Textured Yarn Technology
Prof. Kushal Sen
Department of Textile Technology
Indian Institute of Technology, Delhi

Lecture - 23
Air- jet texturing contd.

So, we continue on the Air - jet texturing further.

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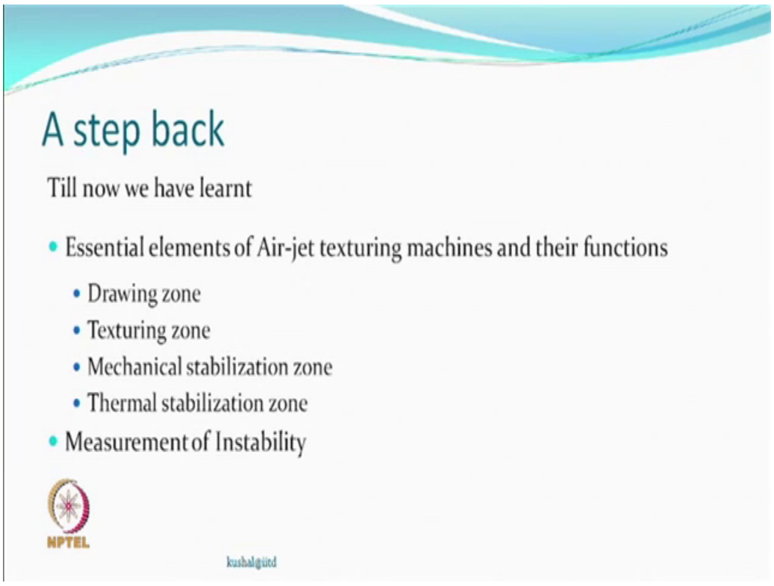

And what have we learnt now is that we have seen there are many essential elements in a air jet texturing machine and their functions also for example, drawing zone which is a sequential process which must take place before put the yarn enters the texturing zone, particularly if the filaments that is to be used as a raw material are POY or undrawn yarns.

Then there is a texturing zone which is the main zone, where entanglements etcetera what happen, mechanical stabilization zone where we believe that loose loops and entanglements will open up entanglements become tighter and so instability can reduce. Thermal stabilization zone where also for thermoplastic fibre this can also helps in reducing the instability and we also learnt something about the measurement of instability.

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We shall today look at the other ways of characterization of textured yarns.

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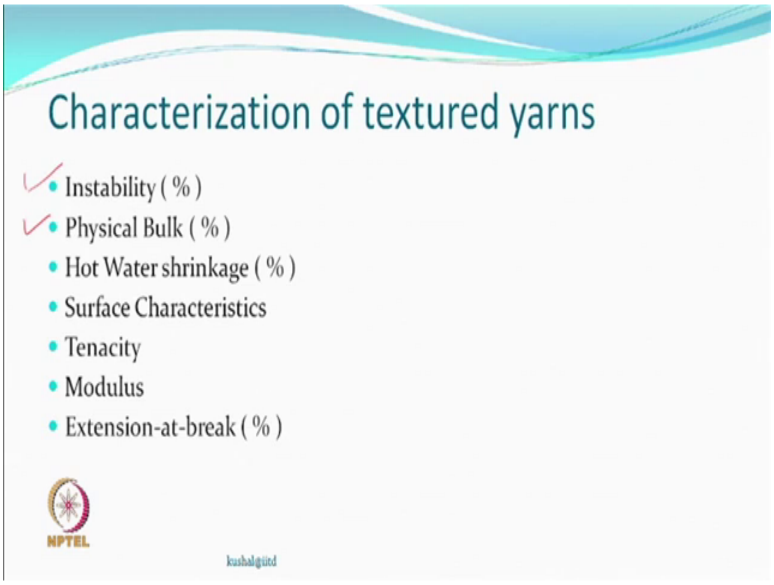

So, various characterization techniques that maybe use we have generally talked about the instability and the measurement of bulk and we said that bulk can be measured in many ways possibly, but winding on a package and looking at a packet density and the ratios are the one which have been used as a more realistic way of describing the increase in bulk of the yarn.

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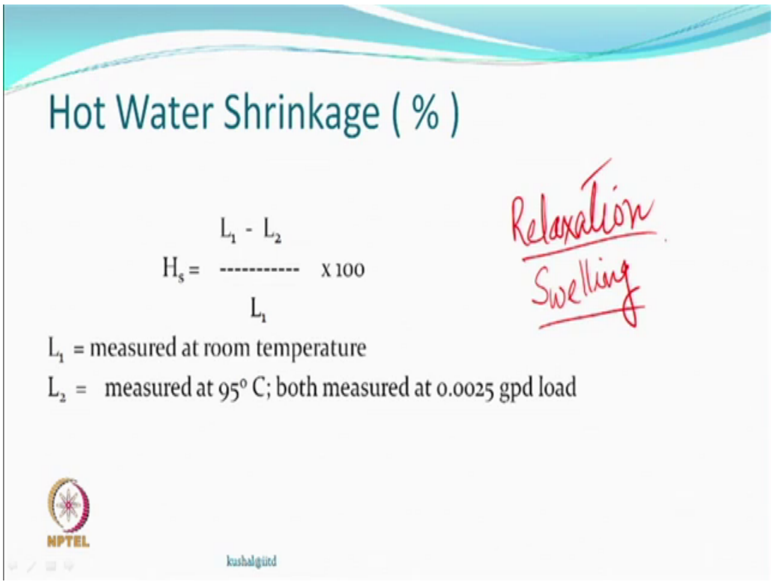

So, hot water shrinkage basically is for any synthetic material which gets affected by the temperatures like thermoplastic material this could be interesting, otherwise the shrinkage takes place because of the disorientation that takes place at higher temperature. So, the shrinkage in water or otherwise takes place either because of relaxation, relaxation of molecules in a drawn yarn takes place at higher temperatures there is one reason.

If it is a non thermoplastic yarn so, stresses that may have been introduced during the manufacture can relax or in a hydrophilic system you also have shrinkage due to swelling. So, shrinkage can occur the system and you may be interested in learning about that. So, simply change in length and expressed as a percentage one can express hot water shrinkage for any yarn we will try to see why it should be related in air jet texturing.

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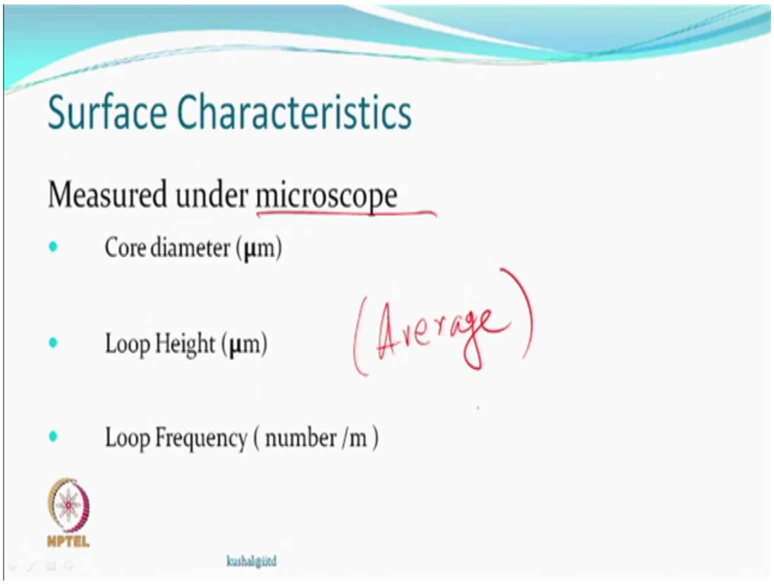

So, one way of finding out the bulk is what we describe, but why a particular yarn behaves in a particular way if one wants to learn more about it. So, you may like to measure 3 more parameter which in some way are related to surface that chain takes place particularly if you can watch it under a microscope.

So, one is core diameter can express it let us say micrometers, height of the loops where is the average height. So, you will be looking at the average and frequency per unit length let us say number of loops per meter for example, can also be measured if you really want to do some explanation as to how a partly yarn is behaving.

So, this optical method in general will not really be use to describe the bulk because we said last time that larger loops contribute to the actual bulk in reality less than the smaller. So, if you watch in the microscope, it will probably give you that should be much bulkier, but in reality it may not be, but this at least can be used to explain certain observation which may have been otherwise used.

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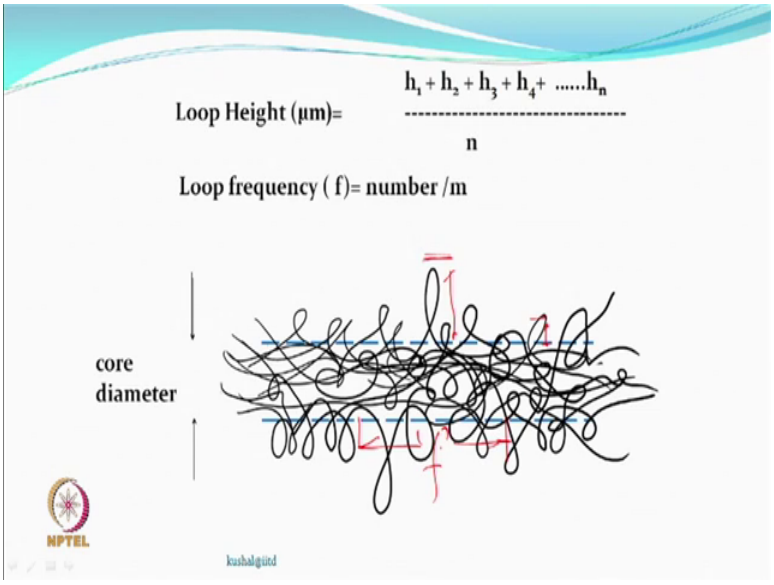

So, there is a textured yarn air jet textured yarn so, what we are looking at is. So, there can be a denser area which will be called the core and protruding loops are the surface characteristics and so loop height for example, can be measured. So, it is a hard work for us or wants to do see you measure in a particular length, how many number of loops are there and what is their height, what it means basically is that you may be interested to be learn that this particular thing is up to this point and this one is up to this point.

So, you keep measuring these heights of various loops and then take an average out of that an express in whichever way let us say micrometers can express.

So, when you use any type of optimization process some of these things would change, then how many the loops are there in a particular length which can in a way tell the frequency of the appearance of loops in that which will change if you change the overfeed if you change the air pressure and so on some of these things can happen.

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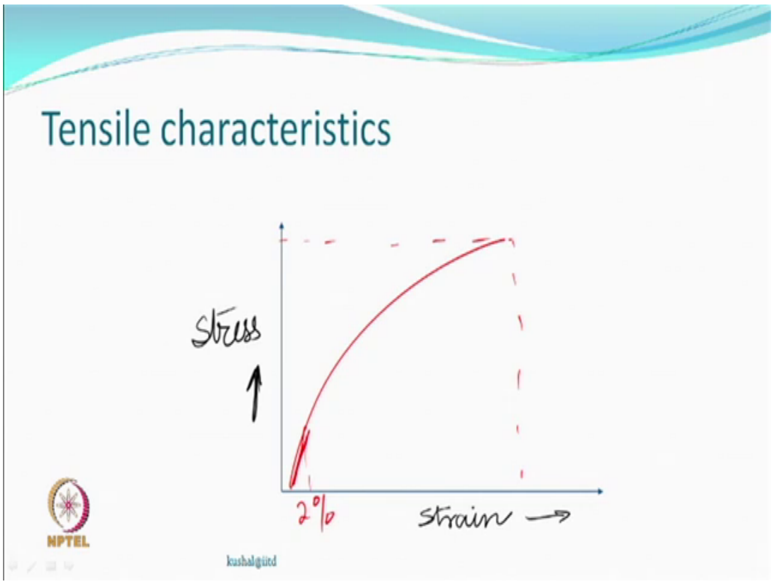

So, we like to measure the tensile characteristics also like a stress strain curve. So, we said this is a bulk yarn so; it may give a curve like this. So, what can you measure is the stress at break, elongation at break and modulus generally may be expressed at 2 percent otherwise 2 percent extension modulus can be measured and can express.

So, invariably as we said the tenacity of the textured yarn may be reasonably significantly less than that of a parent yarn and because a large number of filaments may not be contributing towards this resistance to motion at some stage. So, may be good number of elements are actually are a transfers to the direction of force and so, there may be weaker also. So, they can tensile strength may go down and sometime extension also go down.

And if you look at the modulus of the yarn compared to the parent yarn, this godless can also be relatively less. So, this may be a softer kind of a material and so one can work around and determine there also, but tensile strengths etcetera we should be worried not exactly worried, but we should measure it correctly because the loss could be quite high.

This type of test can be performed on a normal in strong type of a machine tensile texture only thing is unlike the case of false twist texturing where this type of a characteristic was measured after the crimp or decrimping after decrimping. So, you had put enough load to decrimp the yarn and then do these testing characteristics, but here we just have to ensure that you are putting it straight and not lose that is all.

So, now we look at some of the factor which would affect all the properties of the air jet textured yarn.

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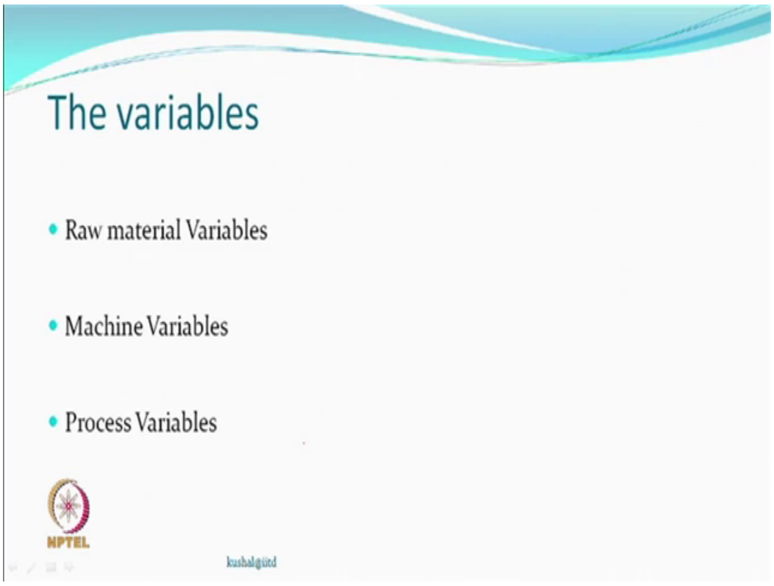

So, we seen a complex machine. So, there can be raw material variables, what material that we are wanting to texturize machine variables. So, you have machine there are many parts many zones all of them can play some role and actual process variable which are in the texturing zone which you have probably more control. The raw material you may have control you may not have control, but it should understand what could be the effect and how the machine behaves also must be understood.

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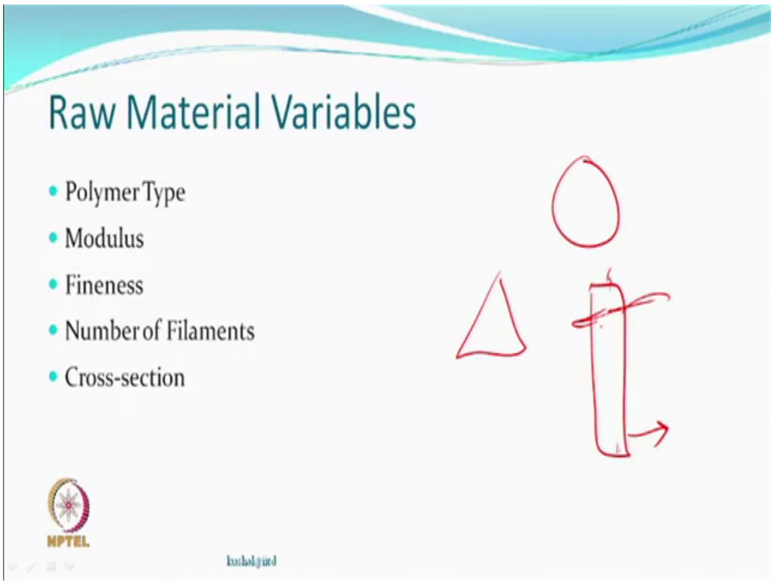

So, we said that this is a mechanical process and the characteristic of the material should not be so important you know we were looking at the chemistry part of it that should not be important, but it is not true. So, we are not looking at the thermo mechanical setting of the material where molecules will be changing their configuration during this process that does not happen, but whatever molecule that you are feeding.

For example, you are drawing and then feeding drawing at a higher temperature and feeding has a chemistry and has a history and what kind of a history see this was one of the thing which also was not understood in the beginning and people thought whatever material you can use it for false twist texturing should also be good enough material for this type of process as well and general believes that you put anything everything will happen was also a thing.

But we understand that based on the chemistry the rigidity of the fibre can change like we said the modulus of polyester may be higher than nylon in general because of chemistry aromatic ring and if nothing else this process involves bending of a filament and loop formation anything that can affect the bending; that means, the rigidity of the material will affect and if polymer type also affects the rigidity of the material to bending then it should also affect. So, that is the way it is of course, we are not interested in changing the internal morphology during the process of texturing.

Therefore we cannot completely say polymer type we will not have any effect you can you can texturize, but it will have an effect we must know if it is under the same process conditions 3 different kinds of polymer fibres may not give you the same result. The modulus as we said determined by the chemistry or determined by the pre texturing conditions that you have had if that changes this can change because this modulus of the raw material is going to be related to again bending rigidity in somewhere. And so, a material with a higher modulus versus the material with the lower modulus will give you different characteristics of the air jet textured yarn.

Now, this was an interesting part which was a great learning for the people who were working on air jet texturing the fineness; that means, the denier if it is finer versus the denier which is coarser. Now we are looking at the individual filament so that matter, in the case of false twist texturing, we had said that is the individual denier is higher you get a better textured yarn.

Here also they use the same material and they found the things, but not really working out well, because again a fine fibre bends very easily and your aim is to make loops and do various kinds of entanglements. So, this is absolutely opposite to what false twist people wanted they were happy with 2 denier, 3 denier individual filament denier or 6 denier also they were very happy, but if you 6 denier here results were not good.

So, here is very simple that if you have finite area and it can bend very easily it can make loops very easily and remember the total time available for all these processes much less than the false twist texturing also. So, if any resistance is created during this process then it will be affecting. So, this is almost opposite requirement and because this was not understood initially so, it also took some time for making a better yarn which would be successful and give a good final product after weaving or knitting.

So, fineness so, finer is the fibre individual fibre better is going to be the texturing; this also became interesting number of elements. So, it can be related to fineness. So, same total denier if the number of elements are more all of them have a probability of getting entangled formation of loop increasing the bulk. So, here the larger is the number of filaments it is likely that you will get a better yarn.

So, when you feed more than one yarn together number of filaments become more if the denier finally, is acceptable then it would give you a better textured yarn because ultimately what we are doing is, we are dependent on making loops, forming entanglements which should be as good as goes. So, this is one so, these all material, then the cross section. The cross section if it is circular or it is triangular or it is rectangular will definitely have different bending rigidities even if the denier is same.

And so, we can expect different results if the cross section is changed because we are only have air or a compressed air within the jet which has to create a turbulence and within that turbulence if something happens this is going to affect. So, while we were saying that we believe that this process is simple mechanical nothing to worry about feed anything, get anything out of it was not so true and therefore, various factors do affect and you therefore, should be able to smartly decide as to how will you handle such material.

For example, this material bending in this direction all right is easy compared to if you try to bend across this and so rigidities will definitely play role and dimensions everything density is same, denier is same, number of filament same, fineness is same, modulus of the material is same and still because of cross section you will get different results. Then there is this inter fibre friction lot of people published lot of work on friction itself, because what was believed was that the way the entanglements take place and the way the loops are kept in position is definitely they related to fibre friction.

So, when you stretch the loops will not open easily if the fibre friction fibre to fibre friction is higher this was generally. I suppose somebody ask this question that you have been given a material what would you like the friction to be less or more just a question yeah more?

Student: Less

Or less.

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Student: Less, less.

Less why?

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Student: Friction resists the loop formation.

So, we must will not answer this question think about it and do better argument, the final product that we have is held by only mechanical reasons and friction is one of them one say entanglements have done and then this yarn has to use different patience. So, this actually was a matter of good discussion and I hope some of you will pick up and I for the term paper fibre friction itself as one of the research topics so many papers were published in this.

So, it was not as easy I just talking here and finished off. Applying different levels of finish, reducing inter fibre friction, increasing inter fibre friction, all that was thought of and done. So, will leave it and this question can answer at some stage you can keep noting that would you want this friction to be higher; obviously, were in the raw material to begin with.

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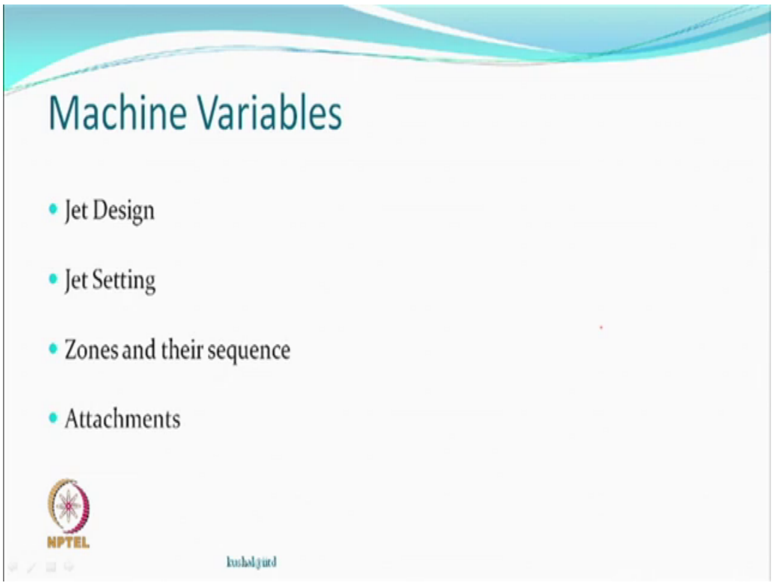

Machine variables.

Now, the most important thing which people learnt at a later stage that it is not simply something where compressed air is coming and yarn has been overfeed into it and everything will happen just like that. So, good amount of work has been done by machinery manufacturers as well as research was done in the education institutes also to see what kind of a design should be there of a jet so that you get two things one good entanglement.

And if you can get good entanglement then your instability you cannot say make a very bad yarn and then keep on doing mechanical stabilization everything will open you may get something, but if 50 percent loops are open and what is the yarn that you are giving thermal or take the bad yarn and start doing thermal stabilization feel everything will be nice, now you have to produce a good yarn to begin with and then improve upon it. So, to understand exactly.

What kind of a jet design you have to understand what is actually happening.

And this appeared to be a complex process it was not so simple look just put some kind of or if put something from there and just good amount of work has been done. As far jet is concerned it is not many companies make jets, any company can make the texturing machine, the winding zone or creel in a hot a heater and mechanical stretch very simple, but jet everybody does not work. So, you get the jet from somewhere and add into machine and work around. So, jet design became; obviously, it not your hand, but you can probably if somebody tells you that, this jet is good enough for this type of a range of linear this is good for the other to in range of linear.

So, one was how good the entanglement takes place which is the most important thing and the other is how much air is it consume consumed. So, say air is free no, compressed air is not free, it is just like opening a tap and just goes on the total energy consumed is very high a very simple process, but it dump air appear that even if you do not heat anything you still are compressing the air and just blew it off.

So, what kind of design would be with consumes less amount of compressed air and does the maximum job those are the things it is people have to work around to understand. Instability was an important thing and therefore, some people actually said that why can not we do pre twisting the yarn and then feed, not just drawing (Refer Time: 24:25) pre twisting the yarn and then feed.

So, what will happen well the twist will untwist some loops will form and as it comes out the twist will flow back and things will become tighter and they got some success also, but not commercial success, scientific success proved a point, but when you want to twist real twist now not a false twist; that means, you are making a process a batch process, continuous process not there so, there were difficulties.

And so, state design became a important material important machine variable, then when they design they also created certain control feature within the jet there called setting putting using a particular setting in a jet itself based on what denier you are using, what kind of a number of filaments are using, 2 types of fibres and whether a product is coming good or not can the turbulence we change. So, they have dials which can control the effectiveness of a jet same jet by changing the setting.

So, it became interesting what means the chamber where things are going to happen the velocity of the air is it going to increase or decrease that type of thing can happen by some of these settings and therefore, this became important. And that took time that is why while the process was understood even almost the same time or even before the synthetic fibres came, but bad results.

So, it took time for people to understand the process and then the design. So, material also was different and; obviously, this small heart of the machine also was the complex system. And of course, then they realize that if twisting is not to be done and so on so forth, raw material that is available so you had a drawing zone, what has to be done before mechanical stabilization zone, thermal stabilization, all these were added to improve the performance, but the moment they have they are there, then if you have mechanical stabilization 3 percent or 5 percent would give you different yarn.

Or drawing for that matter room temperature drawing or temperature to 80 degree or 90 degrees if you do it can change some of the material karaka written material characteristics and things in Japan. And later on some attachments of course, are there these days one of the interesting attachment, which people may find is that people say well you are saying that this material is going to be behaving like a span yarn, but span yarn has here individual fibres which are protruding here you have loop. So, how can a loop be equal to a hare there yeah it is not exactly, but quite good.

So, people say why not we cut the loops and they become here you have got good entanglement and I am cutting loops it is a different you can have those kind of attachments also. And of course, and the heater fumes are coming they have to have vacuum extraction all those type things one may have.

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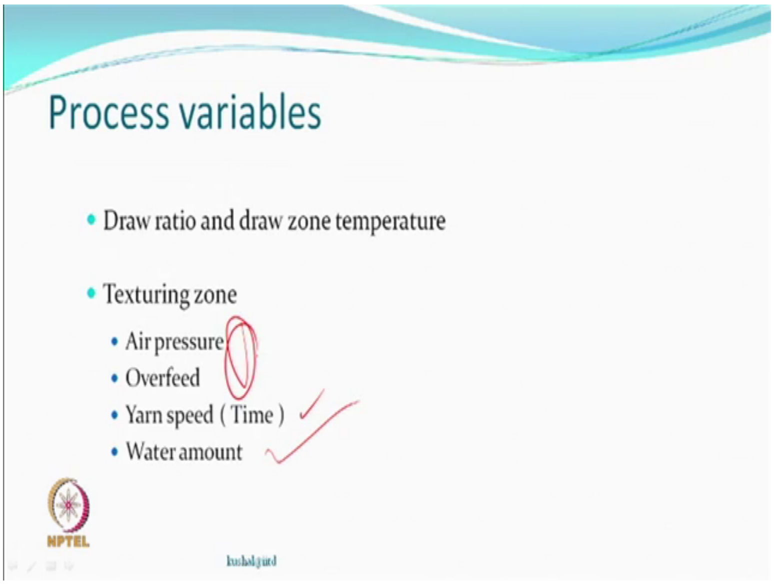

The process variables if you have a draw zone you can have a draw ratio and a temperature of drawing itself may become maybe secondary parameter, but if you keep changing these you will have different material, the one has to see why will you change that because you would like to draw material based on the residual draw ratio and use a temperature which is optimum.

So, maybe that is how you will push it, but if somebody keeps changing this for whatever reason the denier is too high and you say well I will increase the zone temperature so, things can change somewhere else also. The only thing which you may not do is the time not mention time, otherwise how much time you give during the drawing can also be a factor that means, machine speed.

But if this is a process which is happening in sequence so, you probably will appreciate the more important parameter is the time required in the texturing zone, you will be more concerned about the machine speed variation so that the time available in the texturing is controlled and because you cannot have independently running machine speeds. So, machine speeds will not be decided by the time required for completing drawing, you will have to do something else because machine speed, I have to decided by that that is the most important zone.

So, if we come to the texturing zone so; obviously, you have air pressure, you have a control complete control there is no issue in that whatever material that you use you can keep changing the air pressure and see the effect on parameters that you discussed before characterize characteristics of a yarn. Over feed the two important things which will change quite a lot of things and yarn speed means the machine speed which determines the residence time available in the zone and how much time did we say we normally will be having.

Student: 0. 01.

So, you are looking at 2 decimals.

Student: (Refer Time: 31:09).

So, 0.01 right or 0 1 or less than that kind of a time that were having so, this will be an important step. So, you decide your machine times we written here something called a water amount. This process is supposed to be a dry process like false twist texture dry process, but if you remember we had mentioned in that line diagram that there can be a water applicator.

So, effect of adding a bit of water; obviously, good water not a hard water. So, you have to have water was seem to have affected the characteristics of the textured yarn we will talk about it some more details you can do in your term paper. So, amount of water that you add can also be one of the process variable, but if you look at lately once we decide the time machine speed these 2 become the very important parameters which you have control.

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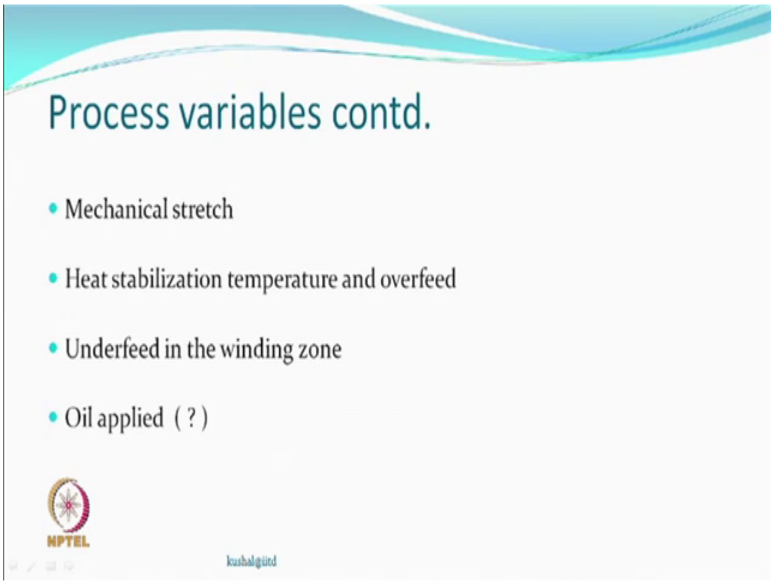

So, the other variations can also be there if you think that improvement is required more. So, mechanical stress 3 percent, 4 percent, 4.5 percent, 5 percent stretch could be a variation, then one can see what happen heat stabilization temperature and the overfeed that you give within that could be the thing again we are not written time here, because the speed of the machine and therefore, the time is determined by the texturing zone.

Then you have winding zone, you know in winding also you may have give some tension, hopefully this is not going to make much of a difference, but if you have already gone for mechanical stretch and heat stabilization, but you normally do a bit of a under feeding. So, that tight packages are made and if replenishing has to be done of a spin finish oil, then there also may be important because during the heating if at all heat stabilization is done you would probably have to replenish and one of the reason is that the spin finish which has been used on a POY with mostly also goes for false twist texturing has already been decided.

So, now saying that the for drawn yarn, I will have a different spin the finish for air jet textured yarn will have a difference will finish may not work. So, you may actually have a yarn which has been finished which part of a component evaporates. And so, you will replenish it at a later stage not very critical, but if you have a bad one and then everywhere there will be problems.

So, we now look at some of the important process variables and their effect on again some of the important properties not every property for that matter, but one can think of.

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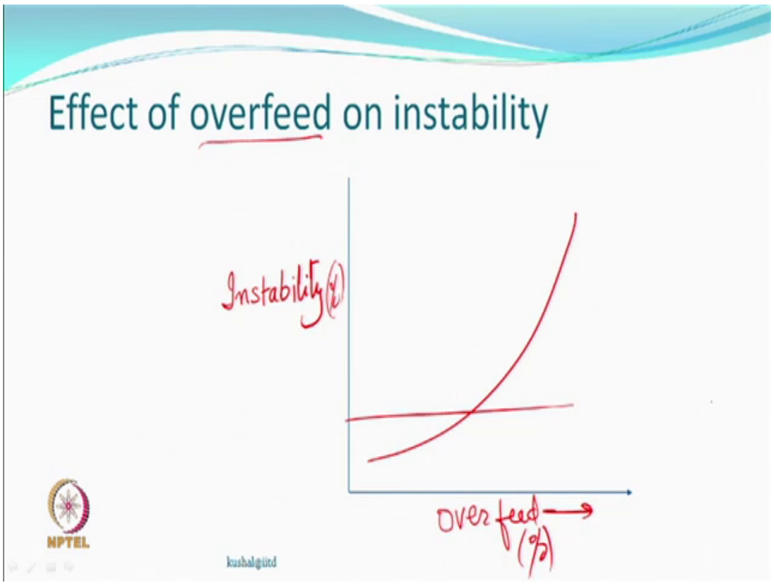

So, effect of overfeed on stability instability. So, we have overfeed let us say which may be expressed as you say the percentage overfeed 20 percent, 30 percent, this also is in percentage. So, we increase the overfeed in the texturing zone and instability is one of the interesting parameters that we have, what do we expect?

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Student: It decreases instability.

Instability will decrease let us go here.

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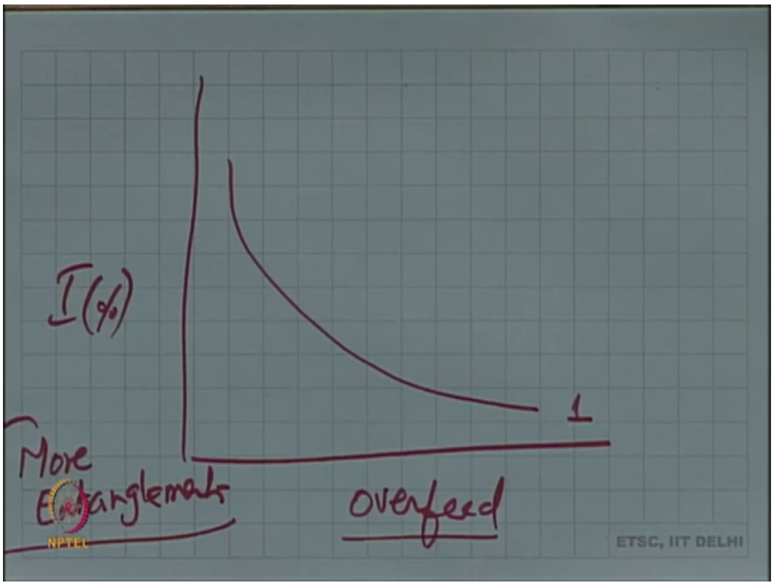

So, you are saying it will decrease. So, I call it curve number 1, anywhere else any other response are we are happy with this I know you response all right. So, if there is no response we like it to be explained as to why do you believe that it should decrease.

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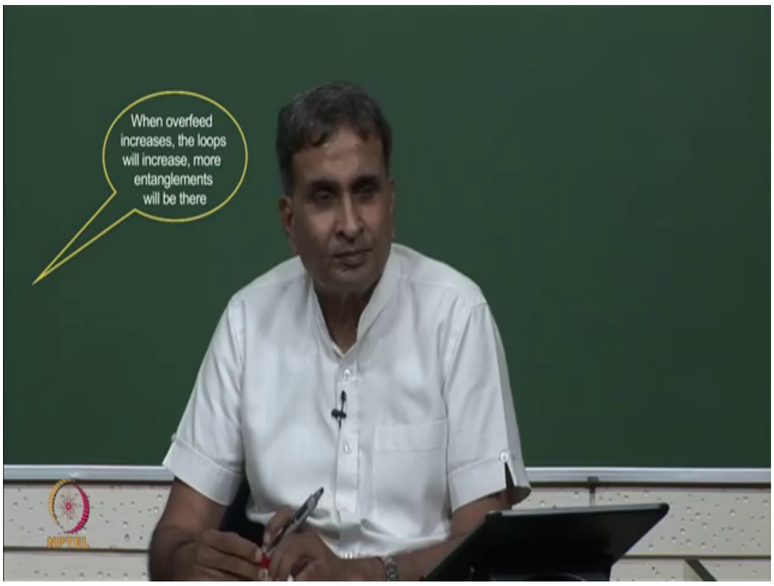

Student: When overfeed increases the loops will increase more entanglements will be there.

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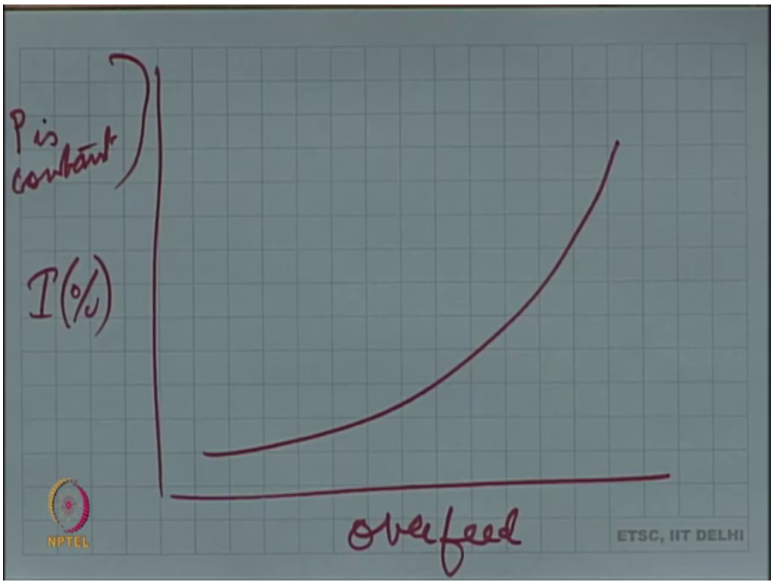

So, what you are saying then you overfeed it there, there are more entanglements so, happy with this argument. So, what is the other argument, slightly what has been found is this happened like this. So, when you give more overfeed then; obviously, more filaments are available they make all kinds of loop they will more loops maybe, but because of this itself the entanglements are not so good why, because when we say we are increasing the overfeed we are assuming; obviously, that pressure is constant. So, whatever forces are available to do the job remain the same, but material to be handled becomes more when you are pushing more material in the same zone.

In fact, if you keep increasing it can become so bad that you just we will see it just open starts opening so, we are; obviously, concerned about it. So, instability will increase or reverse of it is stability will decrease, but we measure only instability. So, you will probably go up to certain points and then say, we will not beyond or change the other parameter.

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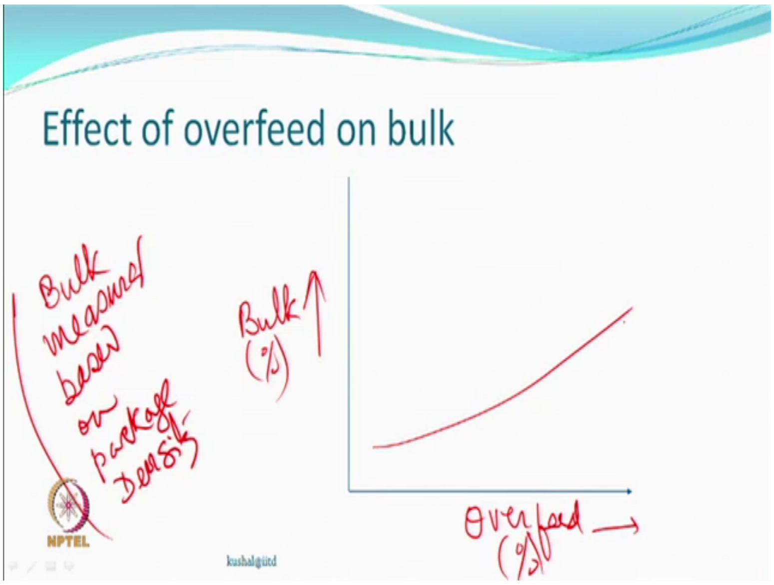

So, we look at the effect of overfeed on bulk. Now, remember the bulk is measured based on the package density of the parent and the textured yarn.

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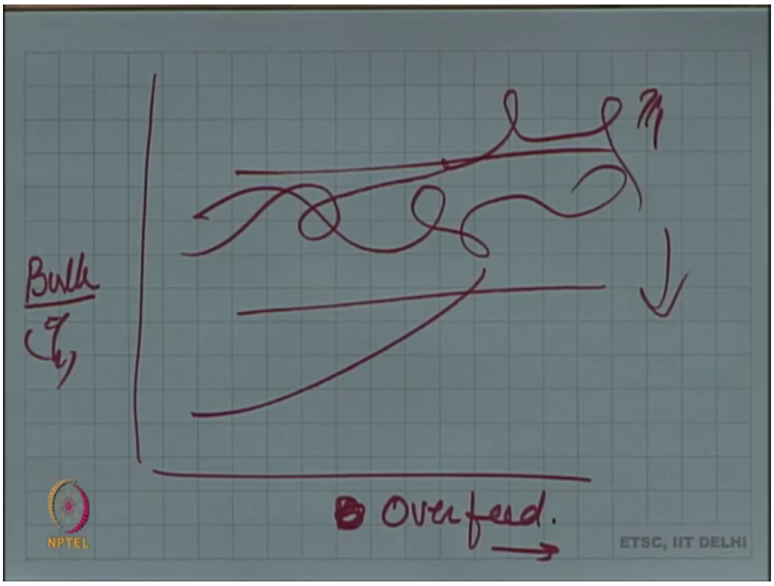

What kind of a effect that you want to see your trend. So, what do you expect

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Student: Increase.

Increases all right, can you decrease?

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Student: Increase and then constant.

Given constant, so before we answer this question let us answer this question.

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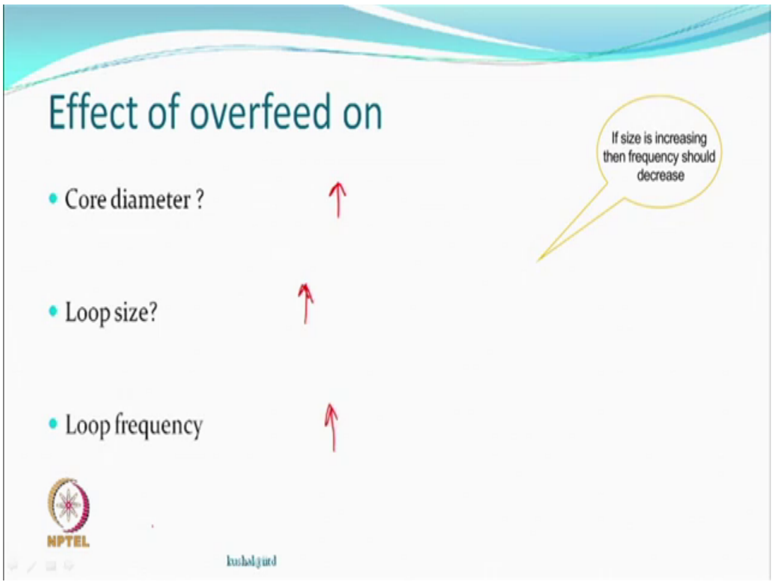

And the question is what would happen to the structure of the yarn which now we know can be expressed as the diameter core diameter or the average loop size and the loop frequency, what we are doing is; obviously, the air pressure is constant, machine speed is constant to the extent that the whatever the overfeed takes care. So, we finally, have the same kind of speeds similar, what do you think will happen to the core diameter, diameter of the core when you just over feeding it should decrease.

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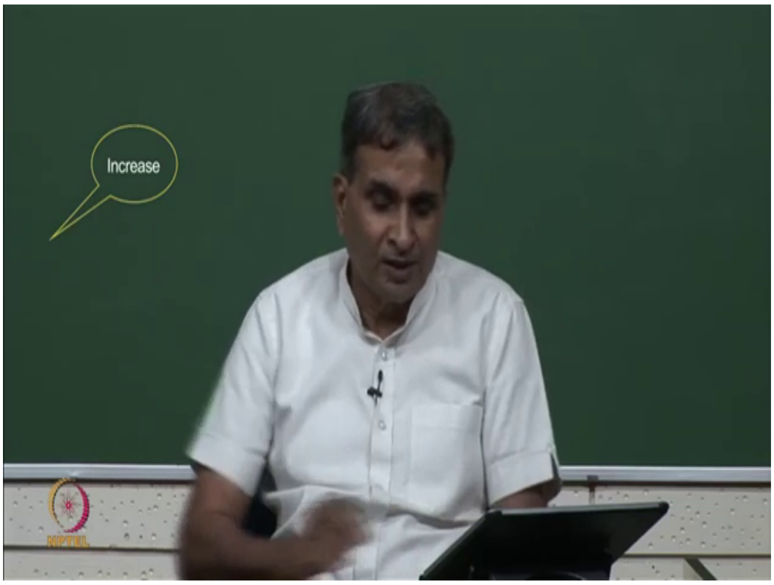

Student: Increase.

Increase all right. So, good the core diameter increases, what would happen to be loop size?

Student: Increase.

It should also increase very good and what should happen to the loop frequency?

Student: Decrease.

Decrease, when you increase the over feed, if we increase the over feed in a air jet texturing process keeping

Student: Increase.

The constant air pressure the loop frequency.

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Student: Decrease.

Should.

Student: Decrease.

Decrease.

Student: Increase.

Ok it also increases. So, because more yarn is available for inside the core, outside the core, number of loops that can be formed because more yarn is available, it is not that large loops are also being formed, but more number of loops are also the number of loops are also increasing, size is also increasing.

Student: If size is increasing then frequency should decrease.

But number is increasing also number is also increasing, because length being given is also more, you have 10 percent over feed, then you have 20 percent over feed, 30 percent over feed, 40 percent over feed. So, excess length also the filament is available which can bend. So, they can bend, you may not like them, you may not like the yarn as such because instability is not good, but this fellow is trying to just keep increasing it is bulk. So, the effect of increasing the over feed is to increase the bulk, otherwise how would you come to this conclusion everybody said this. So, bulk is increasing obviously, there may be some larger loops also which may not be contributing, but some small loops are contributing which may also have generating.

That means if the frequency increases of the number of loops increase, every size increasing, core diameter also increasing, because it may not be very compact, but whatever you call is a core which is other than the protruding loops is also increasing because you get some space for them some may be inside, some may be outside, but more of them are being formed so, core diameter can increase and so, you are right that this is what you will expect.

So, in a sense it is good bulk is increasing, but instability is also increasing. So, after sometime you will say well I cannot get more unstable or can get yarn with more instability even if bulk is increasing will not really like that process so, maybe we will stop here and take it next time.