# New Spinning Technologies
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## Lecture - 03
## Principle of Yarn Formation

So, Today we are going to discuss Principle of Yarn Formation.

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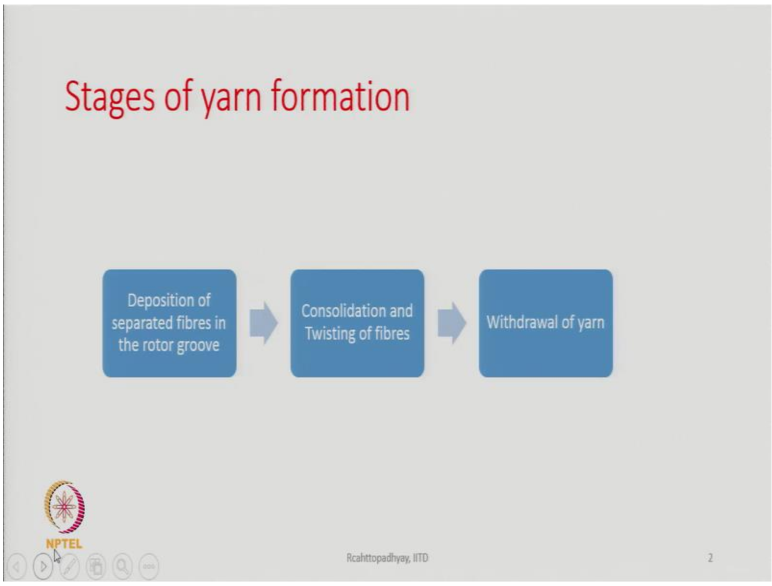


Now, let us look at the slide the stages of yarn formation is stated here; the first stage is deposition of separated fibres in the rotor groove. So, we have already discussed that once the fibre is fed there is a opening roller which will separate the fibres and then feed them into the rotor. So, separated fibres are actually landing on the wall of the rotor and from there they move towards the rotor groove.

Now, once they are settle there, the next stage will be consolidation of the separated fibres. So, consolidation we will see that they are basically due to the centrifugal force which will be acting on the fibres. So, this consolidated fibres are now twisted by the rotor. So, rotor is the twisting element in the case of rotor spinning and we will see also how the rotor actually exert twist into the bundle of fibres.

So, once the twist is inserted into the fibres, the job that is left now is simply withdrawal that we need to remove the twisted fibres from the rotor and then wind the yarn on to a package. So, we will see how the yarn is wound on to a package later on or however, the yarn formation can be seen as if it consist of three separate stages of operations deposition of fibres, consolidation of fibres, followed by twisting and withdrawal. The fibre deposition process is very interesting and we should look into it carefully.

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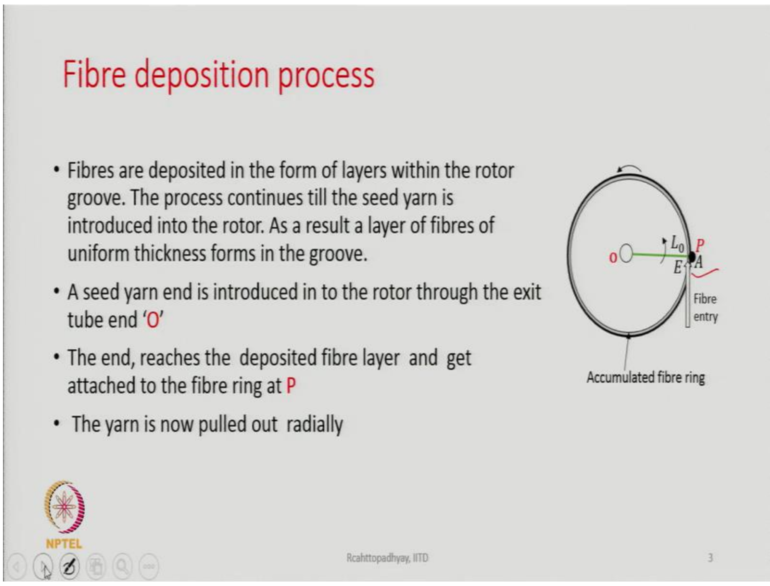


Now, in the diagram what we see here a circle, the circle represents the rotor groove and within the circle represented by the black line, very firm black line which is the rotor, you see another thin line ok that is basically indicating the deposited fibres which are there in the rotor groove. So, fibres are deposited in the form of layers after layers into the groove. The fibre entry point is shown here; 'E' indicates the fibre entry point in this case.

The process of fibre deposition continues as the rotor rotates and fibres are continuously fed. And this will continue till the seed yarn is introduced into the rotor when you want to spin the yarn we have to have a bit of already formed yarn with us which we will feed through the feed tube and the yarn end will be sucked, it will go inside the rotor and from there this yarn end will reach the point shown as here 'P'; that is they will be coming into contact with the deposited fibres which are there.

So, the feeding point of the fibres is the so, as soon as we start feed the operation starts the layer start building up, at the same time we feed a yarn and the yarn end comes into contact with the fibres which are deposited in the groove. The deposited fibres initially will have a uniform thickness. Now as soon as the end reaches the deposited layer, it will get attached to it because the rotor is rotating and the yarn has started getting twisted or it is receiving torque.

So, what will happen? The end of the yarn which is in contact with the fibres in the rotor groove that is the point ‘P’ it will get entangled with the existing fibres which are there and it will be you can say that the yarn end which we have fed will somehow get tied up with the fibres which are already there and hence a joint gets built up and now we start pulling the yarn out that is the stages what happens.

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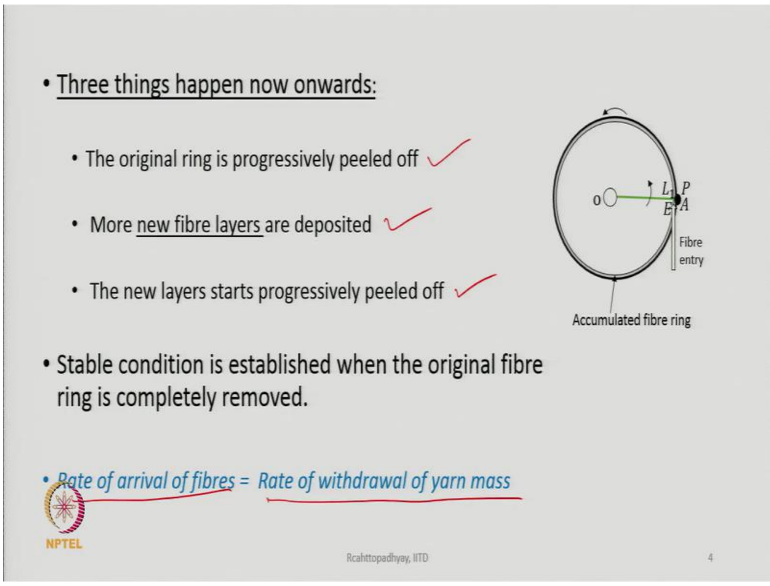


Now, let us say that as soon as the we start pulling the yarn out after feeding the seed yarn what happens? There are three things happens now. One is the original ring of fibres is progressively peeled off. Fibres are already there because before we feed the seed yarn end we have already started actually feeding the material that is there is little no tiny gap between these two we must feed the fibres first and then only we will feed the seed yarn.

So, the seed yarn end must see the fibres existing in the rotor groove. If there is nothing there the seed yarn end will not be able to get entangled with the fibres. So, first we feed the fibres and then we feed the seed yarn end. So, once you start pulling the yarn out the original fibre ring which is there which will be peeled off gradually and now onwards more new fibre layers will be deposited simultaneously because feeding is happening continuously. The new layers start progressively peeled off.

So, one is the original fibre ring which was existing before we fed the seed yarn and now onwards a new layers of fibres will start building up. So, there is distinction between these two one is the original fibre ring which is uniform in thickness and once the yarn will start pulling the yarn out new layers will start building up and you will see what is the difference between these two.

Stable condition is established when the original fibre ring is completely removed and we will have a layers of fibres within the rotor, but we will find that the thickness of the layer is not uniform it will be tapered. Why it will be tapered? that is what we are going to discuss.

In the stable conditions, the rate of arrival of fibres should be equal to the rate of withdrawal of the yarn mass because we are trying to pull the yarn out at the same time I am feeding the fibres from this fibre. So, there has to be a mass balance. So, rate of feeding of fibres and rate of taking out the fibres in the form of yarn must be same.

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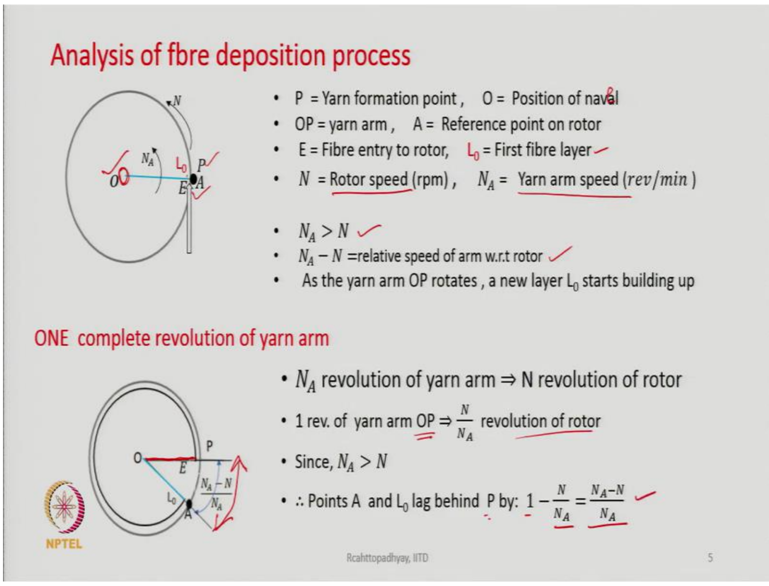


How we will analyze this one analysis of fibre deposition process? Look at the you know diagram on the left hand side first let us you know concentrate on that. What is written here that 'P' is the yarn formation point. So, this is the point where 'P' is there at the beginning ‘P’ is a point on the in the rotor groove and we can say this is the point where fibres are just getting transformed from a parallel array to a twisted bundle we call it yarn formation point.

Then ‘O’ is the position of the navel this is the of the navel, ‘OP’ is the yarn arm shown by the blue color take-off nozzle is there we call it actually navel which is at the center point of the rotor from there to the groove of the rotor the yarn that exist we call it yarn arm. So, ‘OP’ is the yarn arm.

‘A’ is an reference point on the rotor, ‘E’ is the fibre entry point because you know that we have already discussed this the separated fibres are fed through a fibre feed duct or a transport channel. So, the transport channel end say is ‘E’. ‘$L_0$’ is the first fibre layer which is going to be built up it is not yet there it will be there. ‘$N$’ is the rotor speed and ‘$N_A$’ is the yarn arm speed and what is written here?

‘$N_A > N$’ that is the speed of the yarn arm ‘OP’ is greater than the speed of the rotor and ‘$N_A - N$’ that become the relative speed of the arm with respect to rotor. And as soon as the yarn arm ‘OP’ starts rotating, why does it rotate? Because we pull the yarn out.

If we do not pull the yarn out then the yarn formation point speed and the speed of the rotor will be exactly same, but the moment we start pulling the yarn out the speed of rotational speed of the yarn arm which is ‘OP’ will be greater than the rotational speed of the rotor because I am pulling the yarn out. So, the ‘P’ point with respect to the rotor will keep travelling along the periphery of the rotor.

So, ‘$N_A$’ is always greater than ‘$N$’ and the difference between these two is the relative speed of the arm with respect to rotor like speed of the spindle in a ring frame is different from the speed of the traveler there is a difference between the speed of these two similarly here also there is a speed difference ok.

Now, we want to visualize what happens after one complete revolution of the yarn arm that is ‘OP’? So, what it is shown here in this diagram? You look that ‘OP’ is here this is my ‘OP’, ‘P’ point has come over there, ‘OP’ is here it has made ‘OP’ has made one revolution where the point ‘A’ will be ‘A’ is the reference point on the of the on the rotor wall.

So, ‘A’ is moving at the speed of rotor, but ‘P’ is moving at the speed which is higher than rotor. So, ‘P’ is always moving ahead of ‘A’ and therefore, when ‘P’ makes one complete revolution ‘A’ will be behind ‘P’ and what is the gap between these two? That is what is shown here, but when one revolution of the yarn arm ‘OP’ is equal to ‘$N/N_A$’ revolution of the rotor because ‘$N_A$’ revolution of the yarn arm is equal to ‘$N$’ revolution of the rotor.

Since ‘$N_A>N$’, the points ‘A’ or ‘$L_0$’. ‘$L_0$’ is the starting point of the new layer which is ‘$L_0$’, ‘L’ stands for layer and ‘0’ is the very first layer. So, they will lag behind ‘P’ how much? [1-$(N/N_A)$] and that is [$(N_A–N)/N_A$] that is what is shown here it is from here to there this is the lag in terms of revolution. So, point ‘A’ is lagging behind point ‘P’ by how much? [$(N_A–N)/N_A$] revolution ok.

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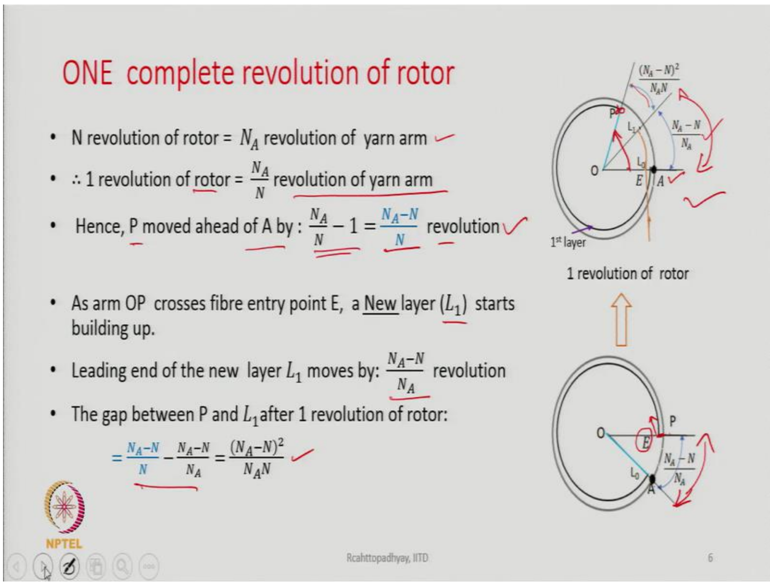


Let us go to the next slide now. One complete revolution of the rotor that diagram is shown here we want to see once the rotor makes one revolution how the picture looks like? So, when ‘A’ has reached here where is ‘P’? ‘P’ must have gone ahead of ‘A’. So, ‘P’ is somewhere here as shown in the diagram. So, ‘A’ is here ‘P’ is there now the moment first of all try to find out how far ‘P’ will be ahead of ‘A’. So, *‘N’* revolution of the rotor is *‘$N_A$’* revolution of the yarn arm.

So, they are revolution per minute or revolution per second whatever we can imagine. So, many revolution per unit time. Unit time could be second or minute it does not matter. So, one revolution of the rotor is *'$N_A$'* by *'N'* revolution of the yarn arm and therefore, 'P' moves ahead of 'A' by how much? The difference between these two [$(N_A/N)$-1] because one revolution of the rotor.

So, that basically means it is [$(N_A-N)/N$] revolution so; that means, this whole from here to there which is not shown this rotation is [$(N_A-N)/N$] revolution. As 'OP' crosses the fibre entry point the moment it crossed it will be like; this is the previous diagram. So, from here we are going there when 'P' was here and then start going moving a new layer start building up behind 'P' and that is the layer '$L_1$' now.

'$L_0$' was the previous layer now '$L_1$' has started building up because just behind 'P' you see there is an empty space there is no fibre there because all these fibres have been removed or these fibres have been transformed into a yarn and then they have been pulled out. So, the moment 'P' crosses this point that is the fibre entry point 'E' which is here a new layer starts building up that is the layer which is '$L_1$'.

So, we are showing the layer '$L_1$' by orange color. Now how far will be '$L_1$' front end from 'A' or 'A' is the point the reference point on the rotor, 'A' has made one complete revolution. This will be exactly equal to how far 'A' was behind 'P' when 'P' made one revolution. Therefore, this distance and this distance are exactly same; they will be exactly same; they will not be different from each other.

So, we have found out that as 'OP' crosses fibre entry point a new layer '$L_1$' starts building up leading end of the new layer '$L_1$' moves by how much? [$(N_A-N)/N_A$] that is this value what is shown here. So, the gap between 'P' and '$L_1$' now we are interested to know this gap 'P' and '$L_1$' this gap this is what we interested to know. This will be the total is this value from here to there minus this one the total is how much? 'P' is ahead of 'A' by this and '$L_1$' is ahead of 'A' is by this value.

So, difference between these two will give me the gap between '$L_1$' and 'P' and that is what has been done here; if I do this subtraction we get a figure [$(N_A-N)^2/(N_AN)$]. So, that is the gap between 'P' and '$L_1$'. So, a small gap is created 'P' and '$L_1$'. 'P' is moving forward as 'P' moving forward it is removing the original fibre ring, it is removing fibres from the layer '$L_0$' also.

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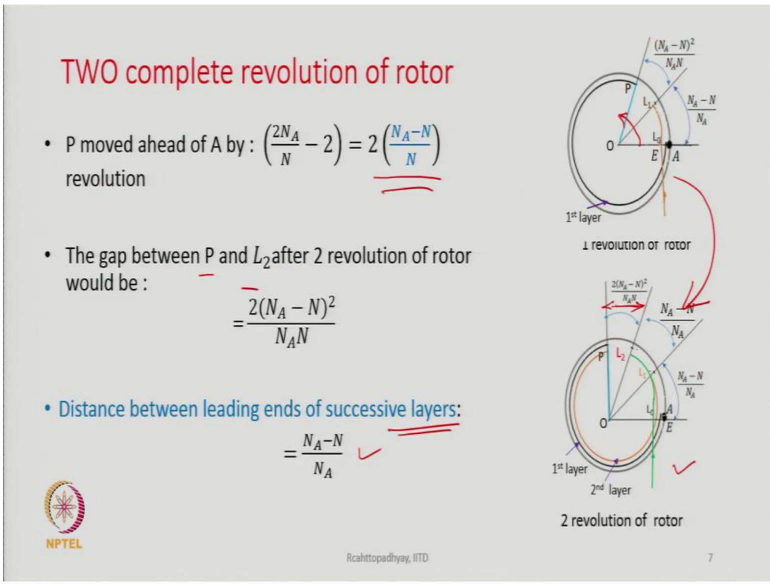


Now is still it is rotating further and further and we will see what happens when it makes two complete revolutions. After two complete revolution of the rotor 'P' moved ahead of 'A' is what is shown here can be is from here to there and this value is going to be $2[(N_A-N)/N]$.

The gap between 'P' and '$L_2$' after two revolution of the rotor would be $[2(N_A-N)^2/(N_AN)]$. See two revolution of the rotor diagram is shown here this is for the one revolution from here we are going there actually. So, now, 'P' is here and when 'P' cross the point 'E' another layer started building up which is shown by the green color. So, every time 'P' is crossing point 'E' a new layer starts getting formed.

So, we had original fibre ring; then the very first layer '$L_0$'; the second layer '$L_1$'; now the third layer has started building up and that is shown by the green color. So, the gap between 'P' and '$L_2$' is this. Whatever was the previous figure when it made one complete revolution it is just double of that and the distance between the leading ends of successive fibre layers you see from '$L_0$ to $L_1$', '$L_1$ to $L_2$' all these distances are $[(N_A-N)/N_A]$, they will be all constant.

So; that means, we are building layers after layers are falling on each other, but there is a shift between the ends and how much is the shift? The shift is equivalent to $[(N_A-N)/N_A]$ revolution that will be the distance between successive layers.

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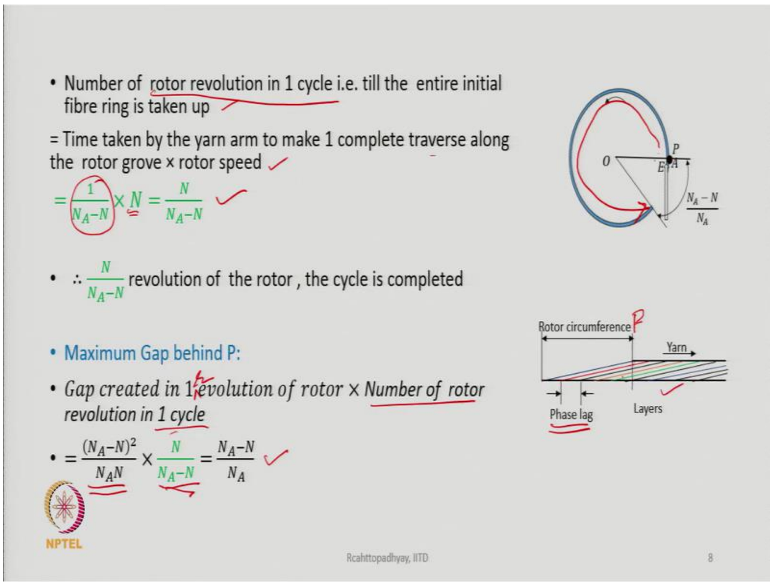


And this process will continue till the original fibre ring is completely removed and then we will have layers of fibres formed one after the other and how they will look like we will come to that. First, number of rotor revolution in one cycle will be, that is till the entire initial fibre ring is taken up or withdrawn that is going to be 'Time taken by the yarn arm to make one complete traverse along the rotor groove × rotor speed'.

See point is, both the rotor as well as the yarn formation point 'P' both are moving together simultaneously and their relative speed is '$N_A$' minus small n sorry '$N$' and therefore, a bit of fibre layer is transformed into a yarn and then that is removed and therefore, it takes goes on for several cycles several rotation of the rotor still the entire fibre ring which was deposited right at the beginning that is before the seed yarn was introduced that layer will be completely removed after this many revolution of the rotors.

So, we call it the rotor revolution in one cycle that is time taken by the yarn arm to make one complete traverse along the rotor loop which is going to be this much multiplied in this time how many revolution the rotor is going to make multiplied by '$N$'? So, this is the number of revolutions of the rotor in one cycle and the maximum gap behind 'P' is the gap created in 1 revolution of the rotor multiplied by number of rotor revolution in 1 cycle.

So, if you see the previous diagram previous you know the slides will find that this was what was the gap that multiplied by number of revolution the rotor takes to complete the cycle is this and if we multiply these two we get the figure which is [$(N_A-N)/N_A$] this expression will give you in terms of revolution what is the maximum gap behind ‘P’ that is from here to there this gap when I have removed all the original fibre ring.

And now onwards, the layers of fibres which will be existing within the rotor will look like this. That is if this is the yarn formation point ‘P’ then you see these are the layers lying one on the top of the other and there is a phase lag between them. So, the maximum length of the layer is be close to this rotor circumference almost little less depending upon what is this gap.

So, actually this will be from here to there; from here to there; that is the length of the layer first layer, second layer, third layer they will be one up to the other in this way. And as I am putting twist at the point of information ‘P’ this parallel layer of fibres is transformed into a twisted bundle of fibres and that is what is continuously withdrawn.

Therefore, what we will expect that when the stable spinning is going on within the rotor, the fibres are deposited in the form of layers, but this layer thickness is tapered it is not uniform. It is maximum where the yarn at the yarn formation point and from there onwards the thickness will reduce.

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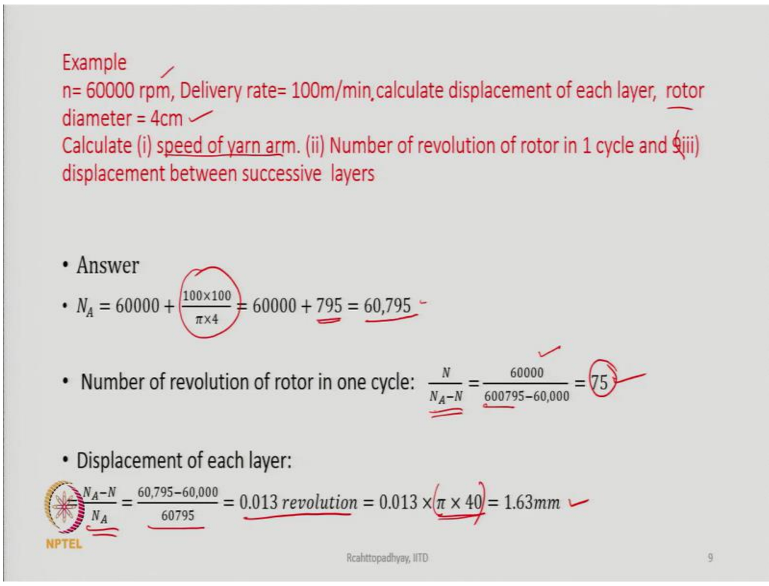


Now, we will take an example to calculate whatever we have discussed. Let us say there is a rotor which is running at 60000 rpm, the delivery rate of the yarn is 100 m/min.

Calculate displacement of each layer? rotor diameter is given 4 cm. Also, calculate speed of the yarn arm? Number of revolution of the rotor in one cycle? and also displacement between successive layers?

And if we want to solve this first of all if we want to know what is the speed of the yarn arm; speed of the yarn arm will be whatever the speed of the rotor plus this value that is the yarn withdrawal rate or delivery rate which is 100 m/min. We multiplied by another 100 to make it cm/min and then divided it by the circumference of the rotor which is ($\pi \times 4$).

And that gives you a figure 795, total is 60795 that is the actual speed of the yarn arm. But if a person is sitting within the rotor and watching the yarn arm rotating around him he will find the speeded to be 795 rpm because then the observer himself is also rotating at the speed of 60000 rpm.

But from a outside frame the yarn arm speed is going to be 60795 rpm; then number of revolution of the rotor in one cycle is straight away take this formula and substitute the values. We already know the speed of rotor '$N$', speed of yarn arm. So, you can find out that just 75 revolution of the rotor entire original fibre ring will be removed. So, when the original fibre ring is actually removed the yarn is not yarn is thicker.

So, that part of the yarn is not really very uniform yarn, but in 75 revolution of the rotor how much yarn you are taking up? We can also calculate that what is the length of that yarn which is very little and therefore, it is insignificant for all practical purpose. But whenever there is a breakage of the yarn and we start the process that is going to create there will be a thick place which will be created.

So, every rotor brake means as soon as we start the operation again, the we feed the fibre first and then feed the seed yarn and therefore, the seed yarn end joints the fibre ring which is already formed and that ring is of uniform thickness, but that thickness is not equal to the thickness of the yarn that we want to make it may be more it may be less depending upon what is the delay time between these two or what is the you know difference?

Anyway. So, therefore, there is a chance of creation of a fault. So, number of revolution the rotor in one cycle is 75, then displacement of each layer also this is the formula. So, again we substitute this is equivalent to 0.013 revolutions and that if we want to know in terms of linear length we multiplied by (π×d) rotor diameter and that gives you a figure 1.63 mm; that is each layer is behind the previous layer by how much by only 1.63 mm that is the difference between the layer ends which is very very little.

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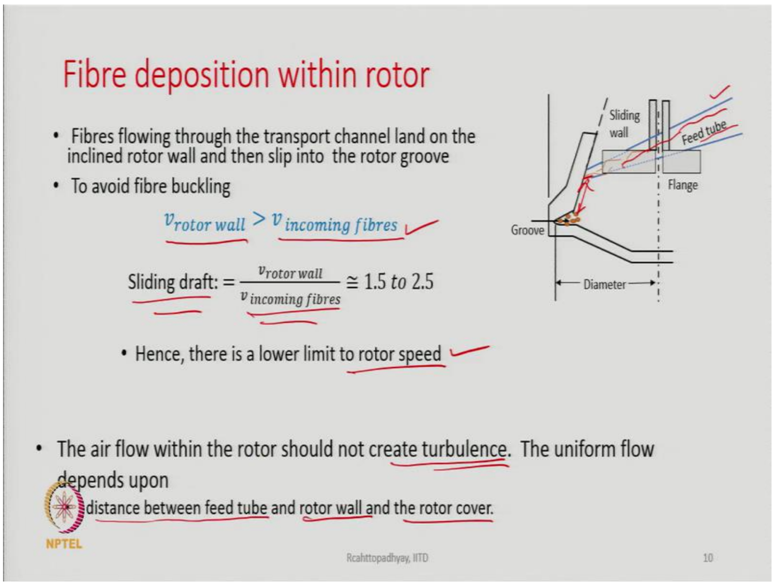


Now, fibre deposition within the rotor. See this is the rotor that is shown here this is the fibre feed tube. So, these are the fibres which you are feeding on the feed tube and the fibres are landing directly on the wall of the rotor. So, fibres flowing through the transport channel or feed tube meaning the same land on the inclined rotor wall and then they slip into the rotor groove because of what why do they slip?

They slip because of the centrifugal force one component of the centrifugal force will cause the fibres to move down and therefore, this is the rotor wall has to be inclined otherwise the fibres will not reach the groove easily. Now when the fibres are released on the rotor wall there is important conditions that needs to be met; velocity of rotor wall must be more than the velocity of the incoming fibres, why?

This is to avoid the buckling of the fibres. If the fibre approaches the wall at a higher velocity, then the fibre end will buckle because end is trying to land on the wall which is moving slowly. So, there will be deceleration and due to this the fibres are going to buckle.

Therefore, this is a very important conditions in in the practical field also that we cannot arbitrarily choose the rotor speed or rotor diameter, we have to keep in mind that the way the rotor machine has been designed at what velocity the fibres are approaching the rotor wall and this velocity whatever it is should be less than the velocity of the rotor wall.

And therefore, the ratio of these two we call it sliding draft which is typically may vary between 1.5 to 2.5. So, velocity of the rotor wall will depend upon the rotational speed of the rotor and the diameter of the rotor. So, we have to therefore, make sure that the rotor runs at a speed so, that the velocity of it is more than the velocity of the approaching fibres otherwise fibres will get buckled, they will be deformed and then they will settled in the groove and there will be going to be end break very soon; the yarn quality will suffer.

So, there is a lower limit of rotor speed therefore, the air flow within the rotor should not create turbulence. This is also important the uniform flow depends upon the distance between the feed tube and the rotor wall and the rotor groove. So, all these thing are important this distance, distance from here to there; they are all important. Within the rotor because the rotor is you know through rotor we are actually sucking air and the rotor itself is also generating air current because it is rotating.

So, the air within the rotor rotates at the same time we are also trying to suck air the whole rotor housing is placed within a negative pressure chamber, then only through the feed tube the fibres will flow otherwise how the fibres will you know move; they can only move if there is a air is sucked air is made to pass through the feed tube; that means, this whole thing assembly of feed tube the rotor must be connected to some suction.

So, turbulence is a great source of you know disorientation of fibres in the rotor in the rotor yarns. So, that aspect needs to be taken care of while designing the entire rotor spinning box and also the parameters of the process. Especially, the suction pressure, the speed of the rotor, the angle through which the feed tube is you know is positioned all of them will matter.

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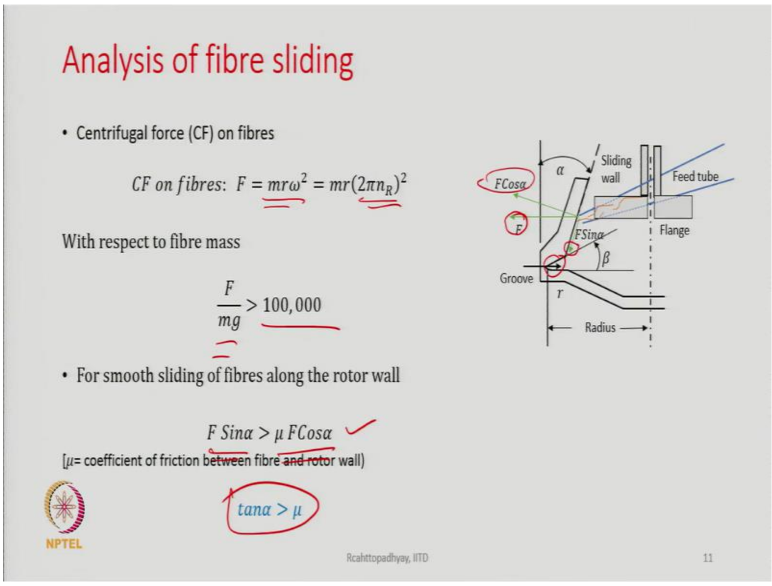


Now, analysis of fibre sliding as I said the fibres are going down because of the centrifugal force and how much is the centrifugal force we all know the basic physics? So, centrifugal force is '$mr\omega^2$'. So, '$mr$' 'ω' is how much? '$2\pi n_R$', '$n_R$' is the speed of the rotor.

So, due to this if this is the '$F$' centrifugal force then it has two component one is perpendicular and the other is towards the base is '$Fsin\alpha$' is forcing the fibres to go down and down and it will finally, reach where? It will reach the rotor groove where the diameter is maximum. So, you want the fibres to be deposited in the groove and remain compressed there like in ring spinning the fibres are held by the pressure between the top and front rollers that holds the fibres together and then that is twisted.

Here it is the air it is the centrifugal force which is you know holding the fibres against the wall of the rotor and then only they are getting then they are getting transformed into a twisted yarn with respect to the fibre mass '$F/mg$' is typically 100000. So, you can imagine that the kind of pressure which is acting on the fibres very very high centrifugal force will be acting on them.

So, we can substitute the values and find it out how much it is. For smooth sliding, '$Fsin\alpha$' has to be greater than '$\mu Fcos\alpha$'. So, '$\mu Fcos\alpha$' is what? Is the frictional resistance to sliding or '$\mu$' is the coefficient of friction between the rotor wall and the fibres. So, this condition has to be met so, that the fibres can go down and this gives you the conditions that '$tan\alpha$' should be greater than '$\mu$'.

So, the '$\mu$' value depends upon the type of fibre that we process and the type of finish that has been given to the inner wall of the rotor that decides the value of '$\mu$'. And '$tan\alpha$', the '$\alpha$' value has to be chosen in such a way that '$tan\alpha>\mu$' or if I know the value of '$\mu$', I can find out what should be the value of '$\alpha$'. So, the inclination angle of the inner rotor wall.

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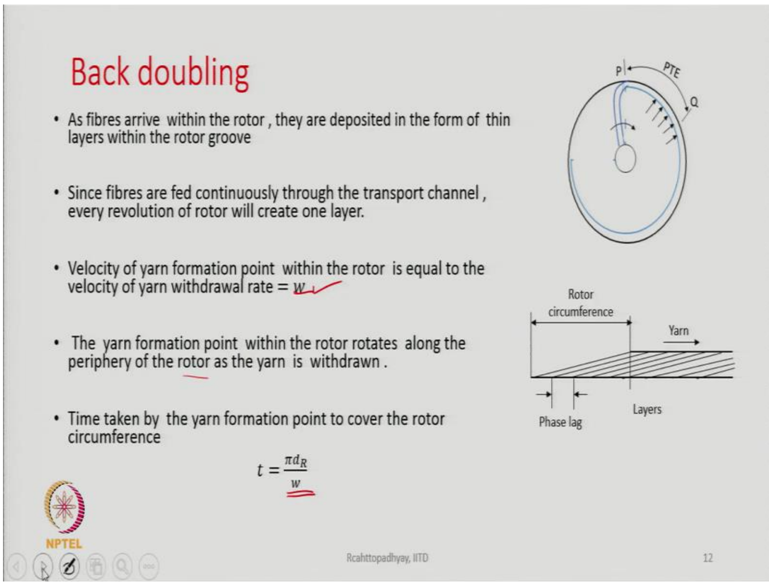


Now, we come to another concept called back doubling. The doubling word is familiar to most of you we have learnt the word doubling from the time you have learn draw frames where slivers are doubled together. So, several slivers are put together one after the other and we double it called it is a doubling operations and there we do it in order to improve the regularity of this sliver. So, doubling in a way improves regularity.

So, doubling is also happening within the rotor; because layers after layers are falling on each other and therefore, there is a doubling action also. So, this doubling action in a way will improve the uniformity of the you know the layers of fibres which are there the uniformity of the mass per unit length of the yarn. So, more doubling better it is always. So, since the fibres are fed continuously through the transport channel every revolution of the rotor will create one layer.

Velocity of the yarn formation point within the rotor is equal to velocity of the yarn withdrawal that is '$w$'. And '$w$' from '$w$' will see we can calculate what should be the rotational speed of the yarn formation point. The yarn formation point within the rotor rotates along the periphery of the rotor as the yarn is withdrawn time taken by the formation point to cover the rotor circumference is going to be how much? '$\pi d_R/w$', ok, so much time it will take.

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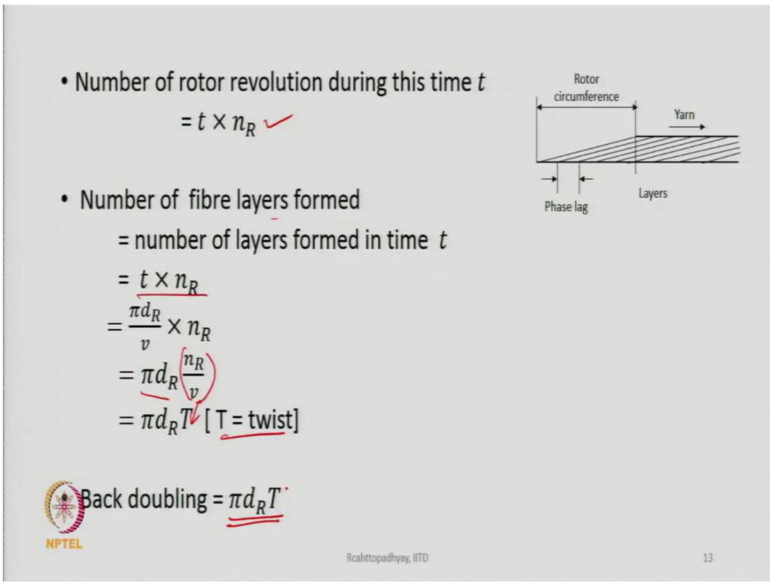


If that is the time it takes, then number of revolution of the rotor in this time '$t$' is how much? '$t \times n_R$', where '$n_R$' is the speed of the rotor. So, every revolution of the rotor makes one layer. So, many revolutions in time '$t$' same will be the number of layers that will be formed.

So, '$t \times n_R$' is going to be the number of layers formed; if '$t$' is '$\pi d_R/v$'. So, it is '$\pi d_R n_R/v$' that is the number of layers and what is '$n_R/v$'? '$n_R/v$' is the twist, '$n_R$' is the rotational speed of the rotor; rotor is a twister like spindle in the case of ring spinning.

So, every revolution of the rotor means one twist is generated. So, '$n_R/v$', '$v$' is the withdrawal rate. So, this part from this part is actually '$T$'. So, '$\pi d_R T$' is the number of layers which are formed and though that many layers will then get transformed into yarn. So, back doubling formula is therefore, becomes '$\pi d_R T$' or '$\pi dT$', whatever way we want to say.

So, where ‘$d_R$’ in this case ‘$d_R$’ is the rotor diameter, ‘$T$’ is the twist. So, unit has to be similar if I write diameter in inches the twist has to be then turns per inch if I write diameter in meter then twist has to be turns per meter. So, the unit has to be same and multiplication of diameter and twist and ‘$\pi$’ will give you the back doubling. So, back doubling therefore, depends upon how much twist we are keeping into the rotor and what is the diameter of the rotor.

So, larger diameter means more back doubling and therefore, you can say more uniform could be the yarn.

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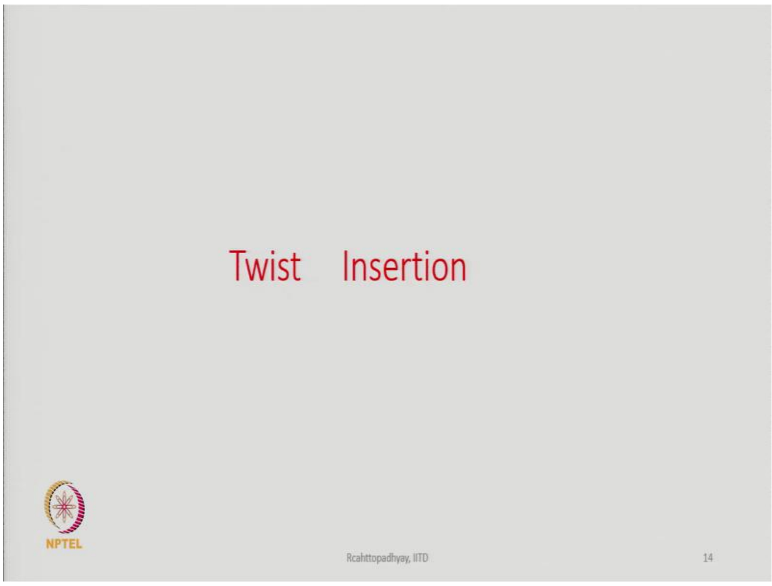


Now, the next topic is twist insertion. So, after twisting only the yarn is formed. So, rotor acts as a twister twisting device.

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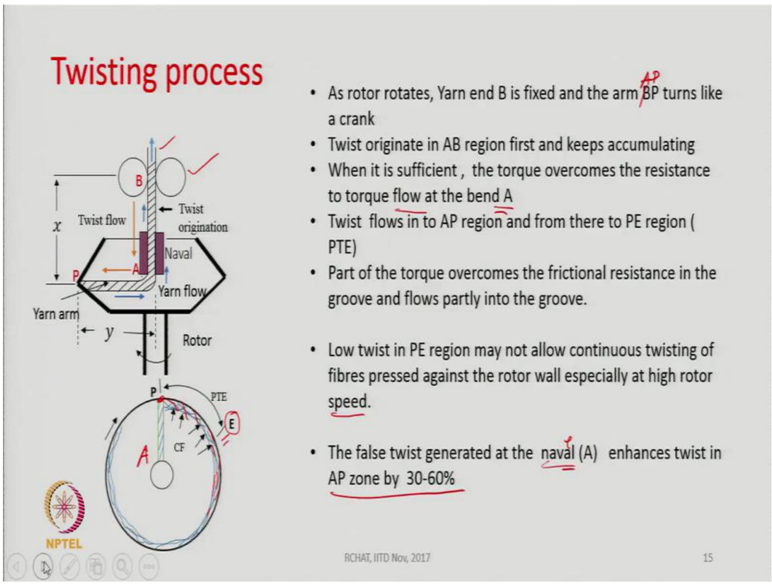


So, twisting process we will discuss now and here is the diagram is simple sketch of the rotor and the yarn, the these two are the take up rollers these are all shown here. Now, how the yarn twist is generated? As rotor rotates the yarn end ‘B’ is fixed and the arm ‘AP’ not ‘BP’ the arm sorry ‘AP’ turns like a crank; look at this arm ‘AP’ this arm ‘AP’ the ‘P’ end is turning.

Because ‘P’ end is attached to the rotor wall and that end is turning around the axis of the rotor and as we turn that ‘P’ the twist is generated in the region ‘AB’ and twist starts accumulating there in the region ‘AB’. When sufficient twist has been generated the torque overcome the resistance to the flow at the bend ‘A’. So, here the yarn bends.

So, there is a curvature and the yarn at the bending point the yarn is contact with a metallic surface. So, any contact is a source of frictional resistance to the flow of torque also; And unless there is sufficient twist in the region ‘AB’ the torque will not be able be able to overcome the resistance at the point ‘A’ where the bend exist.

So, when sufficient twist is there, it will now overcome the resistance and then only the twist will flow from ‘A’ to ‘P’. So, the orange line shows the twist flow directions whereas, the blue line shows the yarn flow directions. So, yarn as it is formed is going out of the rotor twist is generated in the region ‘AB’ and then from ‘A’ to ‘P’ it is continuously flowing.

At the ‘P’ point whatever torque is available or flows there is picks up the fibre because it is in contact with the separated fibres which are know lying there. So, it will take those fibres and also twist them. So, twist flow in the region ‘AP’ region and from there it will go to region ‘P’; from ‘P’ point is here ‘P’ to it will now flow little bit along the periphery of the rotor; let us say it can go flow up to the point ‘E’ after that the fibres that is shown it here a blue lines they are parallel array of fibres.

So, the twisting torque flows from point ‘P’ to a certain distance along the periphery; let us say that distance goes up to ‘E’; then ‘P’ to ‘E’ is a region where the fibres are partially twisted and we call it peripheral twist extent that is PTE peripheral twist extent. So, twist will flow to certain length beyond that it cannot flow because that much torque is not there and we do not need also.

So, twist will be gradually less and less inclination angle and ultimately become parallel fibres because within the group there are lot of frictional resistance to the flow of torque because fibres are pressed with very high centrifugal force. So, the torque has to overcome that also. So, it flows up to a certain distance, but not over the entire periphery of the rotor.

Low twist in the ‘PE’ region may not allow continuous twisting of the fibre pressed against the rotor wall especially at high rotor speed. The false twist generated at the navel enhances twist in the ‘AP’; we will discuss about this part now that is the first twist generation at the point ‘A’; we will see in the next slides we will discuss it in more details.

So, for the time being if we do not now consider the first twist part. So, what we have learnt that every revolution of the yarn arm ‘AP’ generates one turn of twist, the twist is initially built up and accumulates in the region ‘AB’ and once the sufficient twist accumulates there the torque will flow to the point ‘P’, which it will be able to overcome the resistance at the point ‘A’.

Because of the contact point if there is a bend there is too much of pressure also. So, a lot of frictional resistance to the twist flow and then from ‘P’ part of the torque also flows along the periphery of the fibres which are there in the total groove. So, torque flow from top to bottom or yarn flow is as shown in the diagram from bottom to top ok.

So, we will stop it here today, we will see that there are other aspects also of twist; because twisting is something in the rotor which we try to enhance by some other means; the reason is that we want to basically want to increase the production speed. So, we generate false twist.

So, we all know that false twist is something which is false in nature; that means, it will not affect the final twist in the yarn. There is a temporary change in the twist level within the rotor we will discuss that ok.

Thank you.