Textured Yarn Technology
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Lecture - 28
Bulked continuous filament yarns

So, we are continuing with our discussion on various types of yarns Textured Yarns and so, we go further today on Bulk continuous filament.

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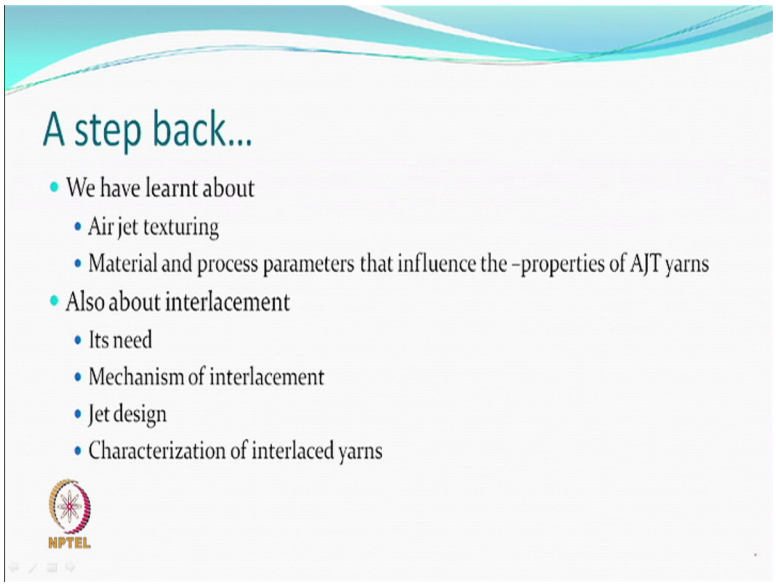

So, what we have done till now last few lectures that we understood the air-jet texturing material and process parameters that influence the properties of air-jet textured yarn. And also importance of interlacement or entanglement, its need, mechanism some jet design and how we can characterize the interlaced yarns. This is what we learn. Now what? So, we have a bulk yarn which is air-jet we have false twist textured yarn which is; obviously, stretch or modified stretch.

This is something which is interesting which we consider as learning from each other; technologies which learn from each other and that is how you had the BCF yarns. And they are also commercially very successful product like the false twist texturing, air-jet texturing the BCF also are commercially successful products.

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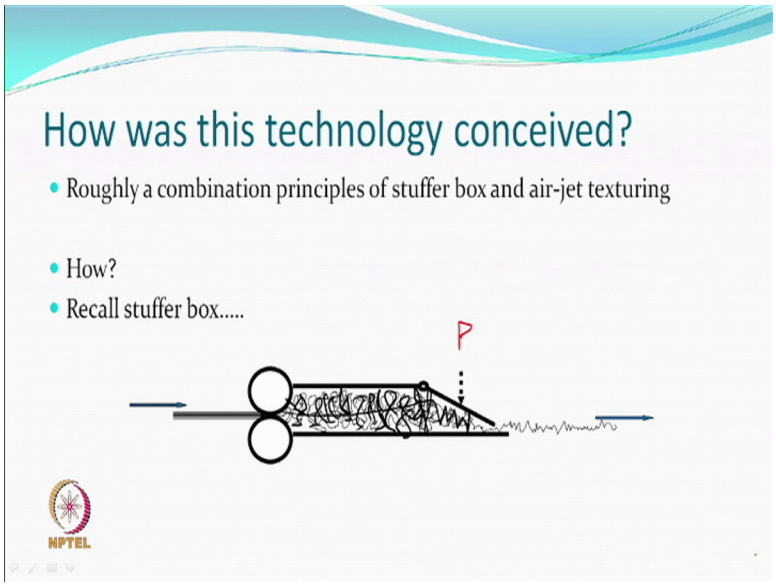

So, this technology that roughly employs principles of stuffer box and air-jet texturing. In some sense stuffer box produces yarns which are in the category of modified stretch yarns, air-jet texturing produces yarns which are bulked yarns.

So, how does it happen? We just recall what is happening in a stuffer box texturing process. They are over feeding the yarn into a box; at the exit, there is a pressure plate. So, the yarns cannot move out. So, they bend in a manner which can be controlled by the speed as well as the pressure and also temperature of the yarn at which they are getting.

So, there is a plug of bent yarn which is made within the box and the textured yarn is brought out from the other side. So, in a way you have appliable yarn which is been hit; which is hitting a wall and so bending and simple process and then of course, you cool down so that this texture remains. We also remember that this technology is being used in staple yarn industry also staple fiber where all the crimps that are given by this process is a simple process before cutting.

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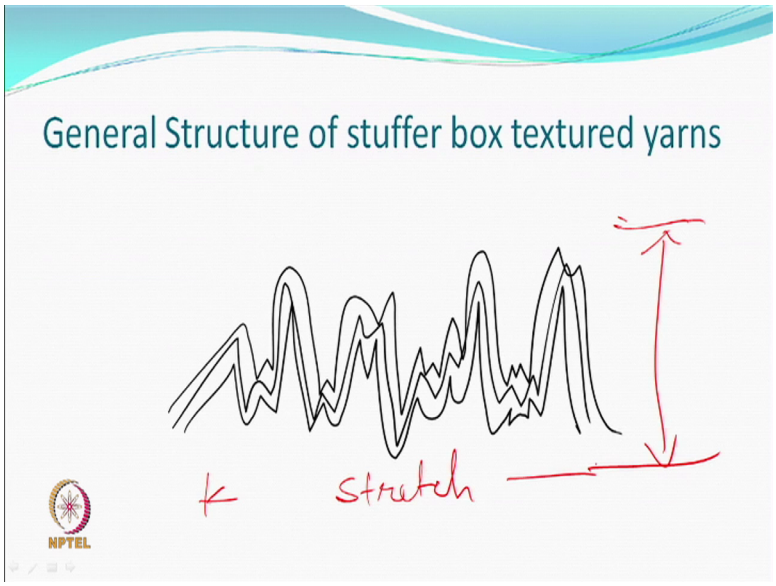

So, we expect that the structure of a stuffer box textured yarn would be crimped not necessarily very uniformly when some the frequency as well as the amplitude may not be uniform. But what happens whenever they bend all the filaments bend together at whatever point they bend so, you get a structure like this. So, it gives you some amount of bulk and some amount of stretch.

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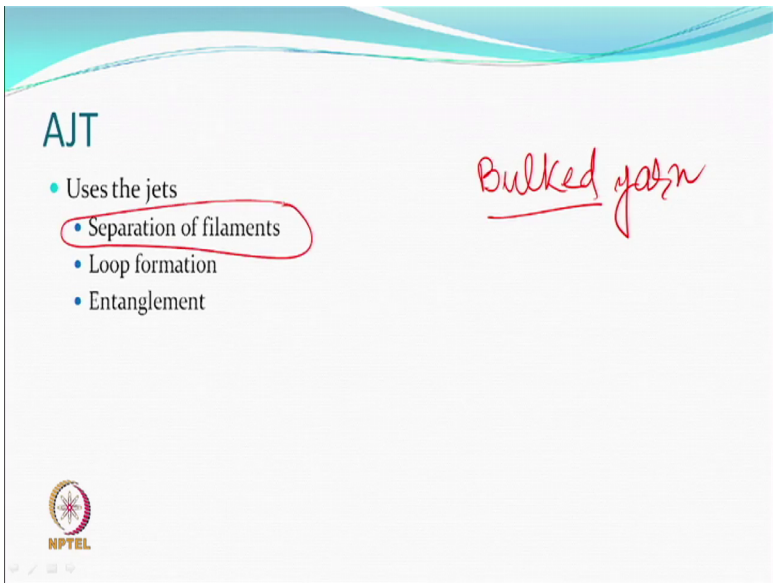

The air-jet textured yarn on the other hand is a process which gives bulked yarn. So, air-jet textured yarn is a bulked yarn. What we are saying is that we were looking at a

process possibility of combining these processes principles involved. So, as a texturing uses jets their main purpose is separation of filaments and then loop formation entanglement. So, one of the interesting part which people learnt that in an air-jet for various reasons, it should be possible to separate the filaments. In the previous case, we were not separating the filaments you are bending the whole multifilament.

Now, that you say its fine one can do, but if at the same time you could also separate the filaments. Then maybe you will get a different product; there is nothing called a loop formation, but the crimp formation definitely is what we are looking. So, the AJT is concerned, entanglement is part of the thing and you produce a welter.

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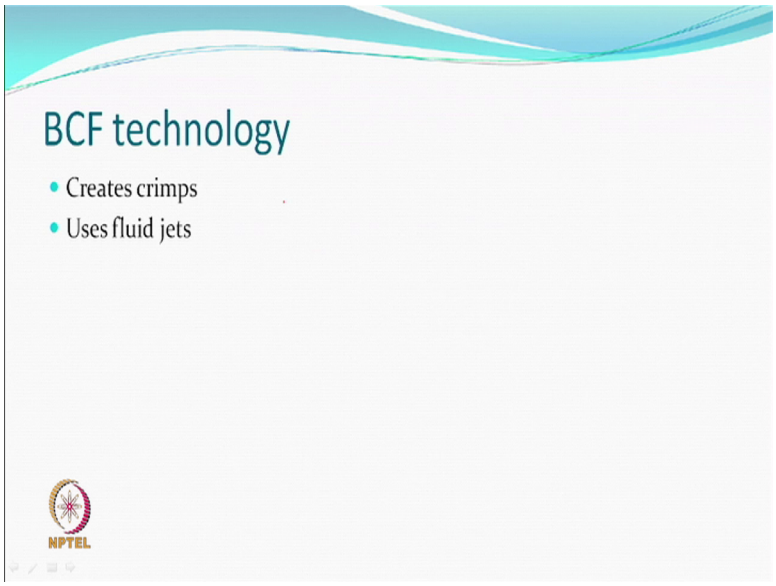

BCF technology wants to create crimps and uses fluid jets and therefore, the fluid jet part learning has come from the air-jet and crimp. That means, you hit the wall and bend that is come from the stuffer box and so this has become more effective and popular.

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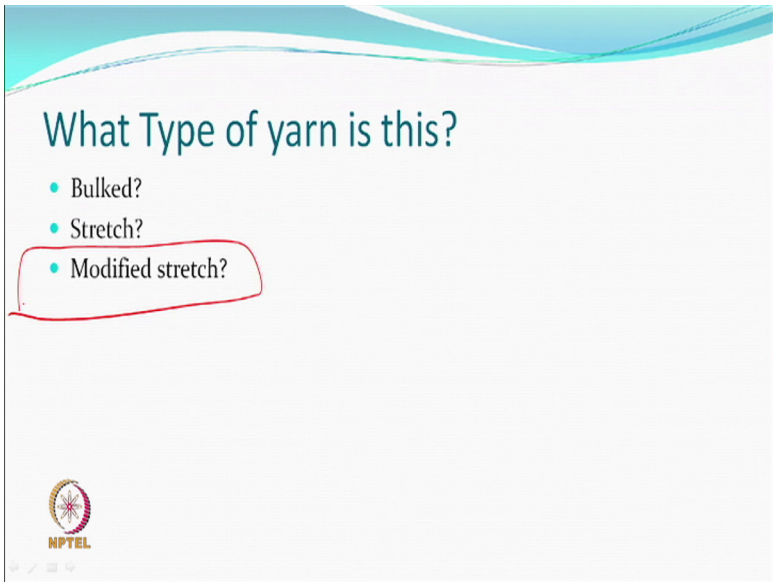

What type of yarn this will be? One technology giving me bulked yarn; they are also giving me stretch yarn. So, this is likely to be in this category that it can stretch, but the difference is you have been able to separate the filaments that is the main difference; so, using similar technology to get a product which is different.

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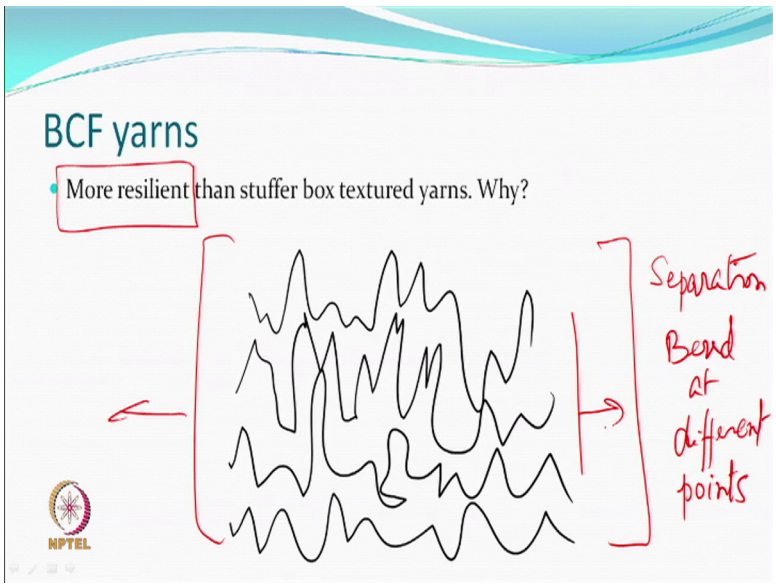

We expect a more resilient yarn, then stuffer box. What it means is that the filaments after separation bend at different points. So, of course, you will have this bulk, you will have stretch. So, these are possible, but because they are not following each other the

overall bulk is larger and so contribution towards this bulk and then compression and recovery from compression are better and so that is what we call as a resiliency. So, these yarn therefore, are very resilient and therefore, are going to similar application like a carpet pile. Stuffer box also can go anywhere, but it was main was they are staple fiber industry because large number of filaments can be just bent. So, this difference has actually made BCF yarns more popular.

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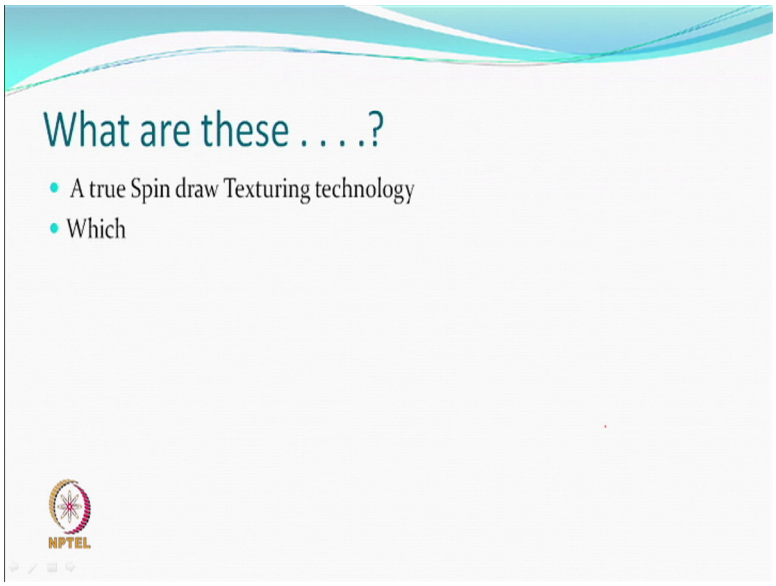

This we will learn that another interesting thing which; obviously, people realize that this technology can allow, spinning process to be combined also the texturing. So, this we can discuss a little later, but therefore, it became more commercially successful and more attractive. They did not have to machine, do not have to have two machines; you can have one machine which can work all the thing.

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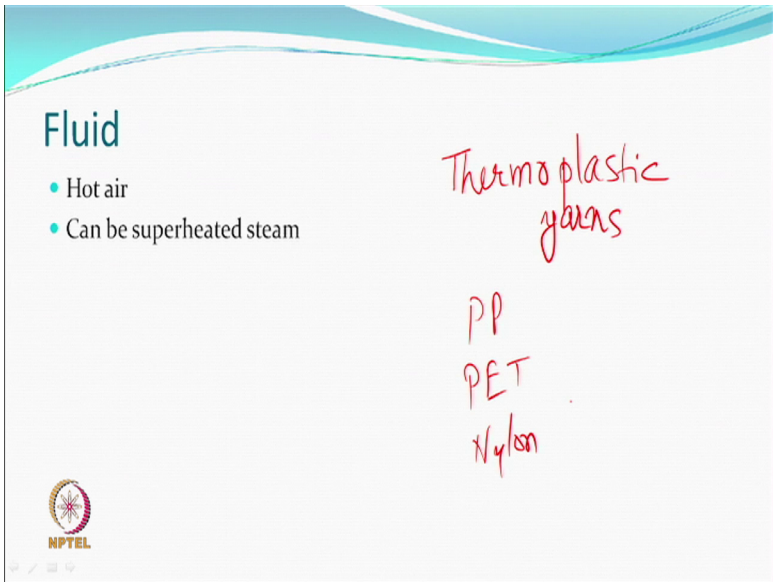

So, the fluid that is used is hot air rather than the cold compressed air or room temperature compressed air. So, in the air-jet we are using compressed air, but we are not raising the temperature. Here, you are using hot air. You can use superheated steam as well you know the advantage of superheated steam is that when it condenses, it passes on the latent heat to the material.

So, the rise of temperature can be fast the disadvantages; obviously, that there can be water droplets somewhere and you may have to design things in different ways. But the hot air means the temperatures are high. How high the temperatures? That would depend on the fiber itself. There is a polypropylene fiber or it is a polyester fiber or a nylon.

So, based on that you will use the temperature and suppose you are using polyester and using 190 degrees air so, this cannot be an open system where you are throwing air and it is coming out on one side and nobody is concerned. You can get burns without any problem. So, you have to have you are going to use fluid which is we call it fluid because hot air could steam anything could happen there, but what it also means that this whole environment has to be secured.

You may not be interested in recovering the air so much. If you cannot a issue because at least you have to reheat less and take it back and again compress and heat it bent. So, one system is that you have to have a hot fluid and purpose is very simple because it is hot

therefore, thermoplastic yarns are going to be affected so one interesting thing also to be remembered that this is also using thermoplastic yarns.

So, PP is very popular; polyester nylon anyone which responds to thermo mechanical changes is a good candidate for this precautions of course, will have to be taken. So, different from air-jet that it is using hot air different from the air-jet that it would not be suitable for viscose and non-thermoplastic yarn.

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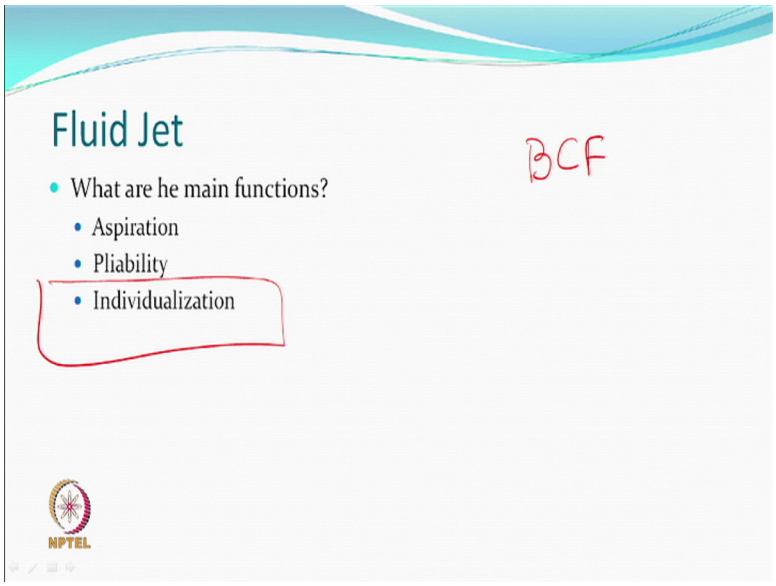

The functions that are expected from a fluid jet for the BCF is aspiration; that means, it will suck the yarn immediately as it comes to the so, it will suck and forward right so the aspiration. Liability, they want to make the yarn softer. So, if you make the yarn softer, the frequency of bends amplitude can be controlled and they can be trimmed down easily. The temperatures are low or not hot then; obviously, the larger bends are going to be made and of course, this is the most important expectation that individualization of the filaments. So, it has to be used in a manner that different filaments are not only sucked and thrown out, but they are individualized also; then only then you will get that structure.

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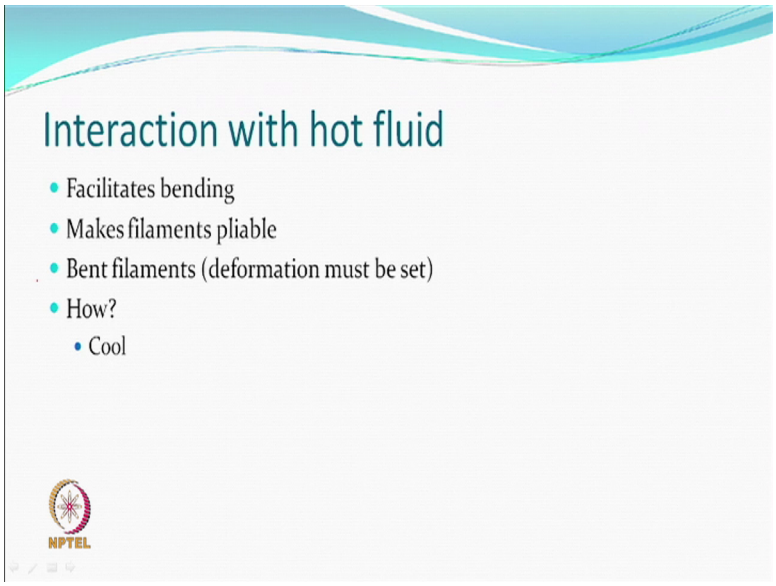

So, common sense also says that after hot air bending, it will become pliable so, becomes easy bending. The bending bent yarn must be made stable so, there has to be a process of cooling the yarn so, that we get the crimps stabilized and so there has to be cooling mechanism.

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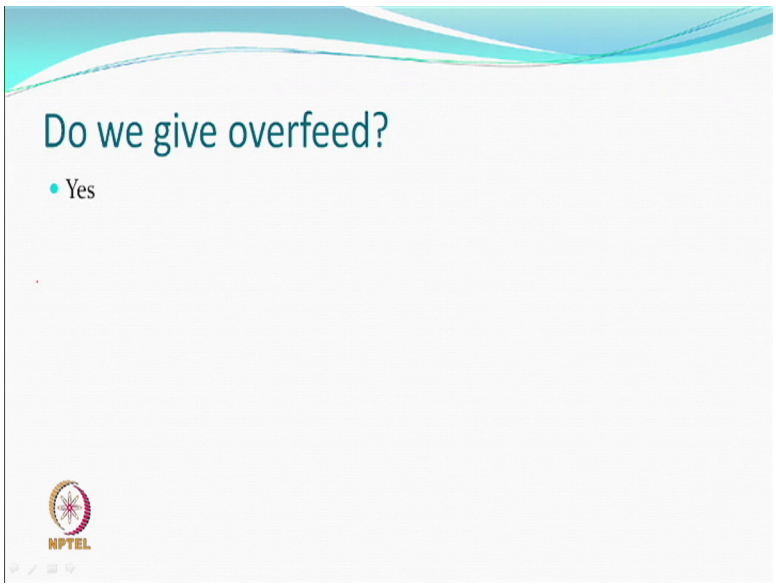

Do we give over feed? Of course, whether it is the air-jet or it is the stuffer box, we are giving or feed. So, over feed will also decide as to what is going to be the number of loop, a number of crimps and frequency of the crimps. Of course, when you say hot

fluid, there is a pressure also involved. So, this aspiration and separation everything else is the pressure also involved. So, you have a pressure governing systems also.

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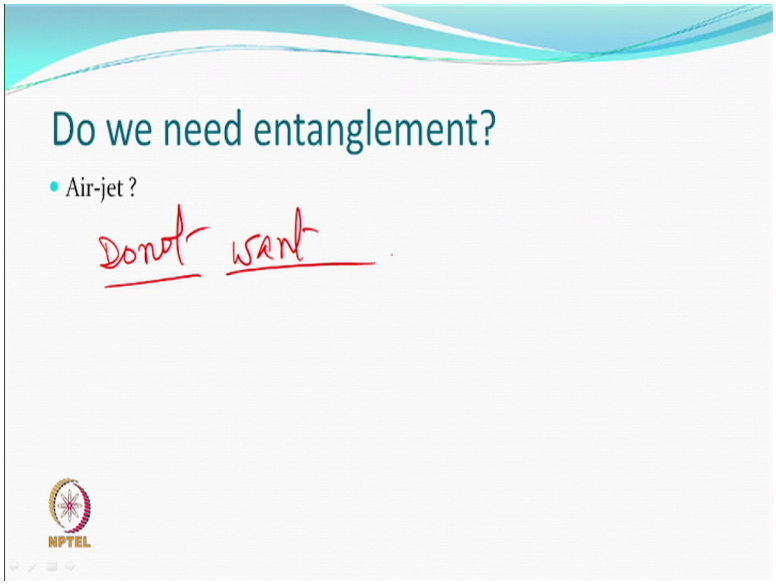

So, the question is do we need entanglements, air-jet one of the function is entanglement. So, using the same jet at a higher temperature so, in air-jet we do expect in BCF; we do not want entanglement. So, we know how entanglement happened in the air-jet texturing. They have to avoid that.

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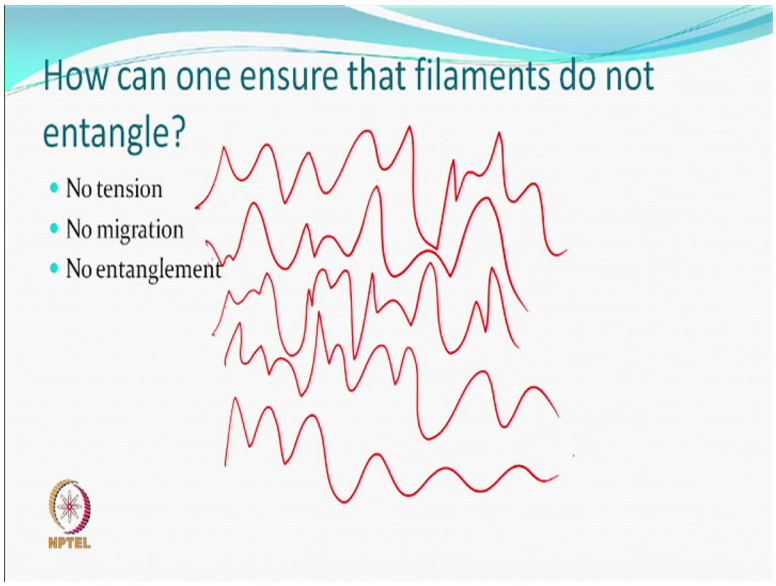

So, how do we ensure that the filaments which have been separated being thrown out of the jet they are applicable, but they do not entangle because our structure we want is that individual filaments bend in whichever way, we have no issue on that. But we still do not want any entanglement, then the compression, extension all that will work better. So, how do you avoid that? We have seen air-jet we have seen interlacement, some entanglement takes place because if it gets entangled there will be a different product, yeah.

Student: By changing frequency and amplitude of bending.

Yeah, but this is happening; this amplitude and frequency change is not a very controlled phenomena is expected phenomena. The control with you is a pressure and the temperature they are the controls that you have. But it will be very difficult for you to say well this one goes only there, they are the vent bends here, the other will bend there it is not there. So, whenever they strike the bending will they so, you are striking a wall. So, the technologies have been used principle, but they still want a different product.

So, one important thing is that at the end of the jet, at the exit and in during collection, there is not tension. Because if you remember, in the air-jet texturing at the end of exit there was a tension and because of tension; why was the tension? Because filaments are flying at different speeds; so, you had tension because there was a tension you had migration and because there is migration so, you had entanglement. So, what you have to ensure is no tension or a low tension, no is the best. Of course, we are over feeding your over feeding in air-jet also. So, this is what is to be done.

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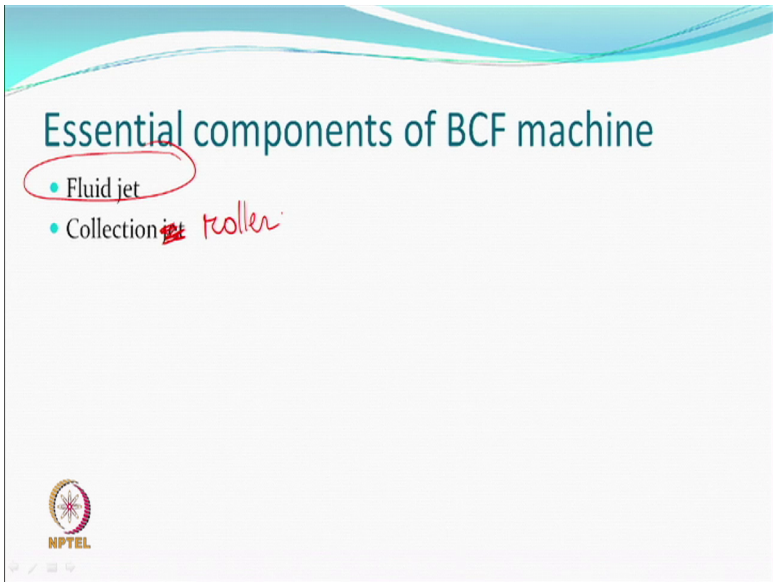

So, for a machine fluid jet is important. So, some designs will be there which is very simple that you have to have some ways in which there is a divergence allowed so that filaments not only move forward, but separate that part of the mechanism is understood. So, the other part which is important is collection after they have been aspirated, pliable made pliable and then they are separated and they are being thrown when the bending is taking place here to collect in a manner which does not lead to tension.

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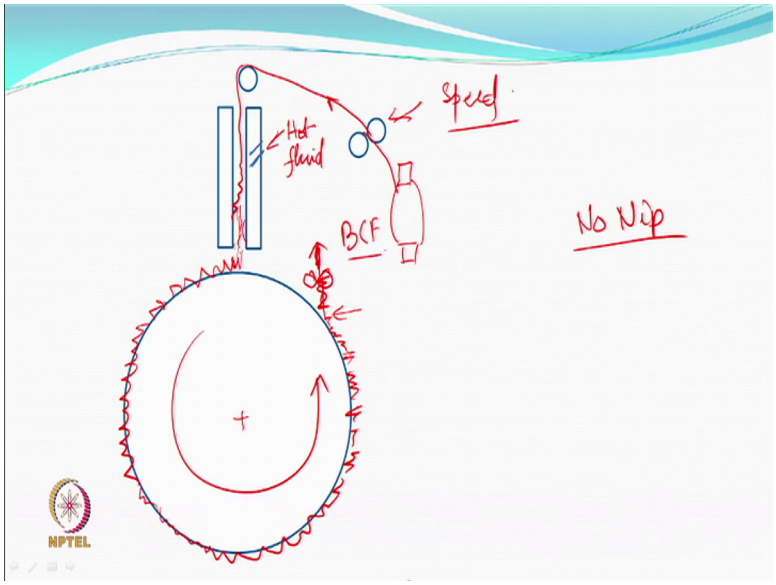

So, roughly a machine may look like this. So, you have your package, you draw the package, this is the jet hot fluid and this multifilament yarn is overfed and so separate. But as it comes out, each filament just near the exit strikes a wall this is a roller, let us say, it is moving in this direction. The yarn is being collected I mean fed; overfed, but there is no nip here. You see in all overfeeding systems, you have a feed roll which is moving at a certain speed which is the nip, then there is a take up roll which is also nipped. So, between these two you have a differential speed and so you overfeed.

So, this speed of this roll is a big roll will be decided by how much over feed you want to give because whatever speed is there which is governed here. Of course, there will be guides and everything else you just keep feeding because this is sucking. It will pick up anything that you give right. So, you give 20 percent, it will take 20 percent the only thing is during this whole process, it should get separated heated enough and then strike this drum. Drum is rotating at a speed which; obviously, from the point of views taking care of the over feed and this yarn in some way gets collected all over the surface.

Now, there can be a nip later. Now by doing this, what have you done? The yarn has almost no tension at the exit of the jet after that is over and what this drum is going to do? Will take this crimped yarn on the surface all along and cool it also; it is a metal stuff cool. So, expected by the time it reaches, this point it is cooled. So, the crimps that are there are set. So, what has happened? Individualization of elements, individual filaments are striking have all bending and just being cooled slowly. After this you can do whatever you want to do with this yarn so you get a BCF yarn here.

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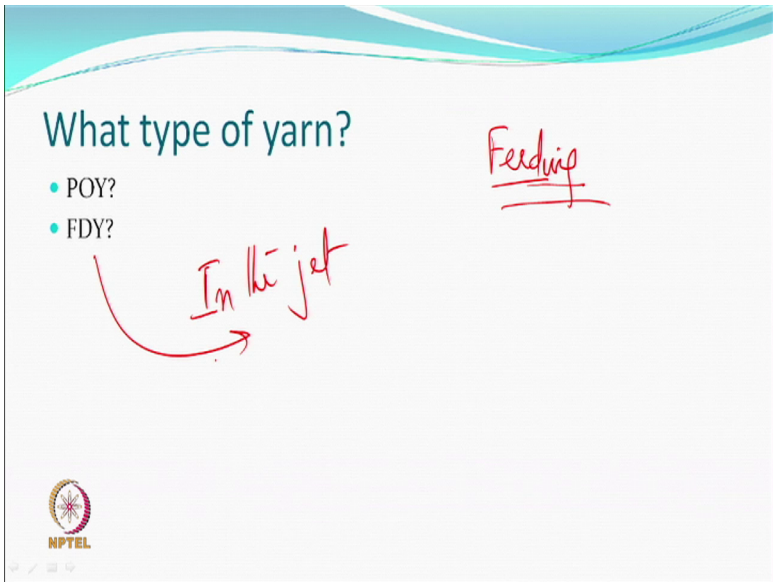

What type of yarn would be feeding here in this jet? POY or FDY?

Student: FDY.

FDY, why not POY? Important thing is the BCF is a final product there is no more intermediate step after this. Then if you are taking a POY which is a very less oriented material, it will be bent of course, it will be set there and then in a very very un-oriented manner. So, later on also its extensions etcetera will not be controllable. So, you can use a POY if you want, but you will have to do pre drawing. So, if you, but what is going to be fed in the jet? It should be fully drawn. If you want to change, you can; I mean if suppose you are saying well, we are getting POY somebody's supplying which is possible now most of manufacturers remaking POY will have to use a pre drawing system to draw and then go through this process. So, this will be a final product.

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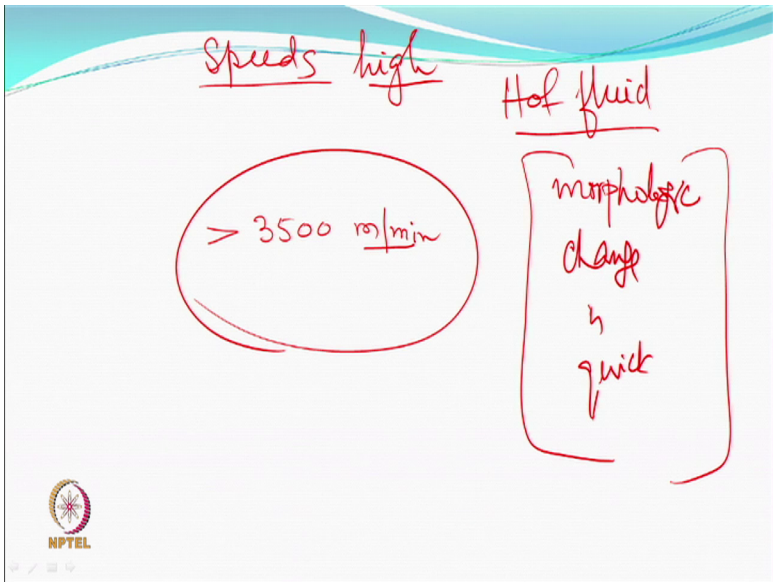

Speeds are more than 3500 meters per minute. Look at the speeds that we are talking about of the false restriction starting with 150 going up to 1200 meters per minute, air-jet texturing 600, 700, 800, 1000 meters. This process can give you speeds as high as this it is a very fast process. Therefore, come cheap, that we can do a production very high and it is simple as long as you understand the principle. So, you very simple process you are not interested in tangle meant so, this yarn is going to be modified stretch yarn like a crimped yarn. So, it is a crimp so, they will open if it is set very nicely, it go back.

So, good use is being seen in the carpet industry; all kinds of deniers can be used. So; obviously, were using half fluid so morphological change is taking place. One can say when the time available here in the jet at this speed will be what and jet cannot be very big let us say even if it is a 5 centimetre and of a jet, maybe 10 centimetre of a jet, what time we are spending? At this speed see so you are expecting things to happen, and they happen? They happen because the actual change in morphology actually is a millisecond microsecond process.

So, the time which is taken in is heating. Heating the material from room temperature to a particular temperature where these changes are going to be facilitated, but actual once you have reached the temperature where the thermodynamics takes over a very quick process automatically, very quick process. And therefore, at high speeds this can be happening, otherwise when can always doubt as to how will you finish this process.

It is true in false waste also that actually the time that is required even if it is 0.2 seconds most of it is in heating and not rearrangement of molecular chains. So, the rearrangement of molecular chains takes place in a very very short period. Thermodynamics you like this just more than 0 of course.

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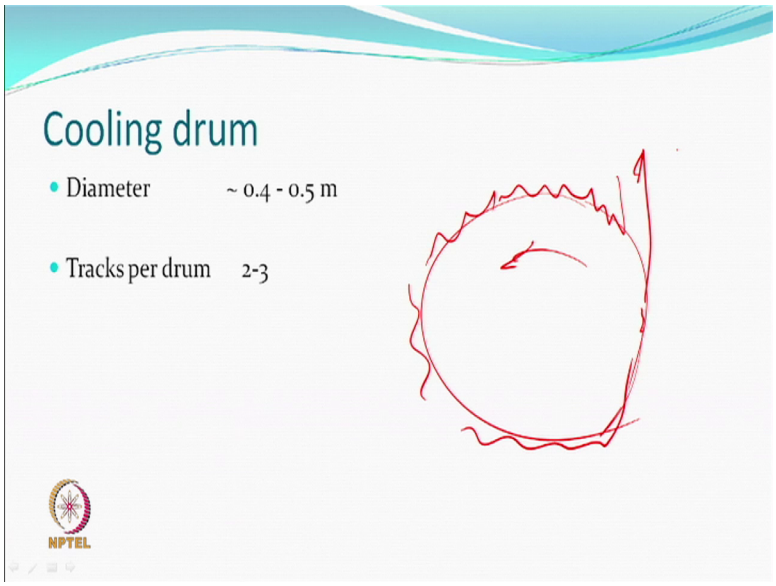

The cooling drum could be 0.4 to 0.5 meters in diameter which if you look at any such machine whether spinning or thing looks like a bigger diameter right because you had to spend some time and during this whole process till, it set no tensions. On one drum because drum is big and you are rotating it so, fixing so many drums for every position that to large drum they say well why not have more than one jet being cooled on one drum. So, fast process so sometimes people use two tracks on a drum or 3.

So, yarn comes one of them is guided onto one track, the other is another track, the other is another track. So, the arrangement have to be done of heating and taking that is way the gravity does not let the yarn fall. It can be done, isn't it?

This is the drum; if he is moving in this direction so, if the heat is here. So, it cannot fall because it is being taken away and then from here you collect straight. So, it can say otherwise if other things are being seen, then you can always make a perforated drum which can suck cool air and can cool and not let the yarn go out of, why should happen? Although it is a large drum then the speeds are, but speeds are high you know should not

have issues of under less tension; see if speeds are high and tension is high winding is right.

It is not a winding drum; it is a drum which is cooling. So, it is; obviously, rotating at a much slower speed, but how much lower? Surface speed, just calculated because the over feed that is all it is a just adjustment you have. So, it still be rotating at fast speed, but because diameter is large so can be, so one around.

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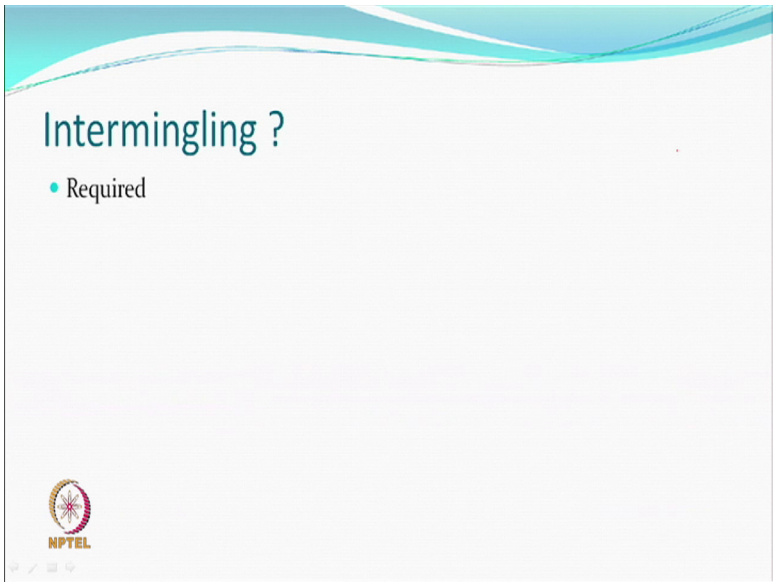

Now, this is the intermingling part of it. So, you know the difference now, this is not air-jet texturing. So, would you require intermingling? Yes, if you require and false twist, you require an fully drawn yarn, you require an BCF also. So, interlacing jets will be fitted before winding and so, you get what you want to get.

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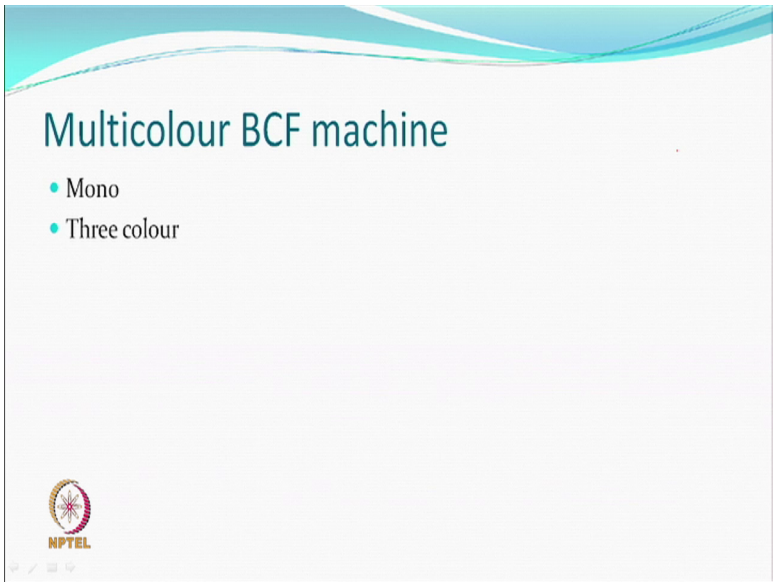

So, multicolour is not a very different thing, you have a coloured yarn so, coloured yarn will come; no problem on that. So, one can have three different coloured yarns, three different tracks; yellow, green and blue. We collected three different packages which are yellow, green, blue no problem which is a molo colour of a different colour, but one can think of that you can mix also, you can separate and mix and get a some mixed colour.

So, people sometimes are using this that will give you a multicolour effect and the yarn itself because during cooling or otherwise, you collect them in a manner; so, they get theoretically you can feed also. So, mono colour of course, means whichever colour is the mono rather three colour some of the companies may be offering option of three colours. As long as it is a package which is a coloured package, it does not pose much challenge.

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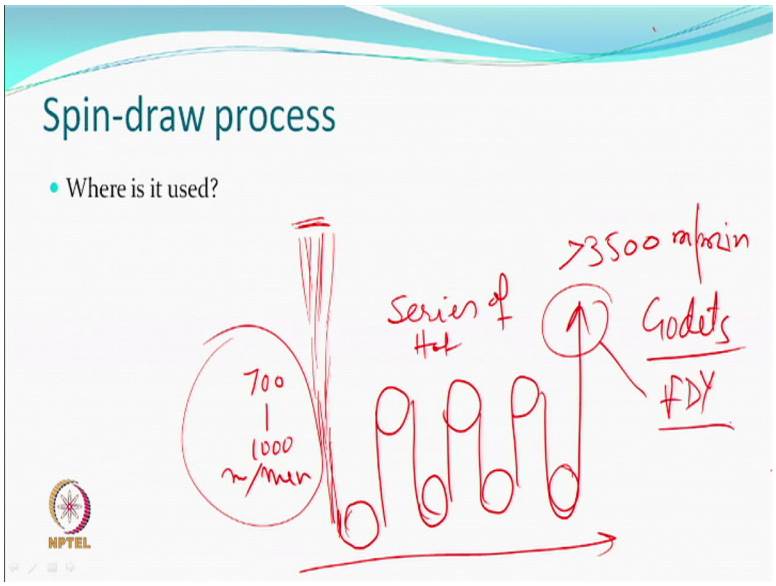

The challenge comes at a later stage where; so, before we go a little further just an attention. You have a spinning process which we saw high speed spinning I say spinning means 3500, you get POY 6000, you get fully drawn yarn so and so forth. But there is a process which we call as spin-draw process which spins at a relatively low speed. So, spinning speed is not high, but as it is being drawn along these godets, the speed keeps on increasing. The speed here could be more than 3500 meters per minute; that means, at the end of this whole process called spin draw, you would have a fully drawn yarn. This type of yarn is quite popular in tired coats as tired coats; spin drawn yarn.

Now, there is something which strikes us here that is spinning and drawing combined are running at speeds which are quite high. Our BCF machine capability is also same type right; if there is the same time, they can combine that is the yarn can be fed at a very fast speed and then again taken out at a fast speed. So, here at the end, this is a fully drawn yarn. This is the input.

So, a spin-draw machine can become an input directly to the BCF. I mean we cannot say this that you can put a spin-draw system or any other system and combine it with false twist texturing. No way, speeds are too different. So, you have a separate package and used two separately, but here fortunately these processes very fast and the other process very fast comparable speeds, then you can combine.

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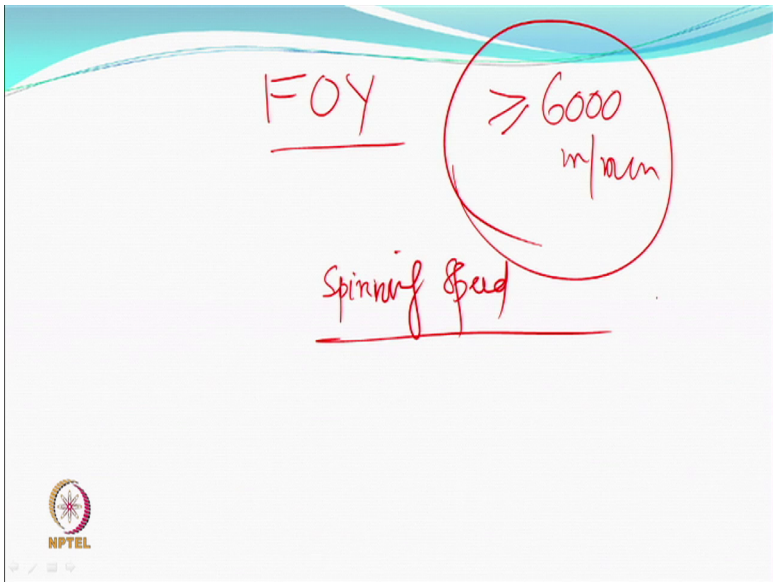

Anyway FOY is that k 6000 meters per minute that is by spinning speed. This is too high people do not use that and can say well why kind of use that that is not done. POY we do not want to use right otherwise is a combined POY machine with this. POY has to be drawn and therefore, a spin-draw process.

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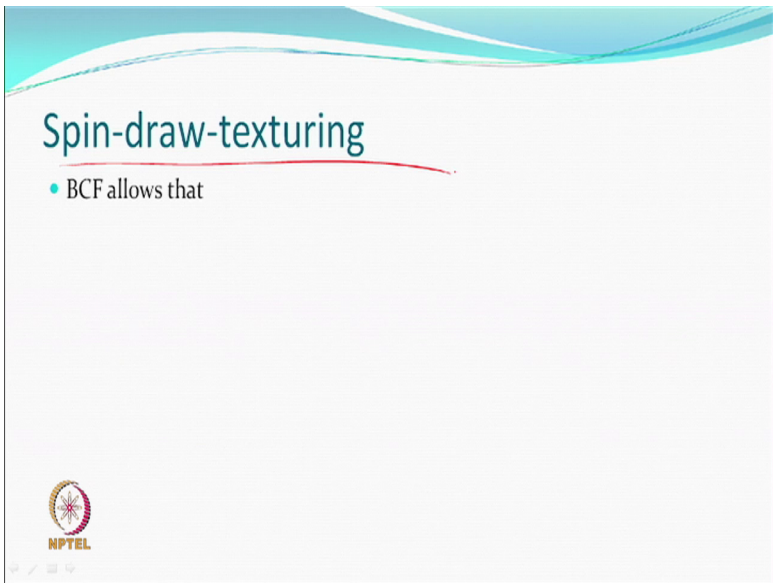

So, for the first time you have a process called spin-draw-texturing can combine the spinning process with the BCF, if you can then you do it. So, most of the plants would actually be like this, but separately also you can do it no problem. But if you want to

combine that would mean that you have enough production that you will be able to sell. So, you can work it out because the moment you have spinning attached with you, it is a 24 7 operation nonstop. You do not stop a spinning process because the moment you stop, everything will be choked. So, it has not stopped 24 7 keeps running and so, your machine also must keep running 24 7 for texturing. If you are combining or you have an option whenever I want to combine, a combined other than wind that is possible.

So, we stop here and with one information that you have a process which is running at a very high speed and therefore, production is high and the cost is less cost of the product because the process cost is less and so, good amount of thing is being produced. You can use it for any purpose, but carpet pile is one of the good applications for such type of yarns; high heavy denier yarn could be utilized for this.

Thank you.