Textured Yarn Technology
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Lecture – 15
Draw Texturing

So, we are continuing with the Draw Texturing and let us recall what we have done.

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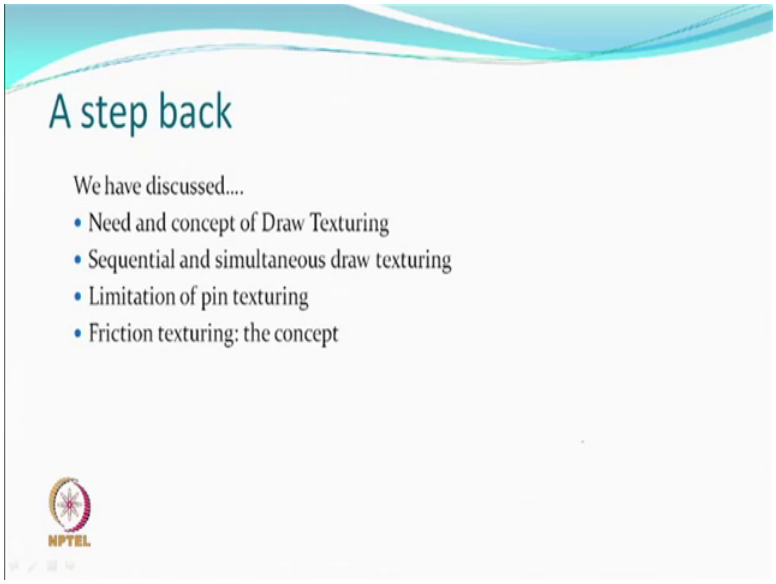

We understood the need and the concept of drawer texturing, so there is a change in material sequential simultaneous draw texturing, limitation of pin texturing and the concept which of friction texturing which actually in a way delimits the speeds that you can achieve or the RPM of the spindle that you can achieve.

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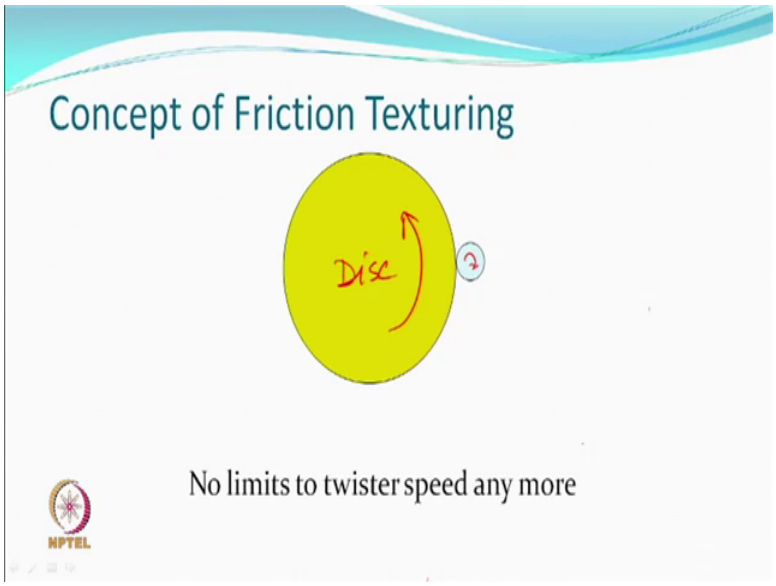

So, this is what was the basic principle that you have a surface where is a disc which is rotating and directly on the surface of the disc you have put the yarn and so that way you said there is no limit on the twister speed, so you can run the machine faster. So, that was one of the limitation that your texturing machine was running at slow speed, while your drawing speeds were earlier higher and you wanted to combine draw drawing with texturing therefore, all the speeds had to be brought down. Now, this development therefore, helped to increase the speed of the machine.

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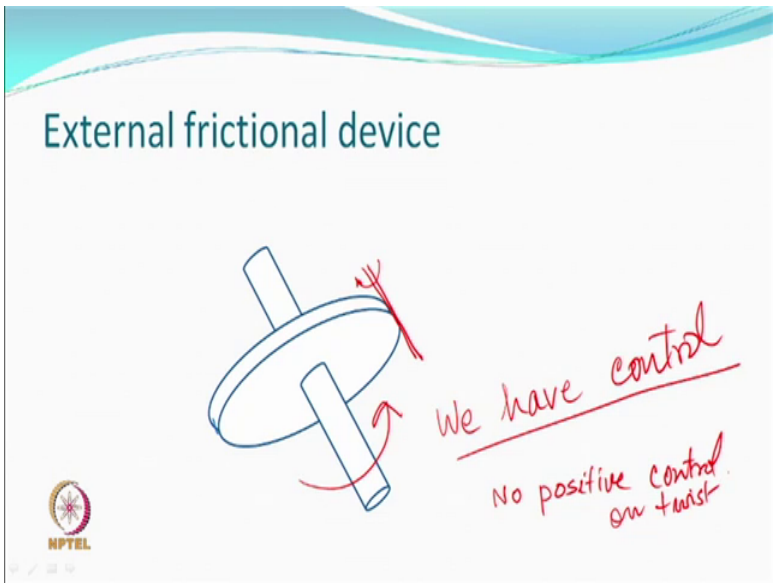

So, this is the external frictional device which could be rotated in any manner s or z; obviously, this would be placed on some type of a belt or some device which can rotate on a speed which is there. So, as far as rotation of this frictional device is concerned we have a control, but the yarn which will be rotating along with this, we may not have any control on how fast the yarn is rotating therefore, we say we have no positive control on twist.

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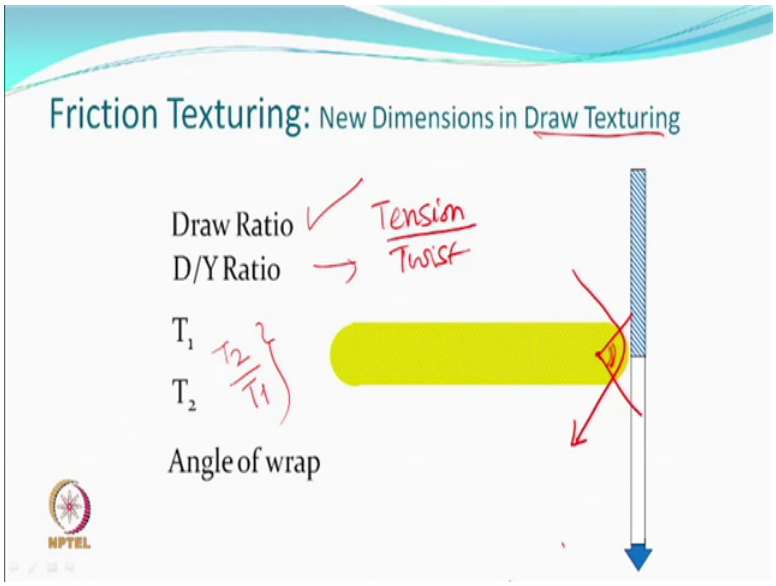

So, that is because of this that some of the parameter that one will have to worry about is the draw ratio because we are now looking at draw texturing as well and also we would be concerned about the so this particular thing takes care of tension. The D by Y ratio will be related to twist, but as we said we do not know the actual value of twist, but we can talk definitely about how fast the yarn is moving over the disc which is also rotating at a particular speed.

So, there is a control there in the two and therefore, we talk about ratios we would then have an interesting role played by the tension always would change when you move from one end of the twister to other end whether it is a pin twister or any other twister tension would change, but there we were only worried about whether tension is high or low, here one has to also worry if the tension is let us say, very low then this is also related to twist insertion.

If let us say you make the tension is 0 you can just appreciate yarn running approximately perpendicular to the surface of the disc and there is no tension in the yarn, then you may not be able to get any twist if another parameter which is also tension before and tension after they get related by the interaction that takes place during the twisting process.

So, actually at some stage we may like to understand the ratio of T 1 by T 2 not just the absolute value of T 1 and absolute value of T 2, but the ratio of the T 1 and T 2 can also have some relationship as to whether the twisting happening nicely or not happening nicely. Then this angle of wrap which is this angle, in case this angle of wrap is 0 let say we will call it we call it 0, there is just not rapping the angle is 0 rap is not happening, then also you might just appreciate that all of them may be moving in whichever direction they want to move they may not be any twist.

So, suddenly you have machine running the disc is running at a speed which is fixed by you yarn is running at a speed is fixed by you and you can still have situation where the amount or twist being inserted is not known you can measure it later, but you cannot have control because there are other things like T 1 T 2 are controlling angle of rap is also controlling and therefore, you can have different value of twist in the yarn while the D by Y ratio may be same well of course, when you do optimization.

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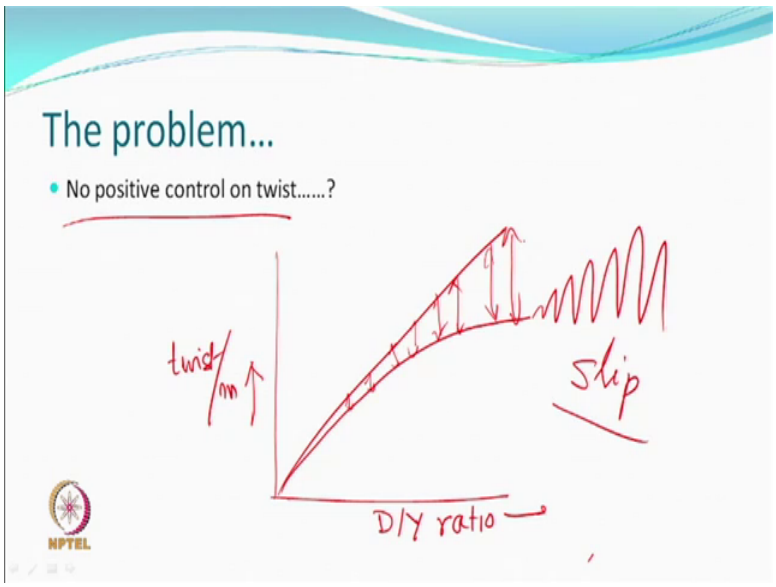

And so this is the problem with this new system that you have which is called the friction dictionary, there is no positive control on the twist and what does it mean? It also means, if there was a positive control then if you increase the D by Y ratio the twist inserted should follow a linear curve.

But in real sense what you see is the actual major twist is lower and as you keep on increasing the D by Y ratio this difference from the theoretically expected to the actual keeps on increasing the difference keeps on increasing. And after a certain value that is when you start rotating the disc very fast you may have so much of slippage that it is a difficult proposition to even talk about how much twist we have inserted because the slippage is too much alright.

So, no positive control means there is a slip taking place between two surfaces a surface of the yarn which is rotating and the surface of disc which is also rotating, so there is a slip. If anything slips over a hard slips textile yarn which is a relatively softer material, which slips over a harder material called disc there are going to be issues which is not just be simply, that there is a slip and that there is amount of twist insert is less etcetera, so you can have problems related with this slip. So, there are new challenges as we call them.

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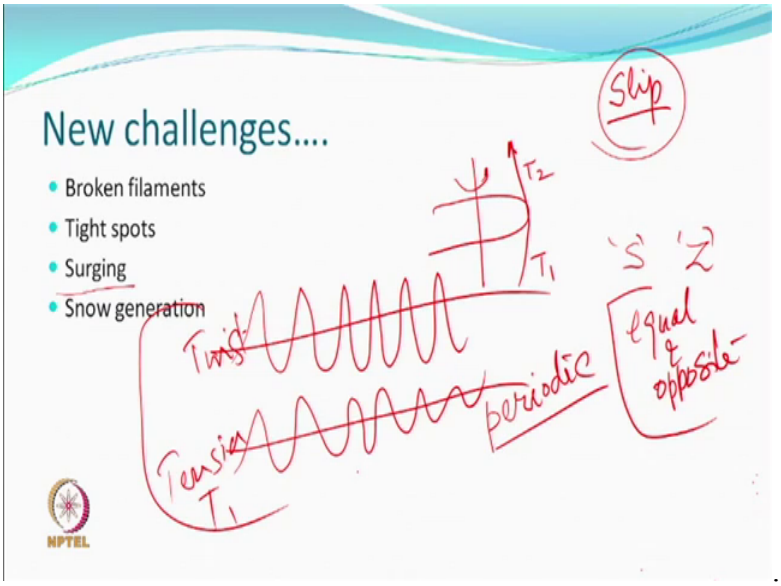

So, we had problem with the material because it was not stable as a undrawn yarn. So, you went for development and got into POY, your pin twisting was not able to give you

high RPM of the spindle and therefore, you thought of friction, where everything appeared nice. And then now we have challenges, the challenges is one is called a broken filament let me just remind you a broken yarn in a filament industry is not liked you generally would not like to put any knot on a package, so there is no slicing there is no knotting.

So, for yarn breaks then it breaks and you stop the package there and then and whatever the weight that is it and you start. So, this broken filament is not the yarn breakage, but the breakage of any of the filaments, let us say your multi filament yarn you are texturing, if one of the filaments or some of the filaments break at some stage or the other, then this problem is called the broken filaments.

So, what could be responsible? Slip, if somebody asks the yarn is moving over the disc which is rotating let us say the yarn is going this way so you have some tension here and some tension there. So, there are two values how they become important? If somebody ask this question as to what do you think would be happening to the number of broken filaments if you change a parameter. So, before that let us understand what do we mean by this and why will it occur?

So, if you take a package of a textured yarn and if you see the surface, you should see no hair on the package, but if you see hairs on the package surface that would mean that something is happening which would mean there is breakage is happening where do you think the breakage actually would be happening? While the yarn is entering the twisters or when exiting the twister.

Student: Entering.

Student: Entering.

Entering the only thing you must remember is that while it is entering it is twisted, when it is exiting it's a twist less bundle. So, one can always think about divided withstand no united withstand and divided before right. So, the problems will occur whenever there is going to be more slip you will have broken filaments and you this is also one of the characteristic which will have to be measured along with crimp rigidity and so on so forth.

If you get more number of broken filaments then you are giving a bad quality on and this can cause problems and what problems we are going through a knitting machine? The yarn is passing through suddenly there is a broken filament that can get entangled with the needle the needle can break or faults can occur tension variations can occur all kinds of things can occur. So, broken filaments; obviously, is a problem which has been created because you have no positive control alright. So, you will only be worried now, what to do?

Tight spots these terms were not discussed before friction texturing before the friction texturing came into existing nobody were discussing these kind of terms. So, what is the tight spot? A tight spot is the portion of the yarn, were after relaxation you see there is some real twist inserted and therefore, the filaments are not separating.

So, that becomes a tight spot there is no fusion here, but the multifilament somehow are now together. So, some real twist either S or Z gets inserted in a texturing process which is called false twist texturing. So, it is still a false twist texturing and you are getting real twist in getting inserted, real twist getting inserted in the yarn how does it happen? Again there is something called a slip.

So, let us the yarn is moving from bottom to top, the yarn was in contact with the disc surface which is also rotating and certain twist was getting inserted in the yarn let us say it was some value S, in S direction some value and as it exist exits this surface it should get Z equal and opposite, which would mean that there is a false twist this is what we said false twist. Suppose at an instant when there was a value whatever N twists were being inserted in S direction in the zone which is the T 1 zone and for whatever reason because machine speed, machine vibration anything to happen the contact is lost, if the contact is lost the amount of twist which has been inserted is n the untwisting will be n minus some value delta n; that means, whole of the n has not been untwisted; that means, some real has gone up.

Because the continuous process yarn is moving continuously and then again contact is established, then what happens because contact was less yarn below was getting less twist, now the contact is made just above it has been twisted more untwisted more. So, either you are twisting more or untwisting more whenever there is a small slip. So, it was not just a question of how much twist you are inserting, but you have a bit of a

fluctuation possible and because of the fluctuation you may be twisting untwisting slightly more or slightly less; that means, positive or negative twist which is real value gets inserted.

So, wherever this inserted at that time the filaments will be really more together compared to the rest of the part. So, when you see under the microscope you will see light spots, you may see how does the matter, but when you die this type of a material you may see the shade difference between the points where it is compacted little more than the open structure.

So, from (Refer Time: 18:19) point of view it may not matter too much because the guys will still have a tendency to recover because the twist levels are not going to very high based on how much bad we are doing the job; how bad we are in the doing job. So, in the friction texturing because you do not have positive control on the twist you will start getting tight spots, if you have more tight spots when you have more problem.

So, if less tight spots you have less problem if somebody says well I will do whatever I can do to make the tight spot 0 you are talking too much because how can you over? The slip the reason is very simple whenever you want to twist a material, there is an opposite force or opposite torque getting generated within the material is resisting.

So, you have a fixed force of friction which is giving a certain torque and now you have opposing things also and therefore, it's a catching up game the twist in the yarn cannot be more than the speed of surface speed of the yarn cannot be more than the speed of the disc it is only following. When you start the machine from 0 it starts picking up goes up to point and then this will happen for whatever reason fluctuations voltages fluctuations and vibrations and things and resistance also, so this new problem is there.

Another term which people had not heard before is known as surging, this is a real problem of the friction texturing and what does it mean? This is defined as periodic variation in twist and tension periodic. So, if you are measuring tension it may increase certain amplitude certain frequency. Similarly if twist is high tension can also high so twist and tension will follow some pattern amplitude could be different.

But they will follow this is called surging is inherent to friction texturing inherent and what does it mean by inherent? It means that you will not be able to avoid it, what is this

forget about the random slippages which will happen for whatever reason this is because the yarn as it is increasingly getting more and more twisted, so there is more and more internal resistance. So, frictional force which is due to the contact is trying to rotate internal resistance is also simultaneously increasing, whenever these values become approximately equal then the slippage takes place.

So you have a stick when if the yarn is sticking it keeps on rotating till the value goes up to a point where the internal resistance almost equal then you slip and then again stick and slip; stick and slip; stick and slip and this will keep on happening, even if you have controlled your vibration, you have controlled your voltages, you have controlled all kinds of machine speeds, if they change then you will have anyway tight spots.

So, what will surging result to? It can also result in tight spots because whenever there is a stick and slip phenomenon taking place something like this will happen periodically twist will go down when there is a slip tension will go down and again pick up the tension will increase the slip increase, let us say we are talking about the tension T 1. I just said T 1 because this is the only thing when you twist under a certain length will increase or decrease with the twist T 2 will depend on many other factors which we are not discussing at the moment.

So, periodic variation of twist and tension is surging you cannot avoid it and therefore, it's called inherent. Snow generation so this is the problem which; obviously, again very very specific to this snow; obviously, it's not the snow that we are talking about there is abrasion when there is a slip there is abrasion and which is the softer material the yarn, even softer than this is the surface which may have spin finish.

So, it's absolutely on the surface then there are oligomers which may be on the surface. So, when they slip this is what keeps on getting removed because of some slip and abrasion one is hard the other is soft and this gets keep on collecting on the disc surface itself at least on the top of the thing.

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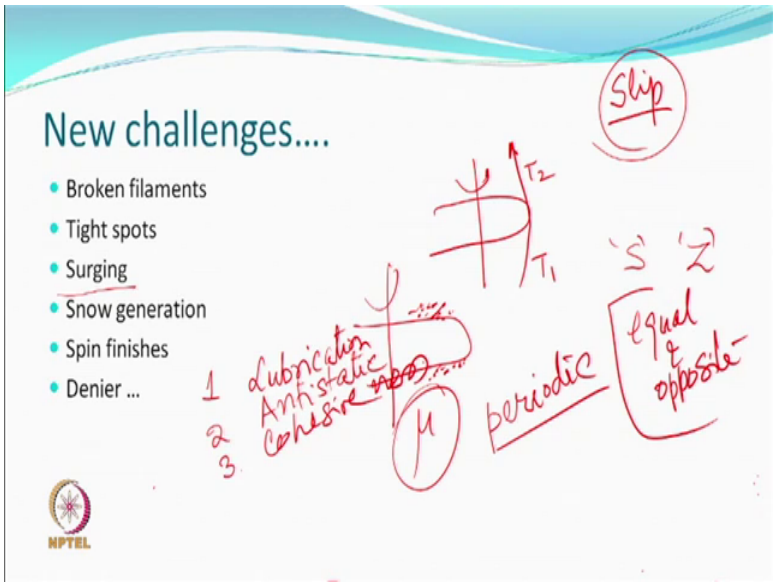

So, you may have some deposits somewhere because of this abrasion and this is white and so it's called snow. So, more snow is there then you know things are not really happening the way you wanted to happen. So, you can see there is a problem visual not just that. So, if suppose spin finish has come out and what is the spin finish it must be having some lubricant and therefore, whenever it changes from one surface to another, the property of the disc surface may change; that means, the frictional characteristic the coefficient of friction of the disc may change because something is getting deposited

And that means, you started with the material which had a fixed known coefficient of friction; friction between the surface or disc and the yarn and you may end up with another surface which may have a different mu. So, if you have different coefficient of friction and you are dependent only on friction for twisting, so you again getting into problem.

So, you are trying to solve some interesting problem and become smart and then you keep calculating what exactly is happening. So, very simple things abrasion surfaces will change particular in the contact, length or the area where the yarn is going to be actually contacting surface if that changes in friction does matter how much does it change? If it changes so you calculate your torque which will be different and so despite everything else you are doing different things at different points of time.

So, solve a problem get into another problem this also became very important the spin finish itself what is the role of a spin finish?

Student: Aubrication.

Alright, so let us say one role of the spin finish is lubrication other function normally is anti static and the third function could be cohesiveness. That is keeping all the filament together so they do not behave like 36 individual filaments, they behave like one yarn weak bonding, but they are together alright. So, they remain together that is one so because there is a liquid. So, surface tension would ensure that they come together.

Now, there no problem anti static you will want it let us say a polyester we are talking about. So, there will be synthetic material, so there will be need for any charred dissipations or it will be there. Cohesiveness we have no issues they must be cohesive, lubrication there is a problem. Lubrication means you are reducing friction your aim was when it turns over the guides and this that yarn over yarn, yarn over metal, yarn over ceramics all friction should be reused and here it is the friction with likely twists.

Now, suddenly you are in different kind of a ballgame, now spin finish formulation is almost somebody else's domain, it is not even the domain of the fiber manufacturer. They only know how much to use then of course, after checking certain thing, but somebody else is deciding which kind of chemicals to be used and which type of composition to be used. So, that final product behaves nicely till it is converted into fabric, after that this is over then you can think of something else, but otherwise manufacture itself is a problem could be a problem winding unwinding all kind of things.

So, the moment is a friction texturing you say now, we have another problem which is the fundamental problem; the fundamental is whether you wanted friction to be there to twist and now you want the lubrication is there and spin finish. So, what do you do? Remove the lubricants, if you remove the lubricants you still have guides you still have to run through that what do you do?

So, it became another interesting person which I hope that some of you will take up as an assignment and tell us as to what are the solutions. One of the solution could be, that you are using a lubricant which evaporates because, before it comes to the friction disc it goes over the heater. So, lubricant is gone from winding unwinding has happened just

gone through then you gone through the surface of the heater and gone up by the time it reaches the friction disc it's friction has been reduced and so now, you have a yarn with less lubricant.

So, if you have less lubricant you have to gain replenish lubricant sometimes after all the process is over. So, that later on does not cause problem so you still have in the same situation. The denier, so denier normally should not be any difficulty in finding out in the earlier case there was no issue anyway the moment you do draw texturing you start with the denier of a POY and end up with the denier of a textured yarn and we hope that they will be correlated with the draw ratio.

But because some of the properties may change because you change the draw ratio or you are bound to change the draw ratio, the denier would be different. So, draw ratio can change some of the mass can go as a snow, the fiber may shrink also after or during this process of setting and so you are just hoping that this will be the denier.

So, you cannot really say well I can give you a mathematical arithmetic number this is the denier you may find it different, a drawing and shrinkage both may be taking place, to what extent some control some not so much control. So, you work around the average and then you will lose some mass interesting. So, everything is negative when sometimes I have got a beautiful technology and idea for you go and start working on it.

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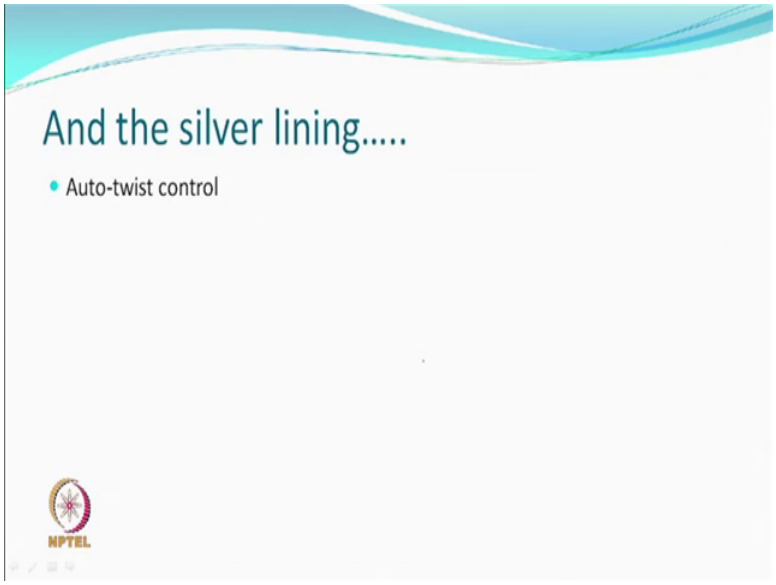

So, you almost see nothing why should I work on that, so there is some silver lining which is called the auto twist control. In case of a pin texturing machine when you are optimizing the twist, the only way to do was go and change the twist wheel on the machine so, that twist can be increased or decreased and then you measure crimp rigidity and optimize difficult process because every time if you have some of you have worked in the industry right.

So, changing a twist wheel is not a job which can be done in a minute or a second, the whole machine has to be stopped if you want to do experiments and then change and then start and then measure and then go back and change and then start I think. In this case you do not have to do that, they call either because of draw ratio increase or decrease or for whatever reason the diameter of the yarn goes up; obviously, not down right or you have change the reduce the draw ratio then the diameter will be up, if you increase the draw ration diameter will be low.

But the surface speed of this yarn will be same as that of the other. So, it will start rotating more like we said finer denier requires more twist. So, when it becomes finer I will start rotating automatically more if it is coarser it will rotate less. So, you do not have to go and change the twist wheel while you are optimizing other parameters right, after all you decided this is the my POY dimension yarn and this is dimension of the approximate nominal dimension of the textured yarn and while then you are optimizing the process parameters.

So, every time you optimize something there draw ratio you know the denier is going to change and therefore, you go and change the twist wheel if you are wanting to keep that constant here you do not have to do that, so there is an auto twist control right.

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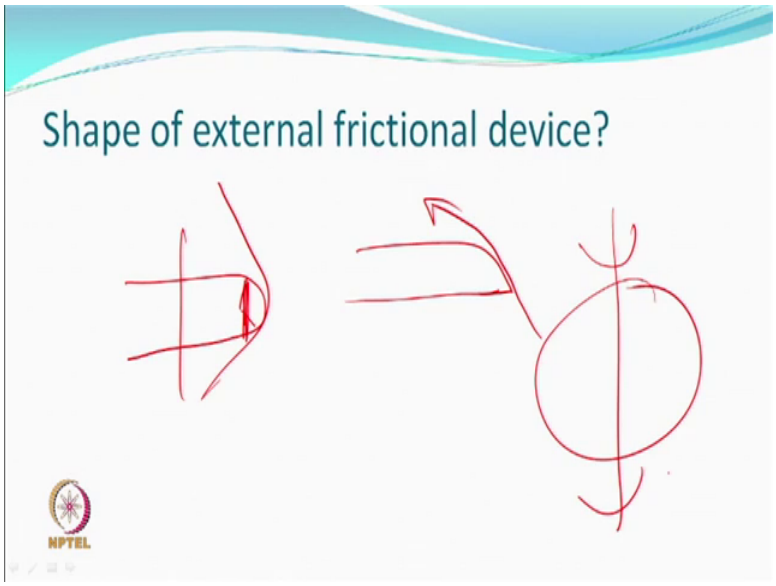

So, the external frictional device the common sense would say that the cross section of this device may be this; that means, this may be hemispherical kind of cross section or half a circles right otherwise there. So, yarn can travel like this people have tried other kind of dimensions where you say all the disc will be there the yarn just comes and goes in this direction you can always make the material could be very hard like ceramic production values could be whatever, but very hard could be metal, could be also any base rigid base which may be having a layer of a polymer like polyurethane.

So, you have polyurethane disks; that means, everything is there rigid and over top the polyurethane how does it matter because very harsh disks versus a very soft yarn versus similar looking material surfaces. So, the damage control could be if the friction is high maybe a slip is less, but then if the disc surface is also softer then you may have to change the disc more often because that surface also can get damaged like the yarn gets damaged.

That the yarn is continuously passing the disc has to be the same surfaces experiencing the fresh yarn every time continuously 24 7. Can there be any other type of a surface think about it instead of this is suppose you have a sphere which is rotating, will it do the job not do the job you can think about it and see if you have some answers to that.

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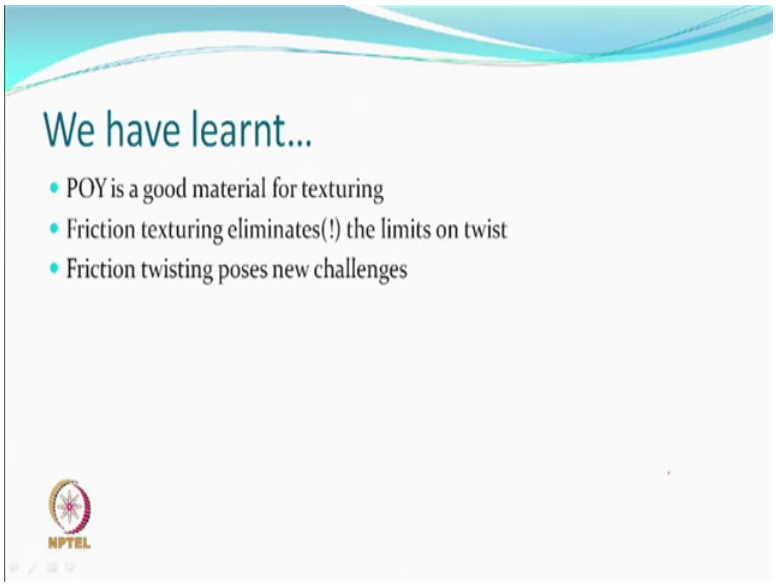

So, till now what are we done? That we understood that POY is a good material for texturing low crystallinity particularly the polyester others also nylon and polypropylene also a good material let us say the POY is concerned because there crystal structure is less stable structure compared to a fully drawn yard friction texturing has given hopes, that limits of the twisting I mean not there anymore, but yes there are new challenges which must be looked after here sometime so we go little further.

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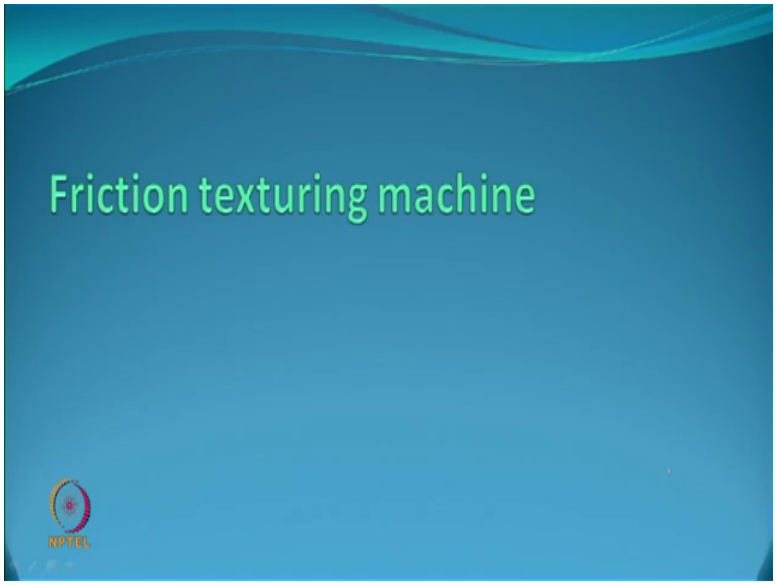

So, it is general profile of a texturing machine which is required to do all kinds of things which we are there. So, it's a friction texturing machine friction false twist texturing machine and it's also going to be doing draw texturing, then there is no people I still do not want to go back despite all the problems you still think it will be a good idea then you stick to friction texturing and try to do as best as you can do alright. So, if you understand maybe you will do it.

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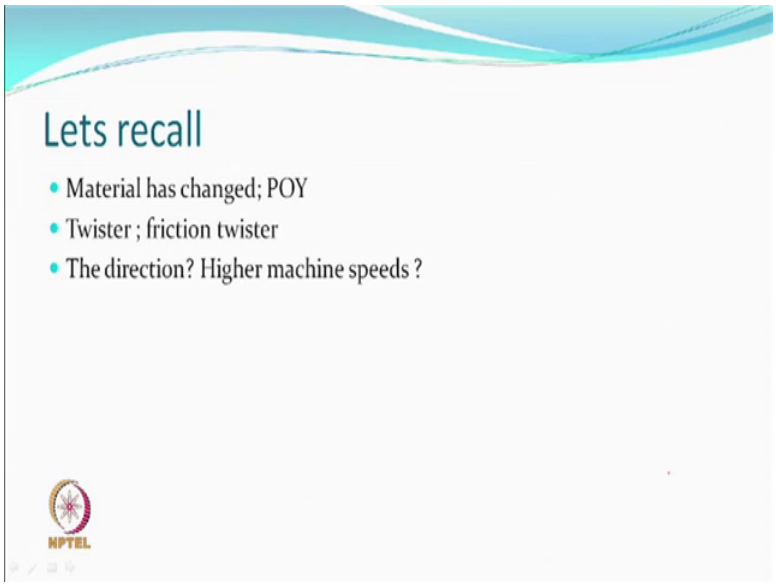

So, because you have been able to handle some of the challenges of the material and some of the challenges of the machine so what do you want? Obviously, you want higher machine speeds. So, that the at least the drawing speeds which were being used if texturing speed could be similar to that and so today the machines you may be thinking will be running at 800 meters per minute, 1000 meters per minute or even higher.

So, that way you say well the draw texturing has an advantage so machine speeds have to increase. Whenever you talk about machine speeds increasing of course, twisting is one part, but residence time available in the heater in time available or cooling we will also change because we are running fast, so you have to worry about that as well. So, now, although you say it's no problem, but you have to worry you cannot just say well does matter I have just increased the speed everything alright, but you have to if you are running the machine faster total time available is less then therefore, you should do it.

Of course simultaneously we also know that the time required for an optimum setting for a POY will be less compared to fully drawn yarn. So, that way you can run the machine in the faster speed, but you may still have to optimize.

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Some of the essential components of machine what we call as a primary heater about which we have been talking about the properties and so on so forth. So, the primary heater is required because you have to heat now cooling because you say I am going to be running at a faster speed people said well you going to have some way to cool it faster and not let it be dependent on the natural cooling from the yarn which is hot to the air, which would have a certain rate of heat dissipation, but if you are running fast you might find that at this may not be sufficient and the yarn at a very high temperature directly coming to the twister.

So, you may have to force the cooling now there is something called cooling plate. So, it's no more a natural process you are actually forcing the cooling also, so you can change the cooling rate. We had talked about secondary heater requirement whenever you are looking at a modified stretch yarn type of thing, then package handling means that you are looking at big packages now because you come with a large package from there why do you want to stop, if you can keep on running in the yarn does not break and you are able to control let the package be as big as possible.

So, that then the bar a and other problem will also be less because same condition approximately you have been able to handle that is and some auxiliary equipment because of whatever we have learned from the discussion that we have had before on friction texting

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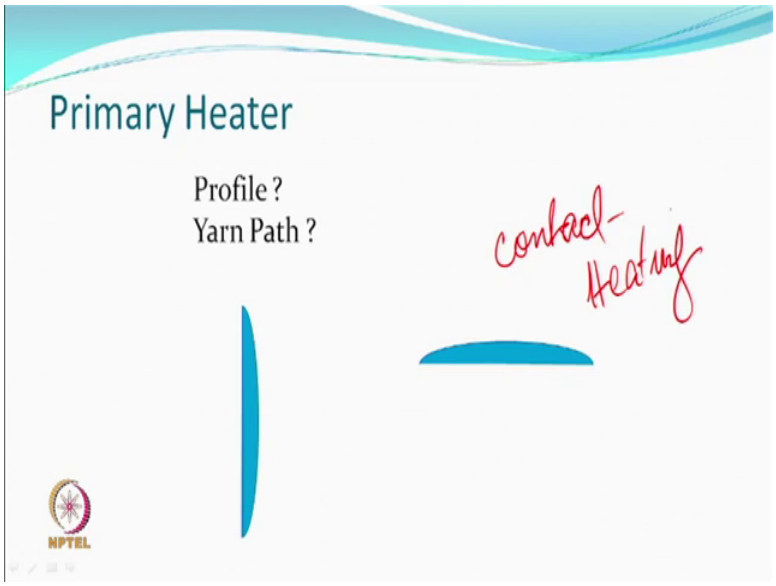

So, primary heater has the function of initially doing the texturing, the profile is convex right we said this is a convex profile. So, the yarn would remain in contact with the heater while it is being heated moving in the linear direction as also getting twisted. So, some type of a profile which is the convex profile how much convex to be made basically based on the speed also and tensions that you will be able to impart. Yarn path it does not matter the yarn can come from top to bottom, it can be horizontal left to right, right to left, bottom to top no problem because yarn is under tension.

So, this heater can be put in any manner that you want so some people have put horizontal machines only for various reasons some are vertical, somewhere the profile is such that the yarn first goes in the top and then comes down. So, yarn is coming from top to bottom on a primary heater or some say it will start from the bottom and go up and then come down to the winding. So, path is not a problem yarn profile is going to be convex because it is going to be always contact heating.

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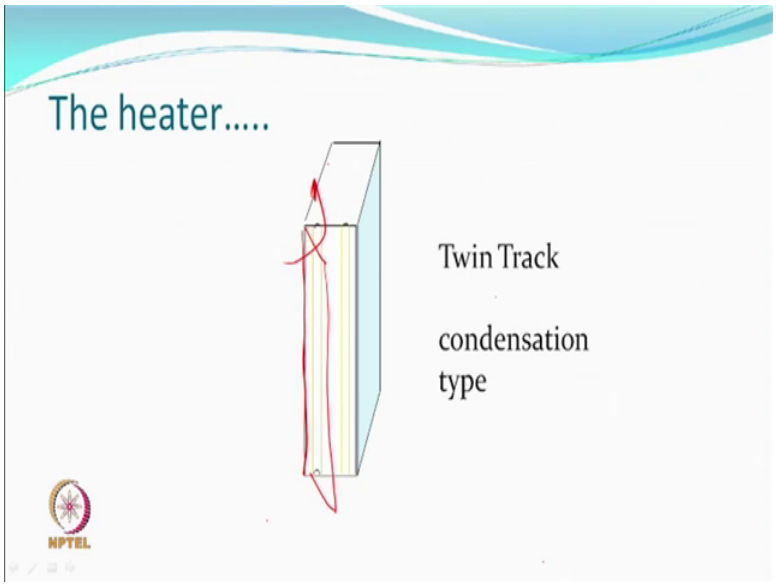

So, there are blocks of heaters so it could be a one big block for the whole machine, but for various reasons the volume, the heat capacity etcetera will be too large therefore, you say well for each position we may handle two yarns on top of it there may be two twisting units so it's called a twin track.

So, in generally a block of a heater where the yarn is going to be contacting maybe a twin track could be a single track also, but people believe that one of the yarn could be S twisted the other yarn could be Z twisted and when you make a fabric it will say this S Z in one go it is working at the same temperature, same condition approximately and then you will get two yarns.

It says condensation type of heating because you heat this whole thing by electrical systems oil fired systems, but condensation type means that there is a hollow space inside and the heating material is being heated and actually it may be in vapor form.

If the temperature is such that the whole material is in vapor form then it can give you the maximum uniformity along the surfaces for the heating is concerned it is called condensation because when something cold yarn is passing over it there may be condensation. And it may become liquid, but then you are heating it will become vapors as long as in vapor from and you are maintaining a certain temperature is the best way to have uniform temperature all along the surface of the heater.

Any other method there will be some difference corners end points and things, here also the ends exit and the entry may be different because radiation losses alright. This particular type of a thing also is covered you know you do not want the heating heat losses from surface. So, this also twin track will be covered so there will be a lid on top of this hinged here.

So, this lid can cover which would also have a ceramic plate which is a thermal insulation and then it can cover you run the machine open the thing, run the machine when the machine starts close it will not touch this because there is a track in which the yarn is running yarn is running in track.

So, it would touch it's like a small hole finally, gets created this door is also curved the tracks are also curved. So, you have a convex surface which is going to be covered alright, so that way you try to work around. So, this is one of the features of the heating.

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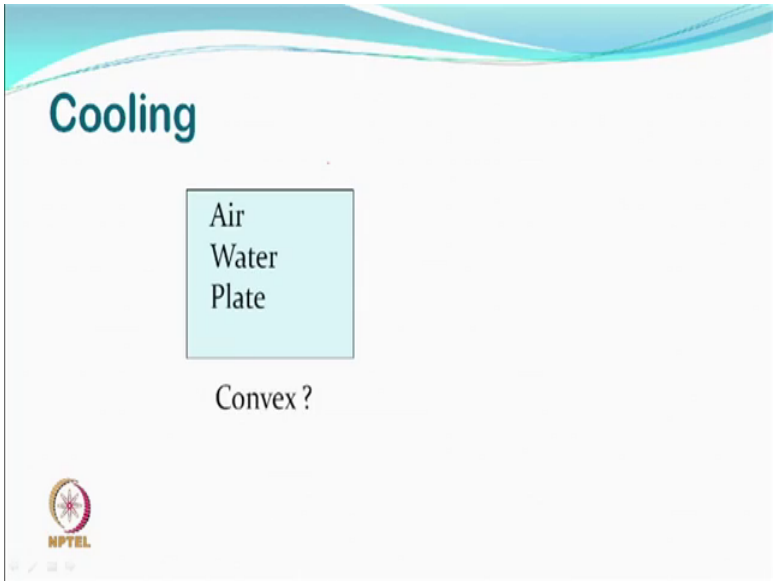

So, people when say they will increase the speed no before that let me just also say what will length of the heater? How is the length of the heater could be if you start keep increasing the speed of the machine. So, today the length of the heater could be 1.752 to 2.25 meters you understand 2.25 meter 2.25 meters, how many people have the height of 2.25 meter here?

Student: (Refer Time: 48:25).

So; that means, because you want to increase the speed therefore, the length or the size of the duration which your dual, period is going to be less period has to be same, so, length of the heater has to be increased. So, that could be such high lengths; that means, you are looking at very high long heaters, we will just take a few minutes stop here and then start somewhere something else.

So, when you want to increase the speed you have to do forced cooling just the air itself because you cannot cool the air of this whole environment below a certain temperature because people are going to working there might. So, you then go or a natural process of heat dissipation, but that may not be sufficient. So, people did try to use liquids to cool liquid can be messy whenever you want to use liquids in a machine which is basically dry machine.

So, then they said if we have a metal plate again a convex metal plate like a heater, then cooling can be more efficient why because the heat transfer in a contact system is more the surface of the metal plate is large the heat ones get transferred spreads over the surface and then dissipate from the large surface area right otherwise, the surface area was only surface area of the yarn.

So, now you are transferring the heat from yarn to a metal plate which by a contact method and then metal plate dissipates immediately to a larger surface and then it keeps on increase by doing this they have been able to increase the speed, still the length of the cooling plate also is can be 1.5 meters. So, you are still looking at a longer lengths. So, longer heating length and a longer cooling length may be the time is not there today we will pick it up from here and then discuss something else later.