Textured Yarn Technology
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Lecture - 21
Air-jet texturing

So, as we mentioned last time that will be starting a new texturing process. And, this is going to be Air-jet texturing and will discuss this for a couple of lectures and understand what it all involves.

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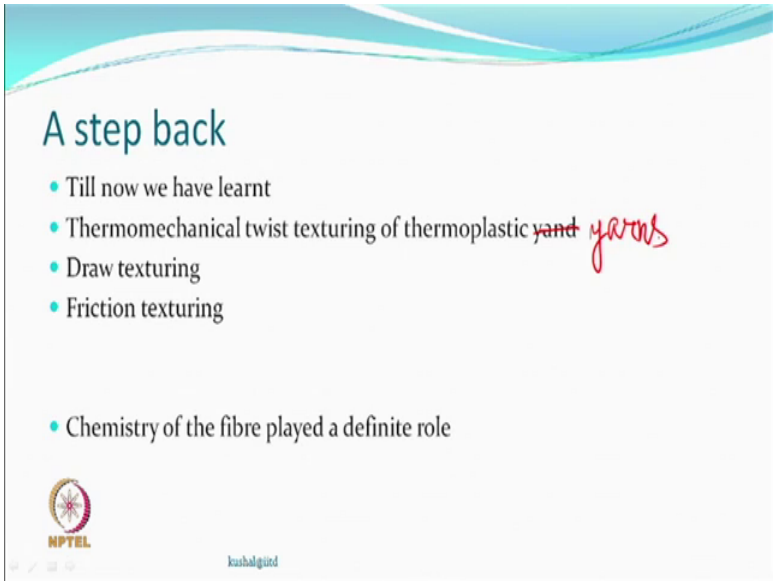

So, till now what we have done is you seen texturing which is twist texturing of thermo mechanical, thermoplastic yarns, thermo mechanical plastic yarn. And, in this we have done the draw texturing, friction texturing. What we have learnt is that the chemistry of fibre plays a definite role in thermo mechanical twist texturing. So, twist was the mode of deformation could have been falls to twist the twist method.

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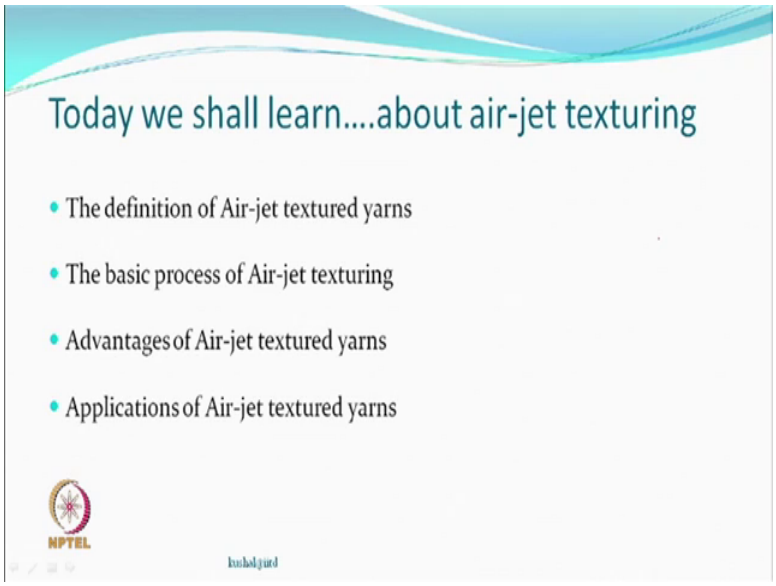

Today, we will learn something about air jet texturing, the definition what type of a product is called air jet textured yarn, basic processes involved in air jet texturing. So, you need a basic process, there must be some advantages we might like to note them. And, application of such type of materials yarn and fabric made out of them is briefly we will look at today.

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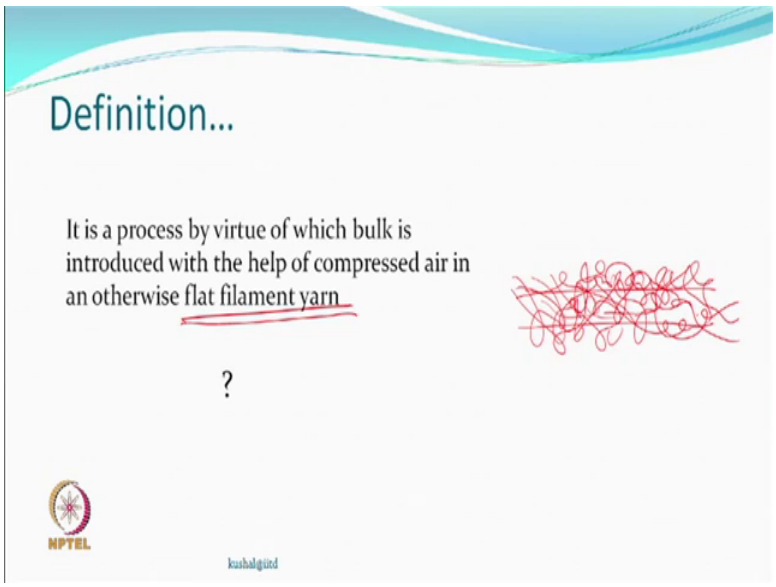

So, if you look at a general definition, it may be said it is a process by virtue of which bulk is introduced with the help of compressed air.

So, bulk is introduced with the help of compressed air in an otherwise flat filament yarn. So, this flat filament yarn was still part of a definition that you have a filament yarn, it is got multi multi filament yarn well large number of filaments and you are going to be using some compressed air and we hope to develop bulk.

So, what would it mean probably some kind of a structure, some structure like this; there are loops bends curls which obviously get introduced, because you have some deformation possible, because of the compressed air getting into play.

So, you can see there may be some area, which is little denser some area, which is lighter and what we expected that the compressive resilience of this material should be high. That you compress the so called loops which are being seen will get compressed remove the force, they would expand back that is one. Also, we expect that the volume, the specific volume of the material which was called the filament yarn flat filament yarn, which has been used should have increased by a certain amount specific volume. And, therefore, will consider this that the bulk is introduced. So, this is how you introduce the bulk in, otherwise a flat filament which would occupy very less mode of volume.

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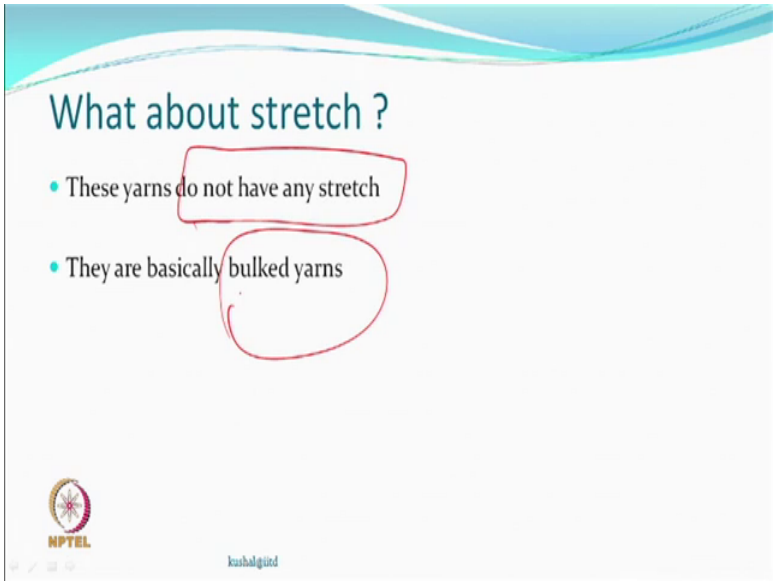

So, what about the stretch? They do not have any stretch do not have any stretch. So, they are truly in the category of bulked yarns. So, as they are moving from the first twist texturing or text text twist texturing, we now getting into another type of a material which is called the bulk yarn. The one which was called the modified stretch yarn was a

derivative of whatever was available in a stretch yarn you are modifying this and trying to get it. So, principally there is not much of a difference except that you are giving second heater treatment.

Now, this material is different.

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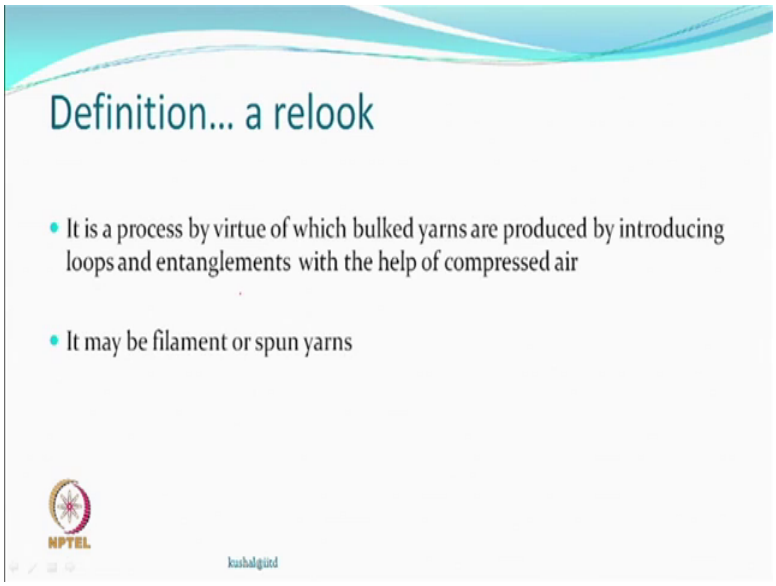

So, today we can have a relook at the definition, the process by virtue of it bulk ions are produced that remains the same. We have to do loops formation and entanglements have to be done. Again, compressed air has to be used, but you are not talking about flat filament yarn, it could be any yarn, you can have a filament yarn or you can have a spun yarn. Just, today people have used this area texturing process to increase the bulk of spun yarns as well. And, spun yarns means they have fibres which have obviously short staple length fibre, but still you should be able to get an increased amount of bulk, because of this process called the air jet texturing. So, it do not have to be a flat filament yarn.

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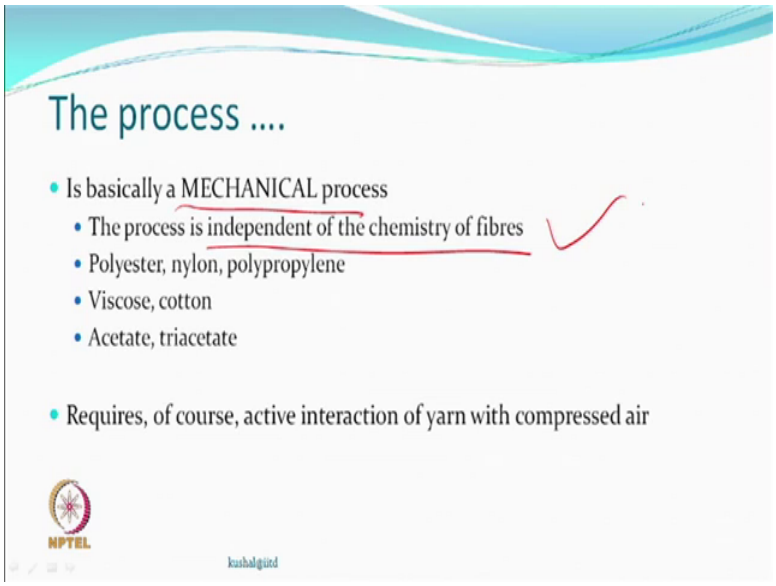

So, one interesting part of this is that this is basically a mechanical process. So, all the interaction that is happening with the fibres and the yarn is basically of mechanical nature; bending loop formation entanglement and so on so forth. And, in some sense, we can say it is independent of the chemistry of fibre, it does not matter polyester, does not matter is a nylon, it does not matter whatever it is. In the previous case we had difficulty in thermo mechanical texturing of viscose and cotton.

So, will looking at a chemo mechanical process being slightly different and complex, we were not very sure that we can do a good job with acetate, triacetate, fibres or for that matter, a click fibre the filaments, but here we do not have that restriction, you just have the filament yarns and now, we say do not have to filament yarn also, take any yarn, just put it through this process and something definitely positive will happen. So, in some sense is more versatile process and any type of yarn could be used. Of course, we need a compressed air and we some active interaction on the yarn and some parameters obviously will have to be controlled. And, some characteristics will have to be observed to be happy that we have done a good job.

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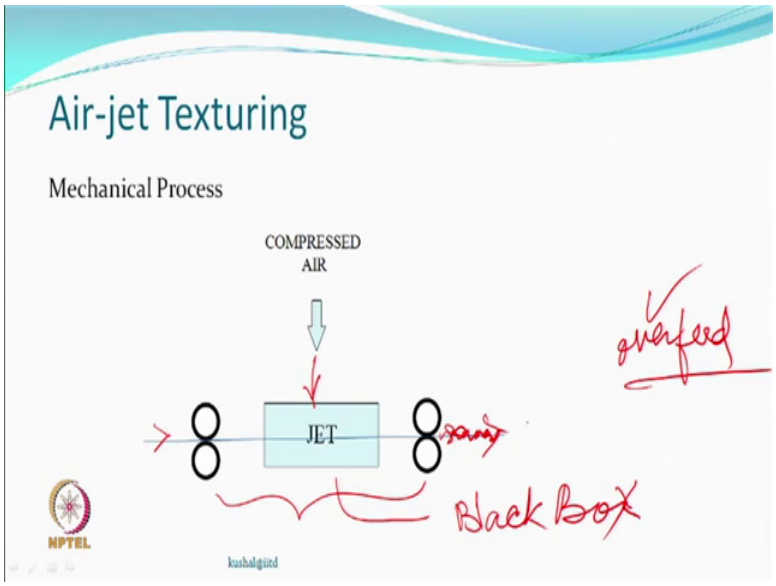

So, you may have a yarn moving from one end to the other end of something called a jet which is like a black box. You do not exactly know maybe what is happening, what you are doing is during this process, the air is entering the jet, the yarn is also entering the jet, the thing that we may be interested in is how do we create a loop. So, maybe we would like to give between these two sets of rollers and overfeed. So, give overfeed; that means, you have excess length of filaments or fibre or the yarn, at the end of this process we expect that this over feed would have been taken care of and when the yarn comes out, which may be a textured yarn would be a tort yarn; it would not be loose lakhs.

So, all that additional fibre filament length that is available would have been consumed in the process of creating loops, crinkles, bends and entanglements. So, you will obviously give that much overfeed which can be consumed. If, the process can take about 20 percent overfeed you not go 70 percent overfeed, then you may not go to the job. So, this optimisation will have to be done, but process is simple.

So, theoretically if you look at the history, this of texturing should have been the most popular method of texturing because this not except of course, it does not give you stretch. So, if you are really interested in stretch then obviously this is not the method.

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So, the three basic steps that must happen before a textured yarn is formed; one constraint this for as understanding is concerned, remember although we have used in our definition, that spun yarns can be texturised. Till we talk about spun yarns, we must assume, we are talking about multi filament yarn. So, the perspective remains clear. So, we have a multi filament yarn. So, which comes through a package, all the filaments are quite close to each other.

So, the first processes separate them. You separate the filaments opening the bundle, this is again quite important; it is an important step. They loop formation youre given an over feed and so, filaments must be bent somehow. So, that some loop is formed and after that you need to do some entanglement.

So, that whatever loops have been created, they stay in their position. The whole thing therefore is how many loops can you form and how better is an entanglement? If, entanglement is poor and you put under strain or loops open there will be nothing called a texture yarn. Because, everything depends on inter, yarn, friction. And, of course, inter or of course, the total amount of force that we generating and the rigidity of the material.

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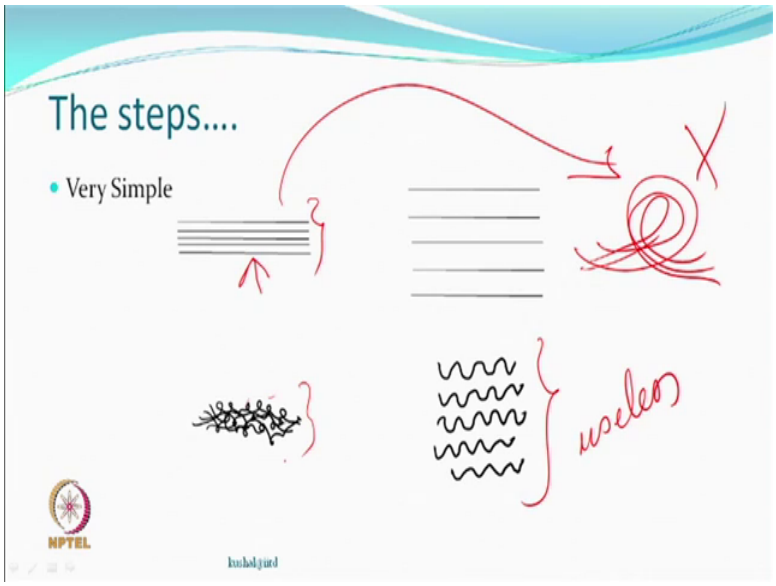

So, simple steps filament which are very close, then you separate them out because of the over feed that you are giving there is a possibility, that you will get some loops formation and after that they must be entangled somehow. So, this opening, why is it important? If, you do not open then you may actually land up into a bundle of filaments making let us say one loop here. So, this bundle will get some force and it start bending. If all of them bend together, it is a bad idea; they will open without making any effort almost. So, what we are interested is that each filament must behave individually through the input of the compressed air.

And, they do not have to follow anyone; based on their position there, position in the jet, they should interact and form bend loops, create loops. And, then also all these things, if the loops are there and have not been entangled, then they can open again without entanglements useless, this if it does not happen and bend like this is bad.

And, so, you would require some amount of entanglement, where the loops are projecting out and there is some area within the yarn, which may obviously is not project putted protruding out, but it is still hopefully hell holding the different filaments at positions, which are little more separate than otherwise they would have been. So, you increase the bulk all right.

So, you can appreciate that, do not try to compare this with this thickness. It is just to show that they are there, but they will be obviously very very close.

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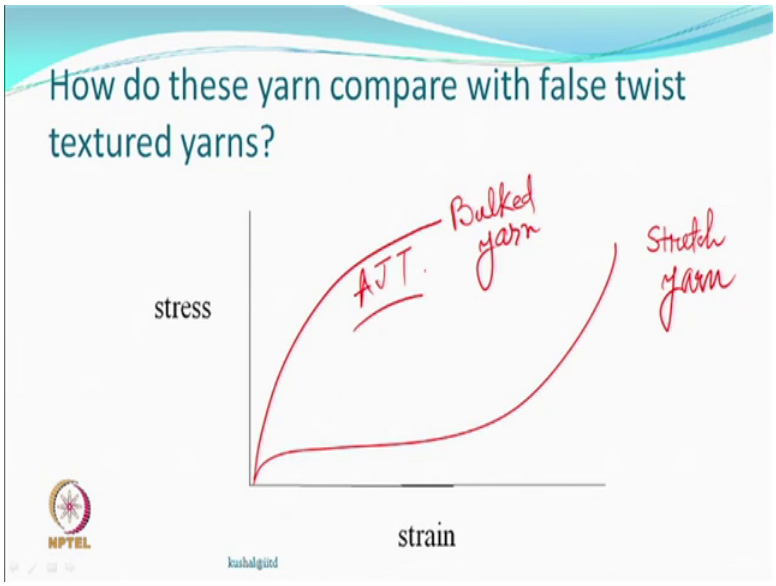

So, if we put the stress strain curve, remember the old one stretch yarn would look like this. And, our material which is the bulked yarn, this is the air jet textured yarn.

So, this is what it says that there is no stretch. So, it takes up load immediately after straining and who gives all resistance. So, the success of this whole program or this fibre remain is how strong are the entanglement? If, entanglements are not so strong, then the modulus will be low. And, what will be the bad part is that the yarns will not go back to the positions which they were occupying before you stretch them. Because, why would it go back? A loop has been opened why should I automatically form a loop.

How the filament will go back into the same position, which it was occupying in the yarn is so much of inter yarn friction. And, what is the motivation? When you open loop, you have not really stored enough energy, you may have just overcome frictional forces, which have been just overcome. The yarn in fact maybe more satisfied you know open you know structure configuration rather than a looped configuration, because of filament yarn was quite stable bending, twisting, increases the energy.

So, the filament would be happy not be in a loop form. So, once you open, there is no way it can go back? So, you may get a permanent extension of the yarn. And, therefore, successful yarn would be which does not which remain highly entangled, there are no slippage. If, there are slips that is finished there is no recovery from that.

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So, what is happening to this technology and this product? This technology being so simple actually was not adopted commercially in a very big way. Despite it being very very simple to do and simple to understand, the texturing speeds were very low means you are looking at 10 meters per minute kind of speed, they were able to produce. Even at the worst of times, the false twist texturing machine must have been more than 150 to 200 meters per minute.

So, you have a beautiful material which is called a fibre or filament and then you would say I am going to do a texturing and then we expect that it is going to take so much time, you say why is taking so much time? That means, speed is very slow, now after some people have understood as to what this whole process involves, they have been able to see the speeds rising from to 300 to 600 and even more.

So, is it just something to do with say rollers not being there obviously no that is not true you have winding machines we could do anything , but one important thing which was there, which is air which is free compressed air is not free, you have to work hard to compress it. And, if the effect is not good enough, then it is increasing the cost or you reduce the speed, so, the effect is good enough. So, what does mean by that? A, normal air jet which is called the black box, the length of that maybe a few centimetres, few centimetres, 2 centimetre, 3 centimetres.

How much time the yarn is going to be spending? Would you like to calculate at 600 meters per minute you want to run a yarn on a machine through the air jet, air jet is about 5 centimetres, what is the time that is spend in the e jet. What the time they spend? Quickly, can you come to some conclusion running the machine at 600 meters per minute, the time spent by the yarn in the jet in some seconds how much?

Student: 0.005 yes sir 0.0.

Now, 0.005 seconds or something similar here and there can you imagine what time are you talking about, you cannot even appreciate second by the time you do this second is over, the other texturing was talking about 0.2 0.4 seconds. Now, here you want to talk about one order less time. How many times you thought you can do any kind of a mechanical process, which will be done so fast.

So, what it means is realization that this process may appear to be very simple, but it is not so simple because you still want a useful product. So, higher air consumption means cost somebody say I am ready to pay the cost give me the product. Then, there is a process property which you called us instability, there we were talking about crimp stability, here I am talking about instability that you generated some loops crinkles you just put under stress you say the open.

So, if you run at a fast speed, you just not able to do what opening of the filaments loop formation, entanglement all these things must take place within around this timeframe. So, one should be always you know when looking at processes should know what exactly is likely to happen. So, they started with good enthusiasm, but they probably did not understand all the things. And, therefore, any acceptable product was being produced at 10 meters, 20 meters, per minute and obviously, it is not very commercially attractive process.

Of course, now, the situation has changed a beautiful research has been done; a large number of people here and there were involved and they understood everything. Everything means, the material itself from a first statement saying that does not matter whichever material look at me will they will do that, but say yes of course, but every material has some properties, which are different than the others you must understand how they are correlated. .

And, once you understand, then maybe the material responds better to this technology and air consumption also for the cost, you would like to reduce the cost as well. So, you have to design some kind of jets where turbulence could be high consumption would be less. Otherwise, like your compressed air open the jet and then within few minutes there is no cylinder, there is no pressure, or the machine is continuously running and producing that is cost.

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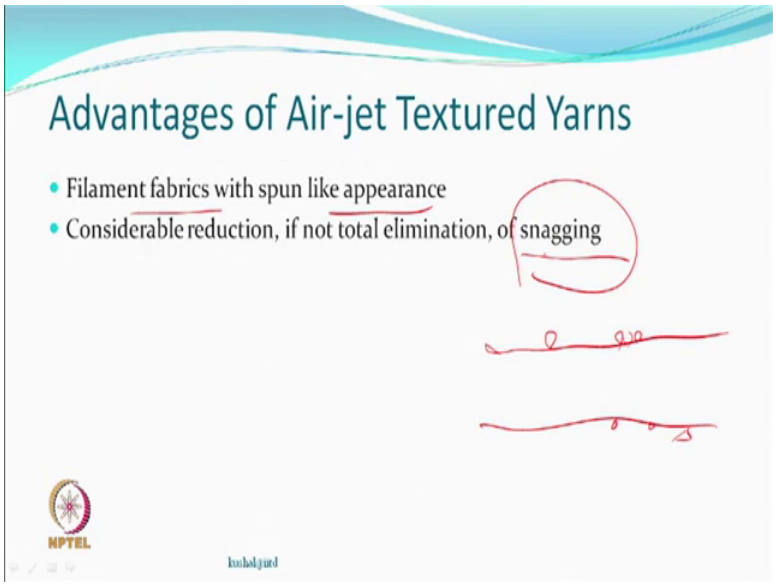

So, we look at some of the possible advantages. This is something which they really promoted this material. Even, if currently we look at whatever you are wearing, how many of you are wearing a filament based material at the moment.

So, it appeared that you had a beautiful false restriction process, which is giving this and that you still thought this panty on look is a look that you want. If, this is true, then they said this is the one which is going to give you. Why? Because surface is really made irregular, everywhere some loop is jetting out, some so secular reflection will never be possible.

And, it will have compressive feeling like you have a spun yarn fabric, when you touch it gives you a little soft thing, because a lot of hair are actually protruding out which you do not see when you feel. And, hair you would have small loops similarly protruding out when you touch them, they will get compressed, but with a little resistance. And, so, one

may say well this is there of course, as far flexion is concerned there is going to be pretty different.

And so, you have a spun yarn look alike material. So, you make what is the product that you want to make. So, that is one. Made from filament giving spun, like twisting. Considerable reduction, if not total elimination, of snagging, have you heard this term snagging, have you heard of the term nagging.

So, that you know this is something similar, but in different way there are no languages spoken, but this was felt in early fabrics made from stretch yarns. They were trouser which is made from a stretch yarn and you sit down somewhere and then get up, depending upon the surface, you might find that one of the filament just got somehow entangled with the surface which was had some roughness. And, just got pulled out of the fabric, just pulled out because does not require too much of a stress to extend it.

If, it actually came out little bit more from the body of the yarn and therefore, the fabric, then it also does know how to go back to that position. So, it just comes out and stays there and you see additional loop and a flat nice surface certainly some loops start getting appearing. If, they were uniformly appearing, you may still like as a fashion. If, something appear somewhere, something appear somewhere else it is a problem. Because, filaments in the fall stress textured yarn were independent, they were freed, they were not bound and that was the strength

so that they could stretch and give you bulk. The same thing in a fabric form, if it gets extended it just stays extended.

So, you have a plain surface and then suddenly some where you see this something has appeared somewhere little more . So, you have a trouser, somewhere you see something coming out irregularly they say we please try to make sure that your surface is very smooth when you sit very difficult. So, what you get snagging.

So, this is a new term, but that is what people felt and call this problem a snagging problem. This is area textured yarn will not snag, why is good is it, a bad one will do everything because the loop is really very firmly held. So, you cannot pull it out. If, you pull me really you have to really apply more stress. Otherwise, not good pull up; if you

do not have pull out then you will not have pull out. So, it will look as it is otherwise also there only loops were there all over. I say one more loop comes out you do not even see.

So, they said considerable reduction, if not elimination of snagging, this is my advantage. Elimination of glitter; again look at yourself whatever you are wearing? 99 percent of people in the daily life do not wear anything with glitters shines. Of course, silk is one fabric which you try to use it, but everyday people do not use it; only when they want to show or you are for example, a rock show somewhere, where the people on the stage and maybe outside the stage they want to glitter.

So, 90 percent of people are hardly glittering, it is only faces are smiling, but not the textile right. So, elimination of greater from where the glitter came and what do you mean with that. Greater means, there is a specular reflection of light and therefore, there is a shine and so if you like the shine is fine; if you do not, then you can have some problems.

In the process of draw texturing a lot of things happen, circular filament yarns they were twisted, there is a compressive stress, they were drawn more compressive stress and so what happens is they change their cross section, we just see and come back.

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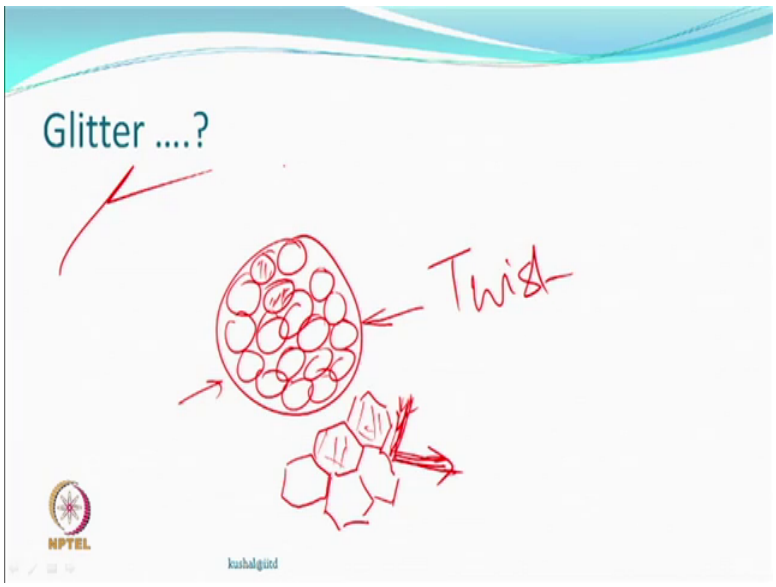

Like, you have when you we talking about the first twist textured yarn, APOY being twisted, starts with a circular cross section. After twisting drawing compression one finds

they change their procession with everything is changing under stress. So, they also change your bending they do not mind getting bend, your twisting their own magnetic twisted. And, if you compress they do not mind getting compressed and what you end up is a large number of filaments would have polygonal cross section, without you are doing anything, which would mean that a specular reflection will be possible of light and that is glitter.

So, people found that the textured yarns fabrics were glittering more than any other fabric that was available. The area textured people say are fibre yarn, they fabrics will not glitter. Because, we are not doing anything; if the cross section is round, it is round; if the cross section is not round, it will not be round.

So, if you start with something which glittered it will remain, it will keep glittering, if it does not, then it will not; otherwise also with so much of loops forming here and there the light is not going to reflect. So, neither you are changing cross section and not the surface is smooth, slow no glitter. Then, the other thing which they talked about was resistance to air permeability, whether you like it or do not at least if you want to wear something where you do not want the chill air to just go in, then you may say well I am looking at it, but if it is form compared comparative purposes, compare the whole stressed, which otherwise may have been occupying whatever volume that it is it still filaments are free.

So, air can pass through from this point to that point easily, while this is relatively more so you have to displace with more sense that is just this change.

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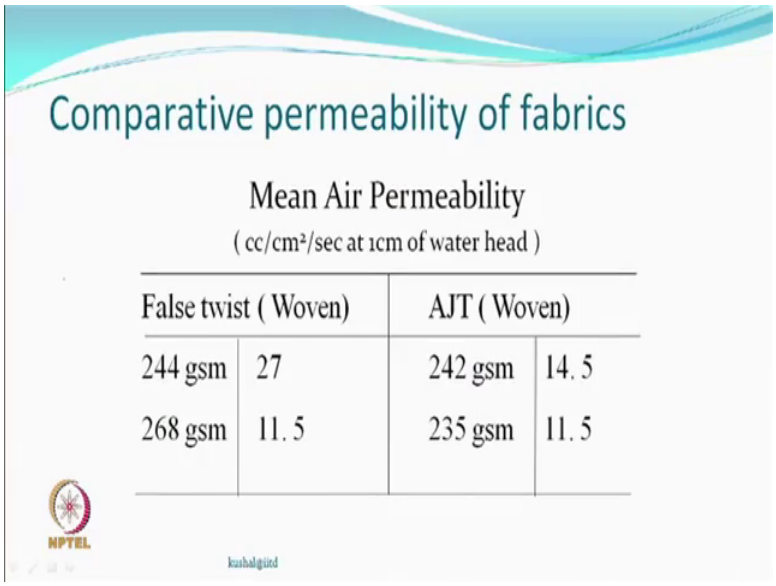

So, let us see somebody had done some study using the permeability. So, the permeability for the air jet textured yarn for the same or less gsm can give same permeability. So, you can make the material lighter because otherwise is less permeable. So, you can do whichever way you want to look at it.

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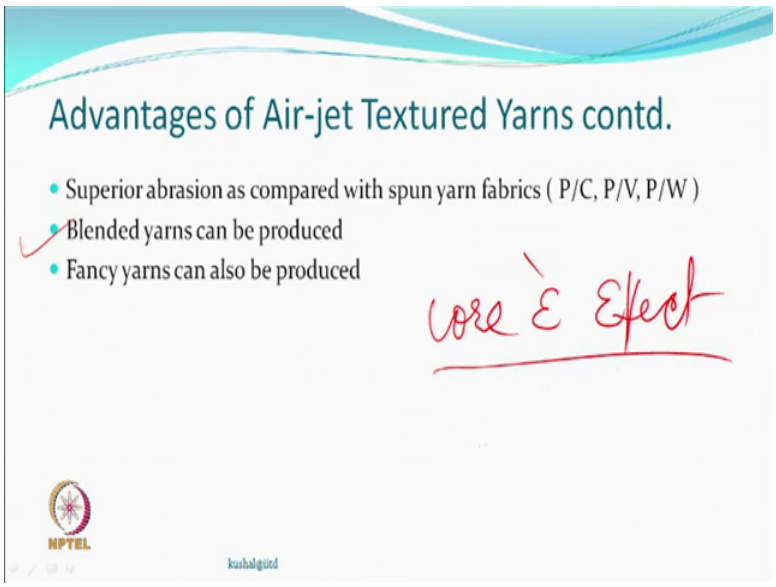

Some more advantages say superior abrasion compared with spun yarn fabric you are not talking about filament.

So, first you fight with the filament people, you fight with the spun yarn. Superior abrasion, what is it abrasion? Abrasion is that some surfaces are rubbing against each other and some fibre can either come out because of whatever reason shorts or staple length, breaking in on part, but here it cannot slip out because otherwise it is a continuous filament it is not a short staple.

So, anything which resists more obviously gets abraded more based on their rigidities and their tensile properties. The one which give away like you say the trees in blizzard, those which are lighter and thinner, they just bend when it is the force is over they come back. The ones which say I will not bend. So, you can break, so, here if there is a loop before offering any resistance, it just bends.

So, if you bend then; obviously, you are offering less resistance. So, that is how they can be better and of course, their filament they will not come out there easily. The other interesting thing is you can texturize blended yarn or you can make a blended yarn during tensioning itself that is you pass the viscose filament along with the polyester.

What will come out will be a mixture of them. If entangled very well, it is a blend, you cannot do false twist texturing passing two filaments together; one of viscose and the other of polyester in the same texting machine, neither their extension nor chemistry related.

So, you cannot do that, but here is a well there is a possibility just pass them through that and you will do that. Fancy yarns, what a fancy yarn? The fancy yarn is that it could be different coloured yarns, we can produce or you can have encore and effect kind of a situation; that means, based on your parameter of control, you can deliberately push some of the filaments in the core and deliberately some outside.

For example, you can say polyester polypropylene etcetera, I want most of them in core and I or this course coming together which could be on the surface and so you have a combined effect.

So, you have a core and effect yarns, fancy yarn, different colour yarns are pairing at different times you can do a proper programming. So, these colour appearance on surface could change. And so, you get some interesting products.

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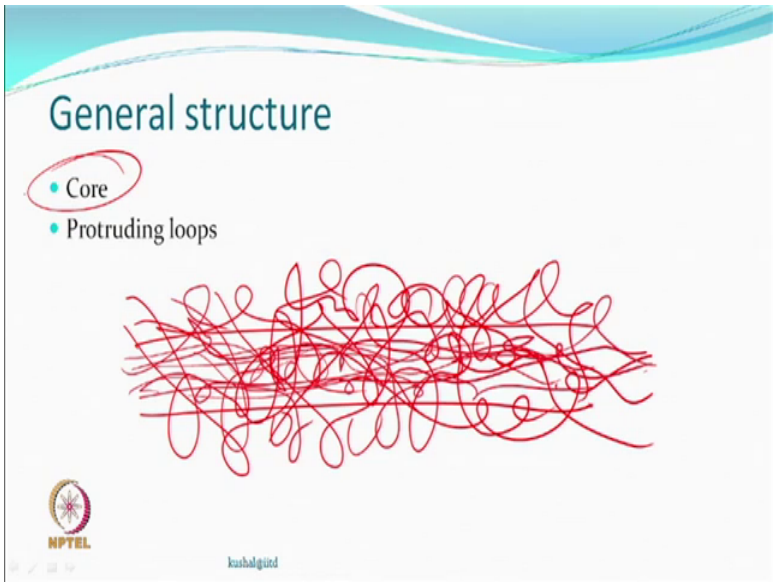

So, the general structure will be that there can be something which is little more densed like this kind of an area; this can be considered as a core of the air jet textured yarn. And, the other is softer, more compressible which is the protruding loops. So, this these loops are going to give you compressive resiliency, they can compress and come back and compress and come back, but when you stretch in the linear direction, this core an entanglement within the core is going to help it not to open.

So, in case if the core is also very loose, then everything will open. So, there has to be some balance of the core and the thing, but the core itself is also expanded, it is occupying more volume compared to if these simple flat filaments were being used.

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So, all those applications where bulk is desirable stretch is not, you can use them. So, you want compressive resilience, but you do not want the material to stretch, this is the right kind of material use suiting, shirting best materials upholstery, draperies, laminator fabrics, what do we want you can make, it a large amount of upholstery for the car and automobiles could be from the air jet textured material. They, do not stretch they are not required, but good amount of resiliency and bulk could be used.

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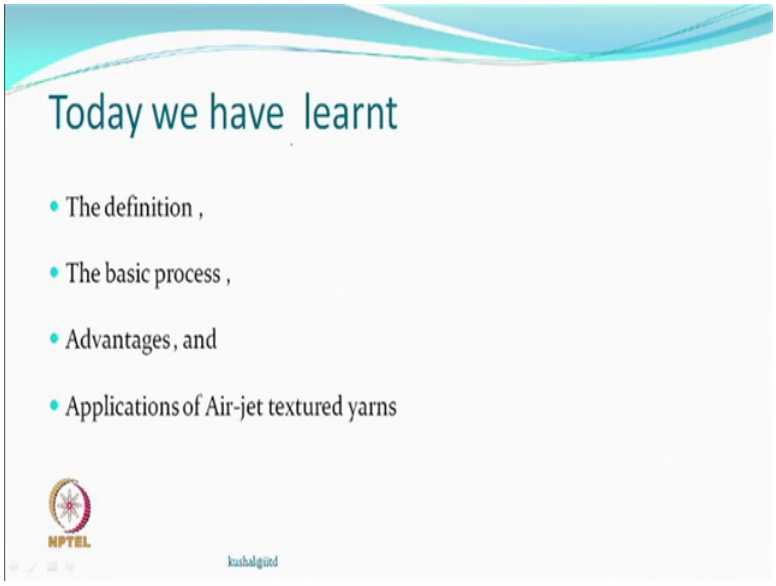

I think that is what we would do it. Today, that we have some way to define what the air jet textured yarns are; what are the basic principles of processes that are used, some advantage in application of these yarns is as what we have done today. We stopped here.