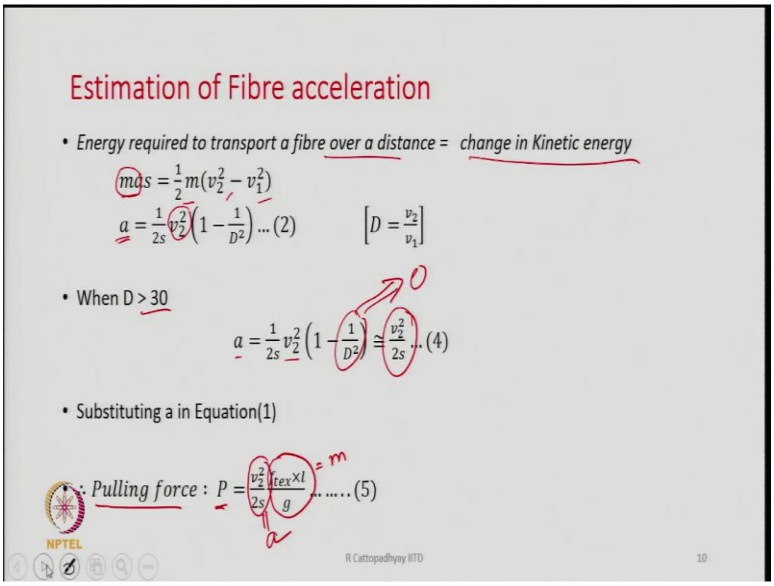

Now, we go to the next page that is estimation of fibre acceleration. So, mass that so, we can find it out now what is the acceleration of the fibres? Now, here first of all the energy required to transport a fibre over a distance is basically is change of kinetic energy. That means,

$$mas = \frac{1}{2}m(v_2^2 - v_1^2)$$

Because the speed is changing from 'v_1' to 'v_2'.

So, force into displacement; this is the force, 's' is the displacement. So, this side is energy and the right hand side is also kinetic energy. So, they can be equated and then from there we can find out what is the value of 'a'. So, 'a' becomes,

$$= \frac{1}{2s}(v_2^2 - v_1^2)$$

I divided it by both the term by 'v_2'.

And therefore, it becomes '1-(1/D^2)', that is I am dividing 'v_2^2 / v_2^2', 'v_1^2/ v_2^2' and by because I am dividing it I am bringing 'v_2^2' in the numerator. If I do it by doing so, I can change the expression within the bracket that we have that expression has been changed and we have now got the value of the draft 'D' where 'D' is the ratio of 'v_2/v_1'.

Now, when 'D' is quite high, that is 'D' is suppose greater than 30. then '1/D^2' becomes '1/900'. So, '1/900' is very very low value is almost. So, '1-(1/900)' is almost close to 1 and therefore, the value of '*a*' becomes '$(1/2s)v_2^2$' and practically it becomes '$v_2^2/2s$' because '$1/D^2$' becomes this becomes quite close to 0.

So, 'a' become,

$$a = \frac{v_2^2}{2s}$$

substituting this value of a in equation (1) we can write the pulling force '*P*' is '$v_2^2/2s$' that is basically '*a*', and this is the mass of fibre, this is '*m*' and this side is '*a*'.

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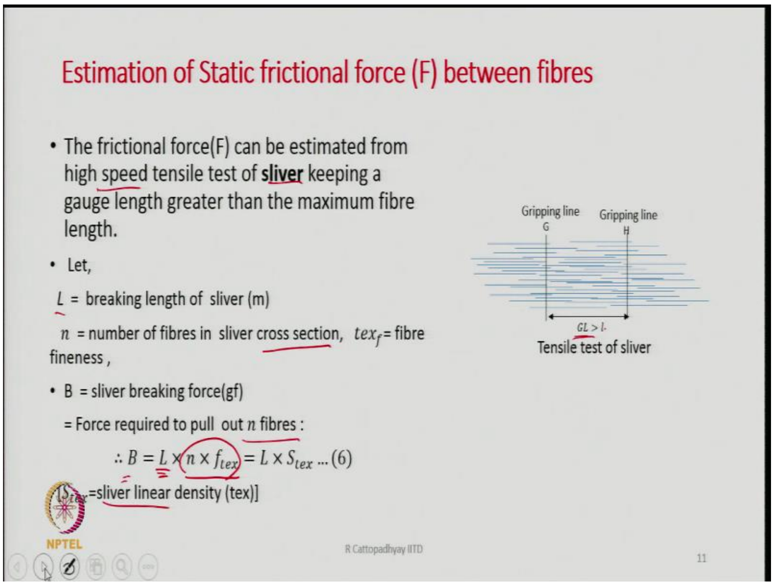

Now, the frictional force between the fibres, for that what we need to do we have to take a sliver and actually test strength on a tensile tester. So, frictional force can be estimated from the high speed tensile test of a sliver keeping a gauge length greater than the maximum fibre length. Like it is shown here; here is a sliver and this 'GL' stands for gripping length or gauge length.

Now, if we gauge length is much larger than the length of the fibre. So, that not a single fibre you able to span from gripping line 'G' to gripping line 'H'. All the fibre should be shorter than this and then we go for high speed tensile test. So, we will get some value of the strength of the sliver. Let '*L*' be the, '*L*' becomes the breaking length of sliver in m, that is the length of sliver which will cause the sliver to break if it is hung.

So, if it is hung then due to the if the length is '*L*' at this length the sliver is going to break that is called the breaking length and '*n*' is the number of fibres in the sliver cross sections and '*B*' is the sliver breaking force. The sliver breaking force is the force required to pull out '*n*' fibres and that is going to be basically '*B*' where '*B*' is going to be the '$L \times n \times f_{tex}$'.

What is '$n \times f_{tex}$'? '$n \times f_{tex}$' is basically the sliver linear density or sliver, tex value of the sliver. Amount of fibres in the cross section multiplied by the tex value of the average tex value of this fibre will give you the sliver linear density, so that multiplied by '*L*' the breaking length of sliver will give you the breaking force of the sliver will get the breaking force of the sliver '*B*'.

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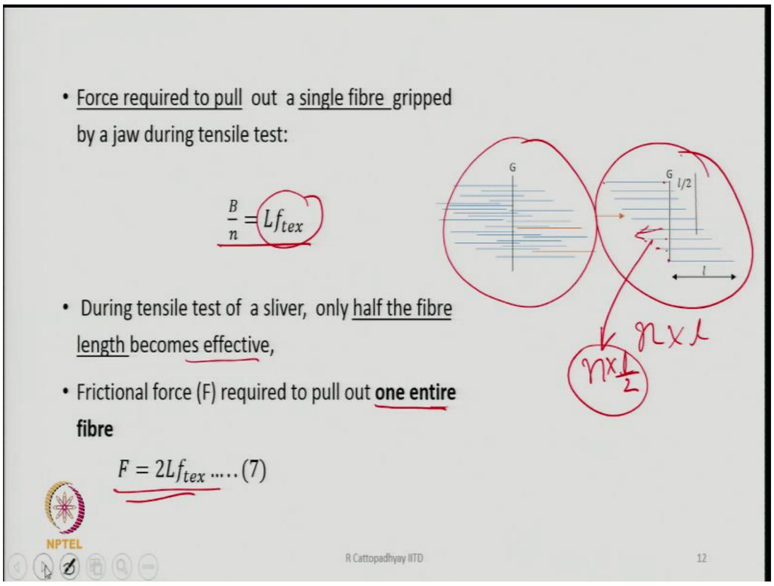

And now, force required to pull out a single fibre gripped by the jaw during tensile test can be found out. '*B*' is how much? '*B/n*' or we have already found out the sliver strength is '$L \times n \times f_{tex}$'. So, '*B/n*' is going to be '$L \times f_{tex}$'. Now, during tensile test of the sliver only half the fibre length becomes effective.

When we removes suppose this is the sliver this is going in this direction and this jaw is going in this directions or this jaw may be stationary. Even if it is suppose if I say that this jaw is not moving the other jaw is moving so, fibres are getting separated from each other. Now, when it gets separated the number of fibres which are gripped under a jaw, jaw '*G*' or suppose this jaw.

Now, what we have done? In the next diagram what we are showing this jaw which is let us say going which is separated bunch of fibres in this jaw. So, this is the after the sliver has broken these are the fibres gripped by the gripping line of the jaw at the point '*G*' and now these are the fibres which are projecting out on the right hand side. Now, if I arrange these fibres in order of decreasing length then we get a picture like this.

Now, in this picture what we find? That the length of fibres which are gripped here the length which is on the left hand side of it is basically will be how much will be whatever is the total length of fibre only half of it on an average is actually projecting on the left hand side.

So, if the number of fibres are 'n' there is fine that does not change, but the if the length of fibre is each fibre is small 'l' the total length of fibre is '$n \times l$', but the fibres which are on this side is actually '$n \times (l/2)$' and on the other side also similarly, it will be '$n \times (l/2)$'.

So, these fibres are basically '$n \times (l/2)$', because there side fibre here which is projecting on the left hand side almost 0, the next one is only this much, next one is only this much this is the maximum length which is projecting out. So, on an average we can see the left hand side projecting out fibres is only '$l/2$'.

Therefore, when the separation takes place actually half the fibre length is participating in it. And, therefore, frictional force required to pull out one entire fibre, but when I try to remove one fibre from rest of the sliver then the entire fibre length has to be pulled out because rest of the fibres are actually surrounding the fibres which is being pulled out.

And, therefore, the frictional force required to pull out one entire fibre is going to be not 'Lf_{tex}', but '$2Lf_{tex}$' that is the difference. So, I am pulling out one fibre from rest of the other fibres which are surrounding it.

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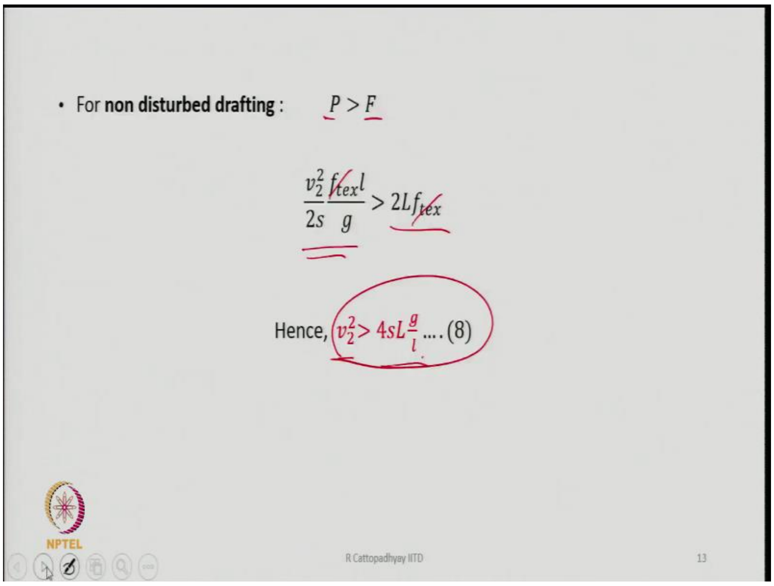

From there we can write now that for non disturbed drafting, $P > F$, this is the conditions. 'P' is much higher than 'F' the static frictional force then that fibre will be drawn and rest of the fibres will remain in that position they will not get disturbed. So, 'P' has to be more than 'F' and that basically means,

$$\frac{v_2^2}{2s}\frac{f_{tex} l}{g} > 2Lf_{tex}$$

So, this is the condition you have to meet and from there we can say that basically means that,

$$v_2^2 > 4sL\frac{g}{l}$$

say 'f_{tex}' and 'f_{tex}' will cancel on both side. So, v square is going to be '2×2' should be '4s' and 'g' will go to the numerator 'L' remains what it is and 'l' comes in the denominator.

So, we will be left out with this equation that is 'v_2^2' has to be greater than '4s', 's' is the distance over which the fibre is accelerating and 'L' is the breaking length of sliver, 'l' is the fibre length that we have chosen and 'g' is the acceleration due to gravity.

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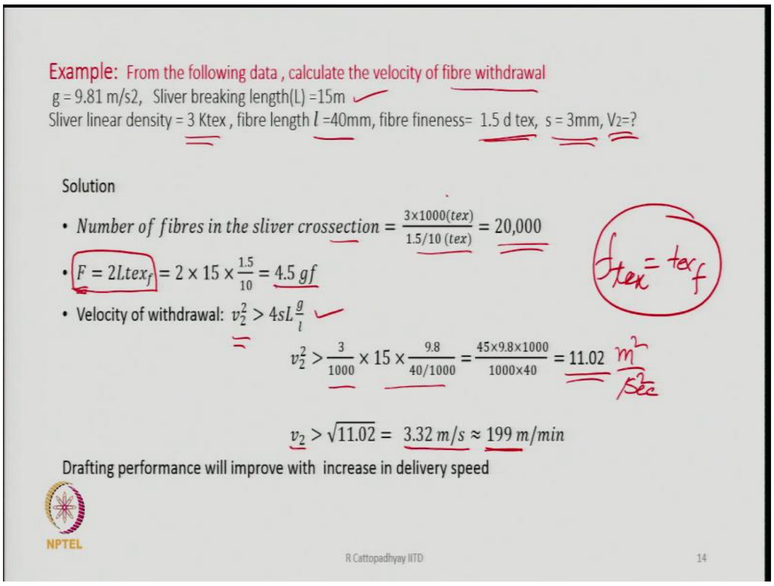

So, from there ok, now from there what we are doing we are trying to solve a simple numerical example. What is stated here that from the following data calculate the velocity of fibre withdrawal? 'g' value is been given. Sliver breaking length is 15 m, this is drawn sliver. So, is breaking length is much less. A card sliver is much more stronger or a drawn sliver is going to be very very weak which is twice drawn sliver.

Sliver linear density is 3 Ktex, the sliver is practically quite fine. Fibre length is 40 mm, fineness is 1.5 dtex and 's' has been considered to be 3 mm that is displacement over which it gets accelerated is 3 mm. So, what is the going to be the value of 'v_2'? So, first of all we are calculating what is the strength of the sliver first of all.

Number of fibres in the sliver cross section is 'sliver tex/fibre tex'. This simple formula that gives you a figure 20000; that means, there are 20000 fibres are there in the cross-section of the sliver and the force sliver breaking force 'F', not sliver breaking force the force that you need to withdraw a fibre 'F' equal to '$2Ltex_f$' or you know earlier I have written I think 'f_{tex}' meaning basically same. So, whether 'f_{tex}' and in this case 'tex_f' as basically same.

So, this is the force that you need to withdraw a fibre following the previous same you know expression I am using and that gives you a value 4.5 gf. So, the velocity of withdrawal has to be again using the same formula other formula that we have deduced earlier. So, 'v_2^2' is '$4sLgl$'.

So, these values I am just substituting and getting a figure 'v_2^2' to be 11.02. This will be velocity square; that means, this unit is going to be 'm^2/s^2' and then 'v_2' is going to be therefore, sqrt(11.02) and that gives you a figure 3.32 m/s and I convert it into m/min multiplied by 60 this gives you a value 199 m/min.

So, it gives you an idea that if I maintain a very high speed of withdrawal in this example, the withdrawal speed is almost 200 m/min, then the irregularity generation because of the drafting wave is going to be much less. So, even though the draft is very high because the speed is also simultaneously very high therefore, the irregularity that we normally you know expect when you go for higher and higher draft that will not be there in this case.

So, the yarn will be quite regular. Otherwise, in the ring spinning kind of system where if we try to go for higher draft, but the speed we do not change then their irregularity will be quite high in the yarn and that will not be acceptable in the market. So, if the draft is high, but speed is low it will not work. But, if the draft is high and speed also is also high then irregularity is not going to be more, irregularity will be practically same or may remain little less.

So, therefore, high delivery speed is beneficial, but for that we have to see the roller has to be more eccentric. So, other you know precaution that we have to take and other counter measures we have to take in order to make sure that the aprons have a reasonable life. So, apron quality has to improve and the quality of cots has to improve and lot of turbulence gets generated.

So, lot of dust gets you know settled on the drafting system either dust from cotton even the dust fibres dust from other fibres also. The spin finish will if we try to process synthetic fibres, the spin finish will also deposit on the drafting system and hence we need a very efficient cleaning system and that means, basically some kind of suction arrangement. So, suction arrangements are must for such kind of drafting system.

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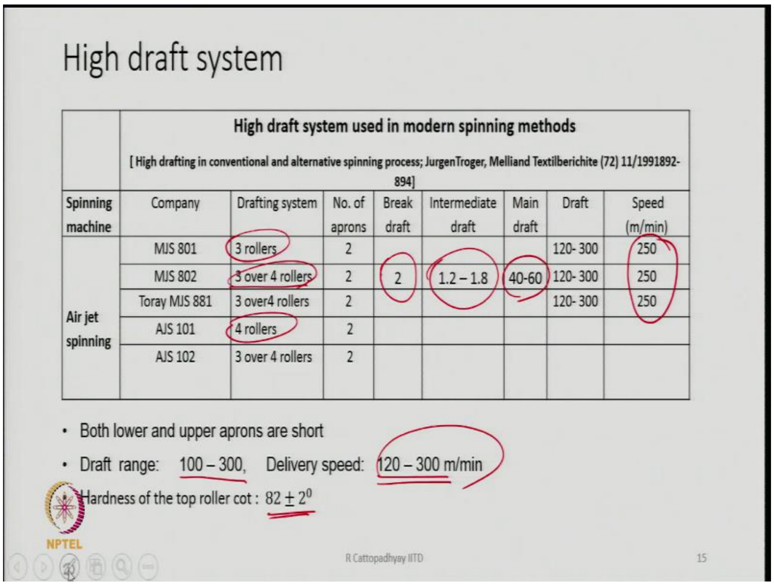

Spinning machine	Company	Drafting system	No. of aprons	Break draft	Intermediate draft	Main draft	Draft	Speed (m/min)
Air jet spinning	MJS 801	3 rollers	2				120- 300	250
	MJS 802	3 over 4 rollers	2	2	1.2 – 1.8	40-60	120- 300	250
	Toray MJS 881	3 over4 rollers	2				120- 300	250
	AJS 101	4 rollers	2					
	AJS 102	3 over 4 rollers	2					

So, high draft system some know figures are given here in this table. So, we see that most of the drafting system are either 3 roller or 3 over 4 rollers are also there and 4 rollers are also there. So, these are the three types of drafting system by different machine manufacturers and we have 3 over 3, 3 over 4 or maybe just 4 rollers is 4 over 4 type of systems are there and draft range could be anywhere between 100 to 300.

The delivery speed could be in this range or maybe more in the recent times because there is always some improvement which is happening on these machines. So, speeds are increasing. The hardness of the top cot is to the order of 82 ± 2° shore hardness and some typical speeds are given here. So, it is not that the speed is fixed at this level, speed range is also there. Say, these are that delivery speed range typically.

So, one can vary the speed in this range. Again, in some cases it can go up to 400 m/min also and the draft is distributed into break draft, intermediate draft and the main zone draft. This is how the draft could be there. It is a three zone drafting system. It is a just a now it is a typical values have been given here, so, but it may vary from machine to machine from manufacturer to manufacturers.

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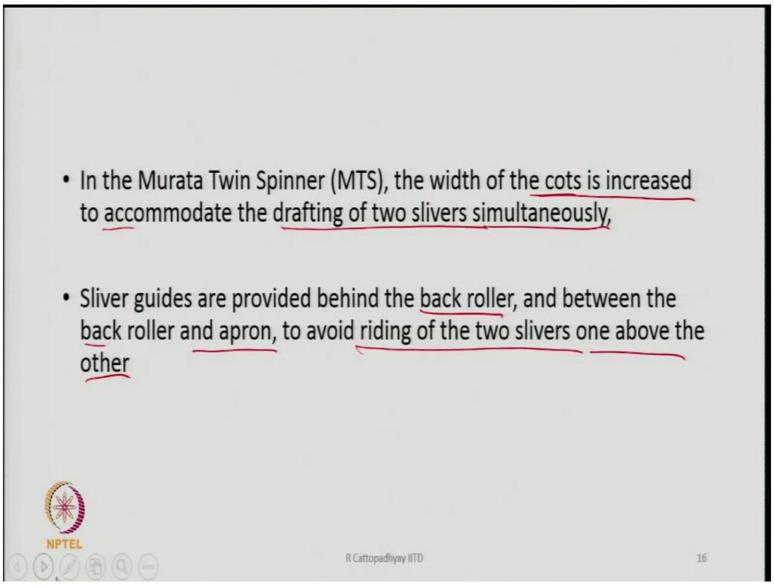

In Murata Twin Spinner, the width of the cots they have this has been increased to accommodate what? Drafting of two slivers simultaneously. See MTS, Murata twin Spinner that means, I am drafting two slivers simultaneously. Therefore, the width of the drafting rollers has to be more because two slivers have to be we have to feed together.

And, sliver guides are provided behind the back roller and between the back roller and the apron, to avoid riding of two slivers one above the other to avoid that. So, some guidance is required. So, this will never you know get entangled between themselves. That is the important thing. The other thing is also it will restrict the width of the drafted fleece that will ultimately produce.

See drafted fleece also is important here we will study you will see that that the width of the drafted fleece is something which is very important in the case of air jet spinning, like we want the width to be more. Whereas, in the case of compact spring we want the width of this drafted fleece or you can say the sometimes it is called also we can say that delta zone of the spinning that width should be as low as possible in the case of compact spinning. But, in the case of Murata air jet spinning system, it has to be just opposite. It has to be widened, not less.

So, we will study that why do you need a wider spinning triangle in the case of air jet spinning system whereas, we did a very very small spinning triangle in the case of compact spinning system. So, the requirements are different in the case of air jet spinning we need basically wider spinning triangle. So, we have to we will understand why we require this gradually.

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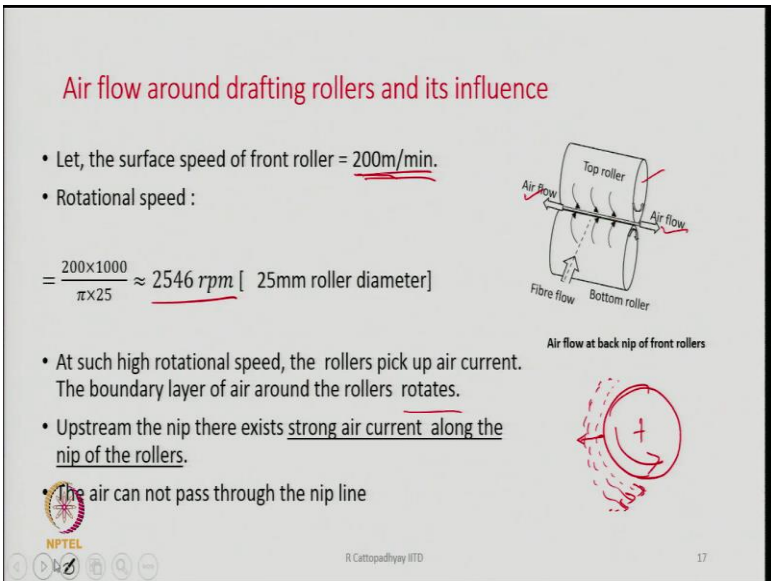

The next thing which is important is air flow around the drafting rollers and their influence. Let us say the surface speed of the front roller is 200 m/min the typical speed we have chosen 200 m/min, it could be 150, it could be 220 also, it could be 300 also. So, one speed we have chosen as an example.

Now, rotational speed of the roller is going to be in this case how much? 2500 rpm. So, the front roller is rotating at a speed of 2500 rpm, if it is producing at the rate of 200 m/min. So, the roller speed is extremely high almost 10 times than the speed of the front roller on ring spinning drafting system. There the speed could be 250, 280 rpm in that range because there the linear speed or surface speed of the roller is to the order of 15, 18 or 20 m/min at the most and here it is 10 times of that.

So, rotational speed also is very very high. At this high rotational speed some problems we generated and we have to tackle those problems. One is at such a high speed the roller picks up air current and the boundary layer of air around the roller also rotate. As we shown here you know, the top roller and the bottom roller you see this arrows are indicating that the air, how the air surrounding the roller is also moving. If a roller rotates at a high speed, this layers of air surrounding the roller will also rotate at a high speed.

Immediately the boundary layer will have maximum speed because it is close to the surface, as we go away from the boundary layer the velocity is going to be less and less. That means, any whenever a roller rotates in the medium of air as a roller rotates the boundary layer also rotates along with the air and what happens because of this? The boundary layers that is with the top layer and the boundary layers of the bottom layer these two boundary layers are actually meeting each other at the nip of the two rollers.

Now, when they meet at the nip of the two rollers, they cannot pass through the nip line because the top roller is covered by a cot and the bottom roller is made of steel. So, between them there is a pressure and the nip is such that there is no escape route for the air to pass through it is completely sealed. So, these air current which is there cannot really pass through the nip and therefore, they will start moving along the nip as it is shown the air flow directions are now shown.

So, these two air currents which is quite powerful because the speeds are very high they meet at the back of the top and bottom rollers and because they have no way to escape through the nip they will move sideways, both sides. And, this movement of this air is going to disturb the flow of fibres.

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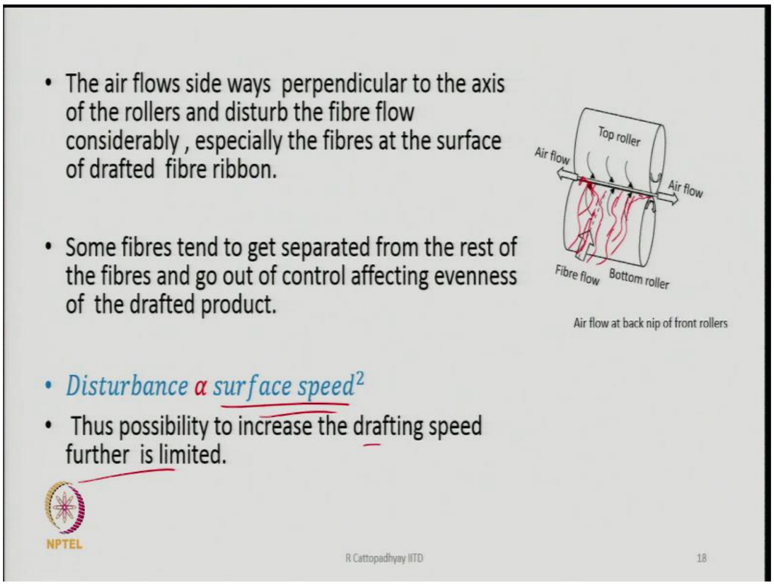

The air flow whatever fibres are there now here these fibres which are flowing here let us say these are the fibres these fibres are going to reach the nip, and they will be gripped by the nip, but while they are trying to arrive at the nip point the air flow is going to divert them. So, some fibres will from the straight line path they will bend a bit. So, the drafted fleece is going to widen because of this air current behind the nip of the two rollers and hence the spinning triangle is going to widen.

Now, the current is too powerful then this can disturb the flow of fibres and as a result it can affect the quality of the yarn also we want the you know spinning triangle to be wide, but at the same time you should make sure that it is not too wide or the fibre arrangement is not disturbed by the air current which is generated because of the rotation of the rollers.

So, the disturbance that is gets created basically a function of or proportional to surface speed square. Small change in speed, but a speed can make a big difference in the you know way the fibres behind the rollers are moving and therefore, it can really affect the regularity of the yarn. So, thus the possibility to increase the drafting speed further is limited because of these reasons.

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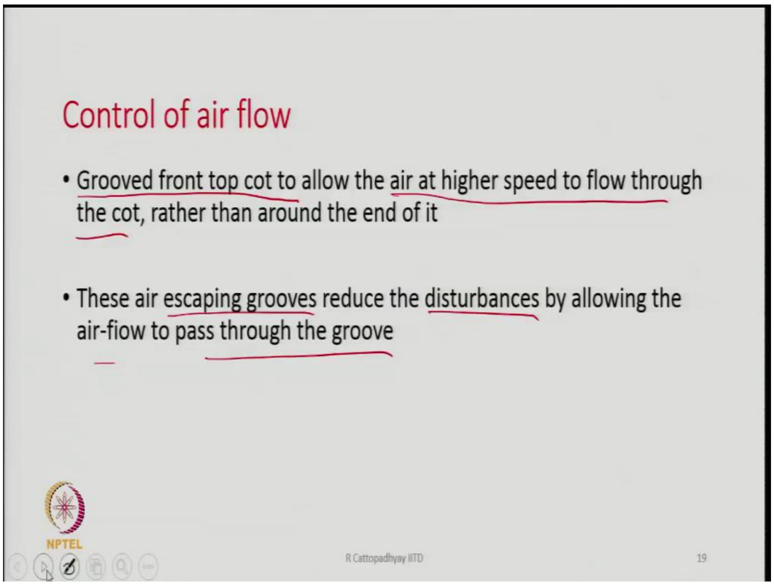

And, manufacturers are also thinking of going for higher and higher speed so, what has been done is going for grooved front top cot. So, the top cots that we have on the front roller front top roller is having grooves on the surface, and these grooves will allow the air at higher speed to flow through the cot because of where the groove is located the nip is not there. So, there is a passage for the air to pass through.

So, you allow some air to pass through by having grooves on the surface of the top roller and that way we can control to some extent the flow of this air along the nip line. So, this air escaping grooves reduce the disturbance, by allowing air flow to pass through the groove. So, and because of this we have been able or the companies have been able to raise the speed of drafting further.

So, that is what you know kind of development that has happened in the basically cots design that the cots are having now some grooves. With this I think we close this session on drafting. So, otherwise whatever drafting you have learnt while studying the ring spinning machines or while studying the speed frame or roving frame, practically it remains same and the only difference is here speeds are high, draft is also high.

And, because of these two there is possibility that it can drafting irregularity could be very high or as we have shown that a high speed does not necessarily mean and high sorry a high draft in combination with high speed may not generate so much of irregularity as one would otherwise expect. But the this is very sensitive the irregularity generations are sensitive to the mechanical fault of the rollers and the gears and the bearings.

Therefore, the rollers, bearings and the gears which are driving the rollers everything has to be much more precision made in comparison to what we have in the case of normal ring spinning machines. And, I think with this we close this particular topic of drafting on air jet spinning machines and the drafting system for vortex spinning machine also practically same, and if in a similar drafting system is also used in DREF-3 friction spinning machines, ok. With this we close this session.

Thank you.