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

Lecture - 13
Draw texturing

So, as we mentioned last time till last time we were working on a fully drawn yarn. And we had looked at the machine parameters and process parameter that were governing them.

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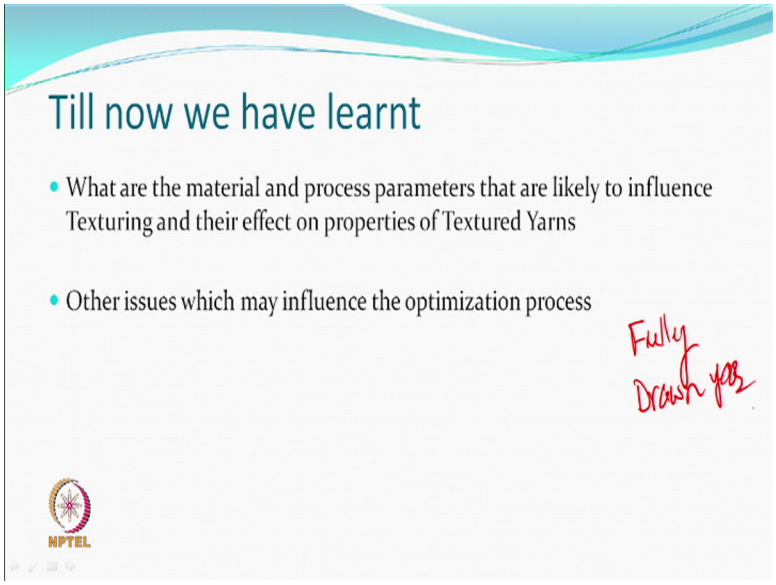

So, the material process parameter that were likely to influence texturing and their effect on textured yarn. We have done, but this was a fully drawn yarn and also we looked at any other parameter that could influence.

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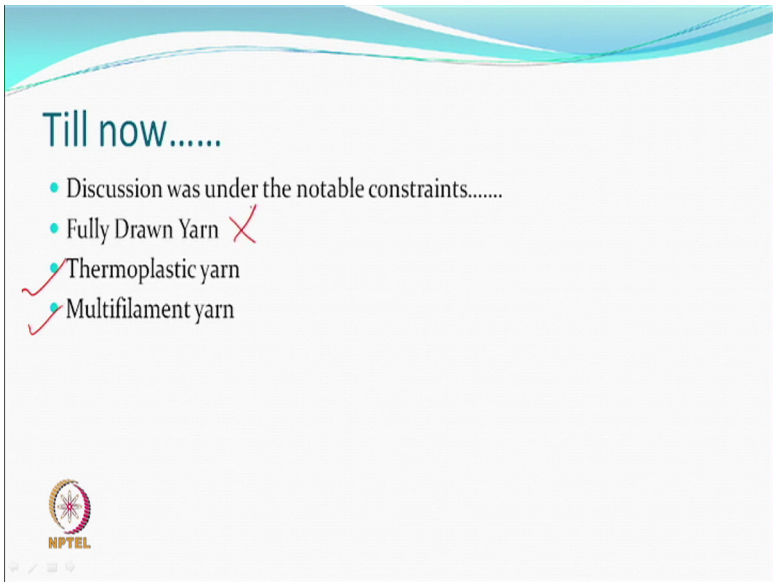

So, these constraints still remain thermoplastic yarn we are talking about, we are looking at multifilament yarn, but as we move on we will try to remove this constraint. And look at something which is not fully drawn yarn as well all right.

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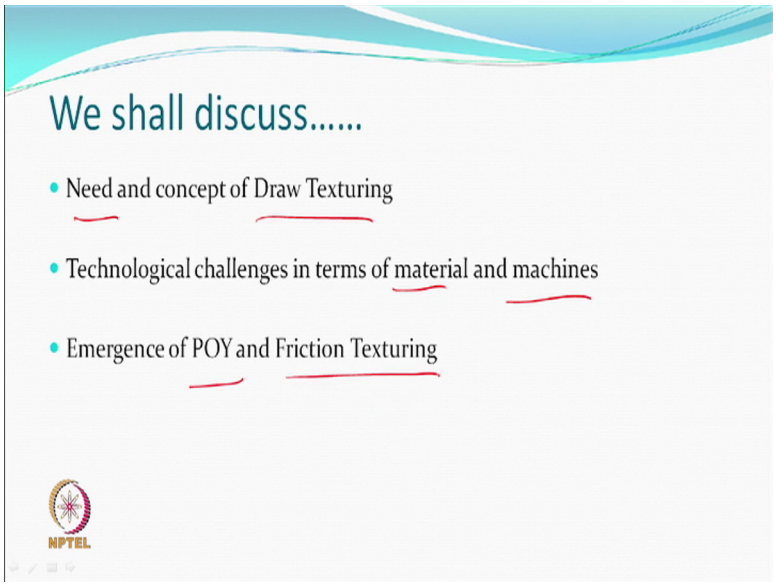

So, this we will discuss what is the need and the concept of draw texturing. The challenges in terms of materials in machine incoming lecturers we will work out. And in this respect we will discuss in next few lectures the emergence of a POY and friction texturing. But today we will not be doing any friction texturing, but this is what is.

So, constraints have changed. So, we now have another material which will be called undrawn yarn or which is not a fully drawn yarn. So, therefore, because it is not a fully drawn yarn therefore, we have to do drawing all right. And therefore, this texturing process will be called draw texturing.

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One of the interesting thing one can always remember in this industry which is a false twist texturing. There has been a good close co operation with the R and D development institutes, fibre manufacturers, machinery manufacturers all of them contributed there might for the success of this technology. So, this is not like you have some problems in one and you keep blaming the other person that your machine is not good your material is not good.

They understood that now they are dealing with a different material and everything has to be differently done. And therefore, big corporation has been there so everyone has been helping each other to understand the problems and also then find solutions to the problems. So, what was the problem?

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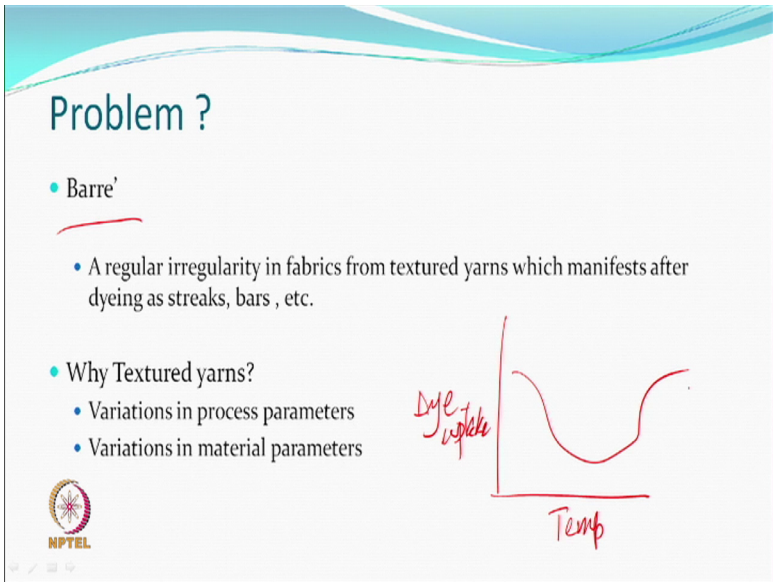

So, you were doing good amount of texturing material was understood the process was understood. So, what was the problem? One of the problem was called barre. Now one interesting thing is barre is a problem which gets generated after dyeing. Dyeing is done after you have done texturing. So, it is very easy to blame the dyer you are not doing your job good and therefore, there is a problem.

So, we have nothing to do with it all right we have given you a textured yarn. And at fabric made from textured yarn if you are dyeing is causing a problem then you better look after your dyeing all right. So, barre is considered as a regular irregularity that is you can see bars lines which are more appeared to be deeper dyed then the rest and so, you can identify them on the fabric if it is used as a fashion statement there is no problem.

But most the people would like to have a uniformly dyed material uniformly dyed fabric or a garment. And therefore, these things are not appreciated. So, this was one of the problems which people face on the textured yarn. So, texturing was good everybody wanted a textured yarn they understood this importance of stretch in bulk. Optimize all properties and then suddenly find well there is something else which we are not able to look at.

So, regular irregularity in fabrics so this appears when you make a fabric knitted or woven whatever. And why does this come and why textured yarns? Because every time

you set up any kind of a process parameter there are going to be range in under which you work a temperature is not a fixed point you have a plus or minus accuracy right. So, you fix up 210, but it will be temperature at any given point of time will be 210 plus minus something.

Similarly any kind of a measurement that you do would have its own variation then this material that we are using is a material which has been drawn before. So, if someone has made some difference in the drawing conditions that also will get added up. So, have a material which you always sawed is a fully drawn yarn and is got same property, is got the same denier, is got the same number of filaments looks same.

But the morphology may not be same a fully drawn yarn is not a product which has only one or we have only very specific properties the specific values. But they have range and because they have a range and then you are again doing texturing. So, there is a thermal history there could be a stress induced crystallinity which happens during drawing that could be history.

Then you have certain materials like polyester are drawn also little higher temperature and so they have a history. So, in a large machine which is got large number of spinning units or texturing units all of them spinning and texturing yarns which according to the whole calculation the machine is supposed to be running the same speed. All the temperature at all the heaters is exactly same.

So, all this is in big assumption and if you remember that one curve at least with temperature you remember of a dye uptake it follows some curve like this. That means, the optimization part had to be seen that; whether you really wanted to do the optimization in terms of crimp rigidities crimp stability and tenacity and then not worry about it that is one.

But what it shows is that if there is a change in morphology the dyes which depend on a solid solution theory that is they believe in some kind of a space there in the fibre which is going to be filled or occupied by a dye molecule. Then any variation there is going to lead two variations. And that is a dyeing variation that may after dyeing you will see. The several this kind of variations all will be there, what can you do?

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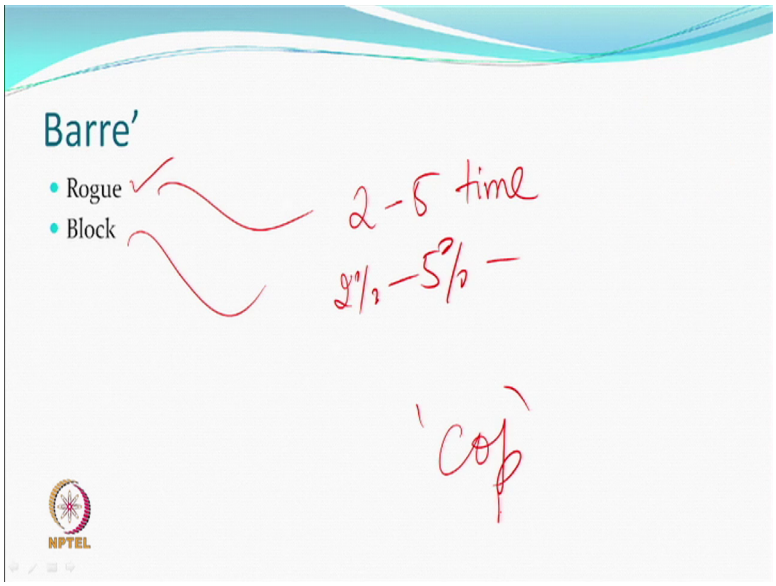

So, barre people defined as two types of problems in the barre; one we called it a rogue, rogue you understand is something we done follow any law. So, we will do something which is very different from the others not necessarily in the positive way. So, rogue barre would be considered to have happened if the depth of shade or the dye uptake or dye on a fibre or a one yarn is 2 to 5 times higher than the next one 2 to 5 times higher.

This is theoretically easily identifiable is done require one single yarn will be seen if it is there. The only thing is that there is always a process before you at least send anything for weaving and knitting that some textured yarn knits would be tested for dyeing also. And then you send them when you find there is a rogue kind of a thing in. Maybe one of the heater was not functioning very nicely and therefore, something that happens that so different, easily identifiable.

So, if it is easily identifiable you will remove it may not give it to someone. Because if you give it to someone then definitely there are rejects nothing you can do about it. The other is called a block barre; block means if the block of yarns with a different dye uptake come together then they are visible. If they are individually lying anywhere then is very difficult from the naked eye to find difference in a dye uptake; the difference will be 2 to 5 percent.

Now see here you are talking about 2 to 5 times here we are talking about difference of 2 percent to 5 percent difference in the dye. So, 2 percent difference it is not 2 percent

shade, it is the 2 percent difference in the shade. So, with a naked eye you will not be able to find. In fact, it is very difficult even two yarns are lying together one of them is a 2 percent higher and the other is 2 present lower you cannot be able to distinguish whether they are actually differently dyed or not.

But if they appear in block that 10 of them or 5 of them come together which have higher then you will be able to see if there is a bar which is running so both are bad. First one is so bad that you have to throw right. So, that people say well somebody slept when the machine was not functioning well and did not do the job. But the second one can happen anytime, that a little variation temperatures of texturing little variation of temperature of the pre previous process called the drawing could cause this difference.

So, say how would you do that what will you do then? Then this will always happen you know rogue you can say well we have had a problem will take this yarn absolutely out of hours line and then not supply it to anyone. Block you cannot avoid very easily because something will always happen. And one of the reason which we will found is that the errors that you cause or create during the drawing itself get only accentuated. This term you understand this term cop.

Student: Yarn package.

Right, so this package normally from the drawing section or the draw twisters when it comes is in the range of 500 grams 750 grams so on so forth. So, that means the textured yarn will also have the same (Refer Slide Time: 13:01) yarn because in the filament yarn you must understand nobody puts a not; if the filament breaks then you close the package right. So, this is no way of splicing there is no noting so you just stop.

So, that means, there are large number of such cops on the machine which are being texturized, which may have a different history and which may have been very difficult for you to find out what is the change morphological change within the thing. Otherwise you test each and every package go through the x ray machine go through all kind of stuff and then save a lie thing this is a class this is a one this is a two this is a three tough and still you can cause problems at the end also.

One of the thing which they found is if you can disturb the block; if you can disturb the block that is on a knitting machine there are 36 packages lying. Then you change their

order the block get disturbed and the block barre can get disturb. That is somebody who is knitting can always juxtaposition the packages and suddenly you will find well the block is gone and you may not see it that is one.

But then again a first you make then you find then you change then you find. So, even if you got a package you might be able to do that. But what was interesting to note was that the doffs of the un drawn yarns were; obviously, of higher weight you know 5 kilogram, 7 kilogram, big doffs for coming from spinning machine. A spinning machine runs 24 7 the draw texturing unit is whenever you get a thing you would draw it you can stop you can do so those kind of things.

So, idea was that can you actually get a single singular history at least a some place and not change them often enough. So, that is I say well then will have to work with the spinning doff rather than which goes to the draw text draw drawing unit. Then you take a drawn yarn and then texturize you know some of this was being done within the industry itself.

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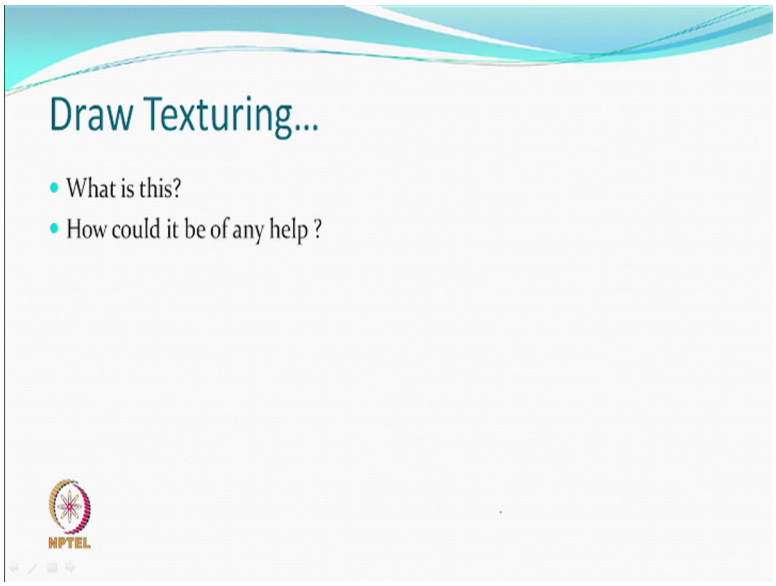

So, therefore, a set can we do something like this draw texturing; that means, drawing to be done on the texturing machine. Since without the getting a fully drawn yarn from somewhere you say I will get an undrawn yarn and we will do the drawing here. So, I have let say more control probably and I will know the history if something is happened. And accordingly we will package them and sell and market whatever.

So, idea was that if there is a large package the change will be less because the history is the large package will continue for a long time. And so all the texturized packages which will; obviously, not be 5 kilogram they may 500 gram kind of packages they will be having a same history you can then segregate them and workaround and hopefully would help.

So, that is how the draw texturing came into picture, but remember how not because crimp city was bad. Not because yarns are fused you know you know fused not because there were breakages happening in texturing, but dyeing. You know this problem identified somewhere else pushed back to the texturing people and industry. And they said it appears a serious business let us do it that is what the corporation part of it.

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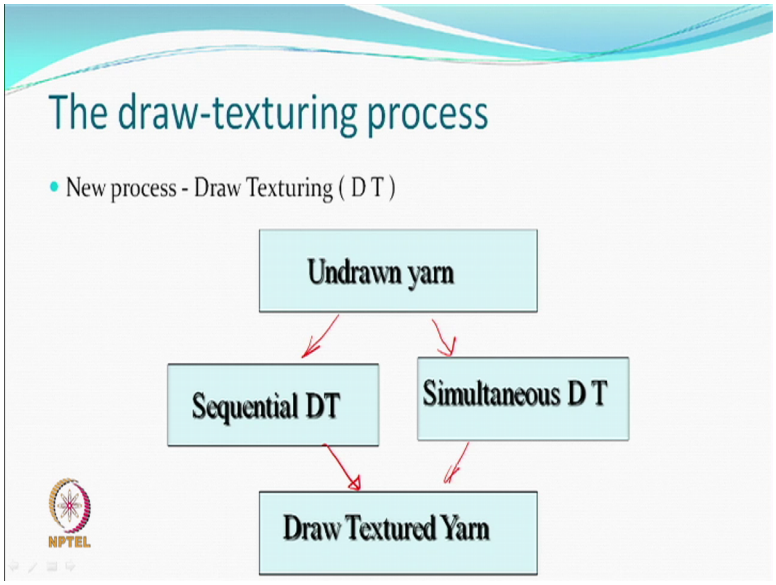

So its a new process which was; obviously, different than what people are done before. So, you can take an undrawn yarn go through a process called sequential drawing. That means, you take an undrawn yarn have a drawing unit on the machine. And after it has been fully drawn then you texturize it and then that will be called a draw textured yarn.

So, on the machine you will have drawing unit and yours sequence is first draw then texturize so called the sequential draw texturing. The other possibility was that you do the drawing and texturing simultaneously, no drawing unit no separate drawing unit. The drawing is being done during texturing and then you get a draw textured yarn.

So, two different routes could be done which would happen both the processes would happen in the texturing industry or on a texturing machine or the people were supposed to be called thrusters; they are the one who said they will do this machine if there is a modification done.

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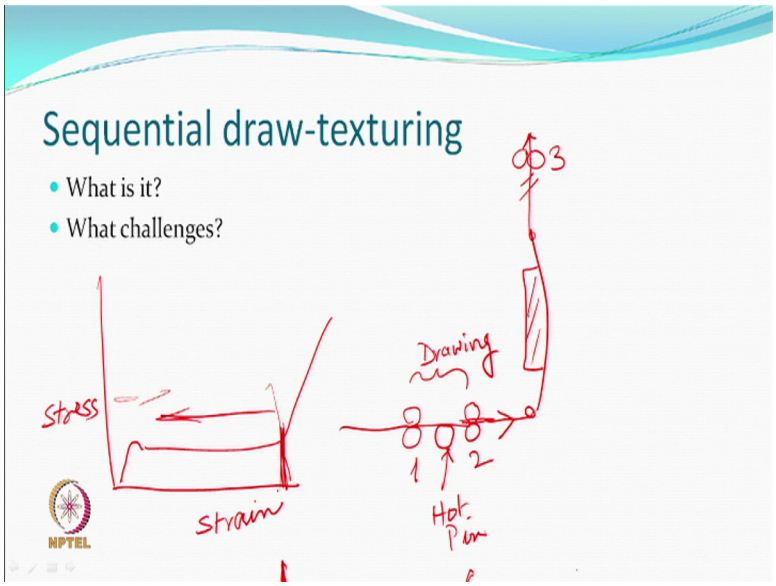

So, you have this feed roller and then this goes you have the heater. The twister and the take up roll. So, this is the way we were operating our false twist texturing. So, what they said is next let us put another set of roll. Before this and between these two rolls you do drawing if this is what you do. So, this is a sequential process first draw and then texturize, but on the same machine this was not difficult to do.

Because only thing I have to do was another set of roller which will be running at a speed lower than this number 2 set while the number 3 set would be exactly same the way whatever you doing. So, say this is easy to do as long as we believe that we can handle the doffs and then this material thing could be done.

So, what kind of a challenges were there? From the point of view of the property of the textured yarn and optimization they were very less challenges because you are anyway handling at that time the fully drawn yarn and at the point number 2 as it exits it is a fully drawn yarn ok. If it was a nylon it goes like this or if this was a polyester one could put a hot pin over which the yarn is moving.

So, the temperature of the yarn could be raised and then you can do the drawing. So, this was all done simple extension or a machine could actually get to the sequential draw texturing. So, from that point of view people were happy except that you need some space where this particular part also has to be fitted.

Yarn coming from creel and between this and satisfied somebody has to be taught this is also an important thing which requires a different temperature different draw ratios based on the characteristic of a undrawn yarn. How many people have seen stress strain curve of an undrawn yarn? You have seen? How would it will be there?

Student: Same as textured yarn.

Same as textured yarn. So, something similar, but one sees something like this. There is initially there is a stress build up then something like a yield point comes. And then there is a flow and then you get the normal yarn which is like a fully drawn yarn.

If everything is done correctly the difference between textured and this yarn is this is not going to go back all right. So, when you release the strain of stress is not going to back. it is the transformation all right. During this transformation; obviously, what were happening was stress induced crystallization or thermal plus stress induced crystallization was also taking place during.

As there is no question of the yarn retracting back to the original position. In the stretch yarn what we saw is now it goes back and that is what we want. But in this case this is not happened, but at the end of this point you have a fully drawn yarn whatever was being obtained from a draw twisters something similar you will see from here also all right.

So, the only change is that there has to be some additional drawing unit which would be attached. And with machinery manufactured said no problem we will easily do that and let us see what happens. So, the question is you started with this problem and you say well this can be done. So, could you address this problem?

So, they said yes, we could address this problem, that having a similar history or a pre history of a material always led to a better material. So, we are not looking at the rogue barre which means machine has stopped heater may have not work somebody is just

sleeping that problem is not the one which looking at the solve, but the problem of the block variation within the thing getting reduced.

And so you suddenly find will you can work around and the barre was addressed. So, you should be satisfied keep doing sequential draw texturing. But there was some issues which were also raised. One of the issue this was addressed let us say, yes.

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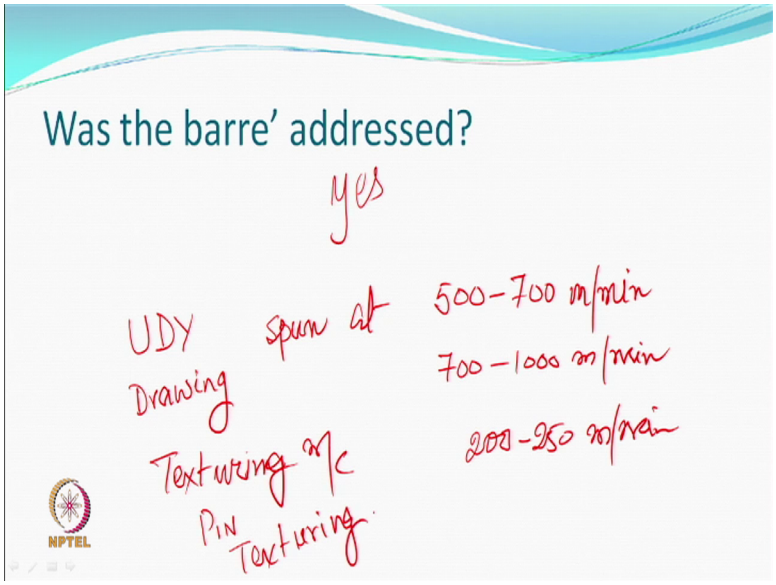

The other issue which was raised was that the so called undrawn yarn was being spun at 500 to 700 meters per minute speed all right. So, this is how the spinning was being done nylon polyester things like that. Then the drawing was being done by somebody else. So, drawing was being done at around 700 to 1000 meters per minute.

So, that is one, but there is no problem because these are two processes which are discontinuous process. Spinning is happening somewhere else drawing is happening somewhere else is just something which you understand ok. That there is a large doff been created doff will go doff will go to the drawing in an machine the drawing machine will do the drawing get the cops and the cops to be supplied to texturizing.

The texturing machines were running at 200 to 250 meters or even less. So, essentially what they said is that by adopting this method of sequential draw texturing. You have reduce the speed of the whole process the drawing has become slower something which was happening a production was good high.

Now everything is all right if you are very happy with the barre is fine, but at least you must appreciate that you have slowed down all processes not the spinning of course, because spinning it disjoined. But what you have joined is drawing and texturing, there is a mismatch in the speeds. Therefore, you are reducing the speed if it is with you then its fine.

Then the question is look if you are doing whatever we are doing then can we not when this disadvantage is there. Because our texturing machine have certain speeds and we have to live with it. And that time if you remember we had talked about something called pin texturing. You remember pin texturing the twisting was twister was a pin all right the spindle was the pin.

And at what speeds you are rotating 10 raise to 5 rpm all right. Running at that kind of a speed you could get this speed. And so the big challenge was there of course, but main thing is because you were texturing at a slow speed the drawing was getting slowed then we will said well if that is to happen.

Let us try not to have a additional drawing unit to the spinning at texturing machine, why do not we do the drawing while we are texturing? Because the feed roller speed and the take up roller speed could then be adjusted anyway so why cannot we do that.

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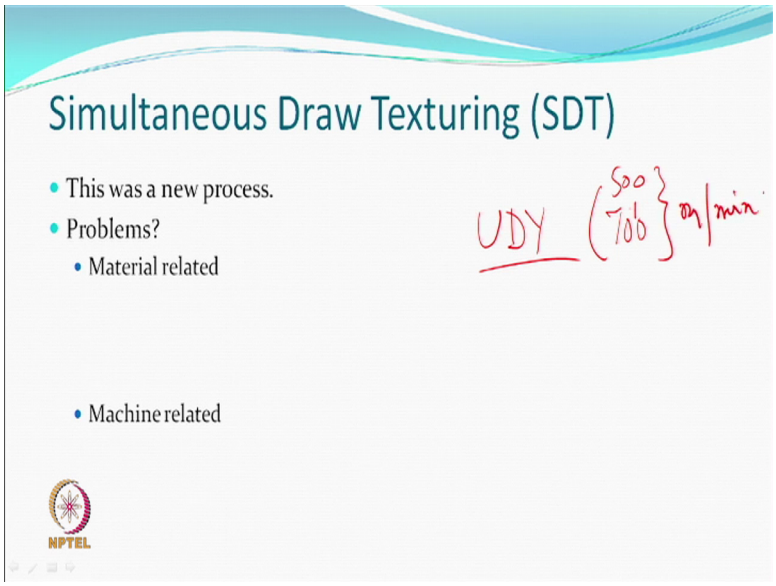

So, based on that they said well we are happy with the sequential, but let us try this where no additional drawing unit will be required we just change the speeds of the two sets of rolls, that bade common sense. If you are not getting the advantage of speed at least get the advantage of space and let us see what happens right.

So, they say let us do simultaneous draw texturing. This was the process which was totally new. No one in the texturizing industry had any idea as to what is going to happen. In the sequential case it was very clear that you are texturizing a fully drawn yarn and though at optimization was already done. Now you had a material which was different material will absolutely different material and now absolutely different process.

So, there was a big challenge on this and which; obviously, as I said the people on texturing industry the people in the R and D and the research institutes; obviously, looked into this problem as well. And the problems were created initially by the material itself which was called the UDY. So, material itself was the problem creating problem.

Machine problem; obviously, would be there, but that has to handled differently. But let us first see what is the material problem that you talking about. UDY you understand approximate speeds at which it is being done is 700 or 500 to 700 meters per minute. The undrawn yarn had three major problems; one of the problem was called ageing; that means, storage stability.

Earlier what was been done is that you had the doff; doff was being drawn the drawing machine was; obviously, in the premises of the fibre manufacture itself. So, the doff will go to the drawing section drawing will be done cops will be collected and then supplied to textured yarn manufacturers. Wherever they are and they were quite happy with that.

So, what they found was after a week of spinning the material if you have not used it there is a property deterioration; based on the temperature of storage and the humidity you can control of course. So, the problem was that you must use this material within 7 days. Easier said than done because after the doffs are removed.

We have a quality check after that somebody decides how to pack, somebody segregating in packing them. After packing they are excised duty and what now then you are taking it somewhere else for texturizing transportation time. So, you would lose not less than 3 to

4 days in just deciding and transporting maybe more when you find there is a problem of ageing.

That means, they did experiments and found well yes there is a degradation taking place of the material. So, obviously if instead of trying to solve a problem you are not creating a problem because this history is going to be much worse than the history of a drawn yarn. Because and once you cross that limit then every day you are likely making a different product and so this was a bigger problem.

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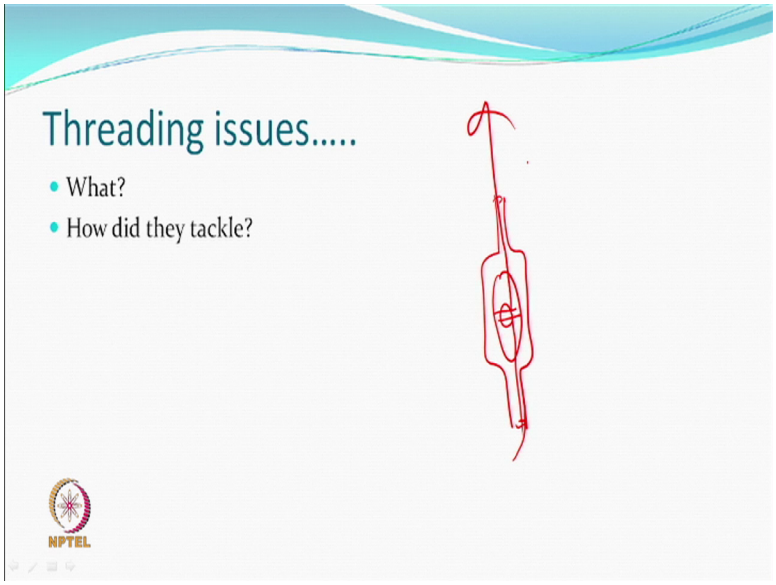

So, the dye uptake would increase they would found they found that dye uptake of the yarn would keep increasing as the time progresses which meant exactly same thing what would happens in the barre. And then the customer the texture I would say I am not going to use this yarn at all there is no point I am not using it.

So, then the spinning units industries thought that they can put a texturizing machine within the complex and they start doing texturizing. Now so they want to become experts and texturizing that is a difficult thing again. Now this is a case which was also not considered very nice. Threading, so what was the threading? So, this was a pin which was being rotated in whichever way.

And the yarn was supposed to be going from one direction into a hollow arm and the tube and get out from the other side, every turn means one twist so that is ok. So, this is

not the problem that threading was a tough one if they thread once and then start the machine everything is. But the problem was you start the machine and the moment you start the undrawn yarn touches the heater it will just break so that is one.

So, if you do something and start if there is a break for whatever reason then you again restart. They found was so many breaks that I told you in a multifilament industry. Break is something nobody likes, nobody likes breaks anywhere. But in the spun yarn you have knotting allowed splicing allowed then you can keep making the yarn continuous here, so, you know it is broken is broken.

So, you may have a 100 gram package so this 100 gram is finished so it becoming. So, the material was fused on to the heater; so, this was so weak a material. So, they said we will do one thing we will before starting the machine we will pull the yarn with our own hands and then start the machine after that anyway drawing will take place right.

But cumbersome how may drawing has been done by the man maybe you can waste that yarn, but that was it. So, every time threading was the problem the people who working really got fed up this is not the material we want to use. So, giving a material which we do not want to use and so, this was one problem so.

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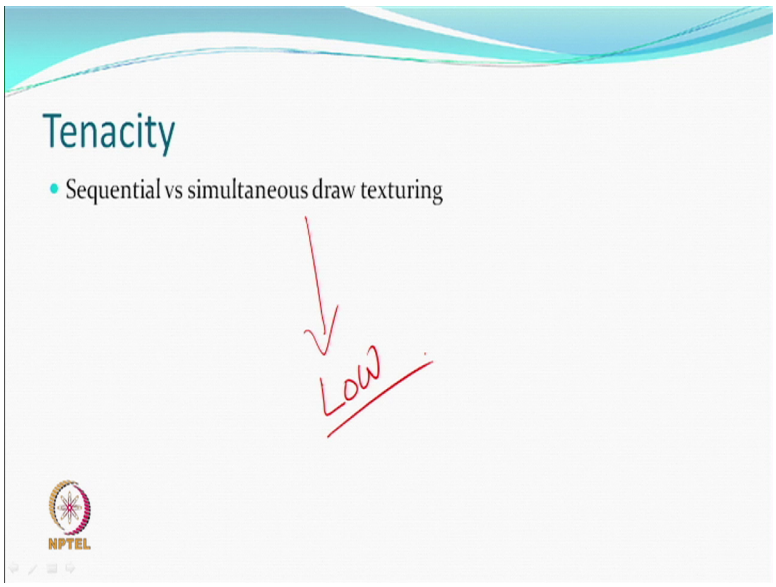

Then they found another thing that the tenacity of sequential sequentially textured yarn was higher than that of the simultaneously draw textured yarn. So, in this case the

tenacity was low, we did say that well tenacity is not an important thing, but you suddenly find that almost every material that we produce is a poor then you have to worry about it.

So, if you have so many problems coming in a sequential draw texturing. Then you say this is not the process that you want to adopt. So, one of the ways was that leave it forget it go back to the sequential draw machine a draw texturing machine and work it out it will keep working. So, that kept on happening. But simultaneously people wanted to know plus find out the cause all right.

So, because it is a less crystalline material let us say polyester is hardly any crystalline material when you just spin, the crystalline develops with only the drawing and then heat setting and so on so forth. So, without any material like a non crystalline material its a very unstable system. You just pull something it changes and the void shall I say or the moisture absorption capacity of this material was also high.

So, everywhere the moisture is there, temperature is there, in a polymeric system you have moisture and temperature well peroxy radicals will form if light also is there oxidative degradation happen. So, you say well you will getting degradation that is a known thing because you have not drawn. Otherwise normal draw ratio would be 3.5, 3.8 draw ratio and ours not been drawn or very less been drawn, just because some speed is there so that was problem.

And because of this also stability was very low and then you could just few the moment to cut also. So, you had to absolutely avoid that the heater before the material run and then tenacity is poor. So, nothing was actually appear to be nice for the sequential draw texturing machine.

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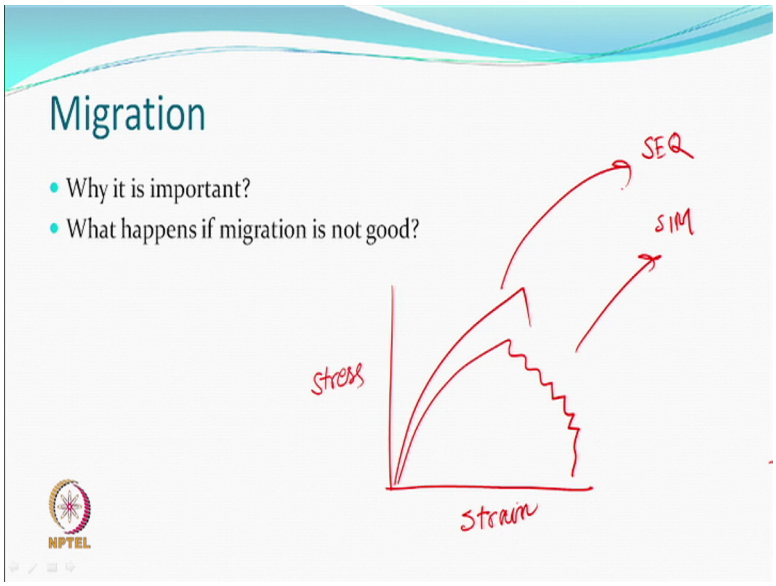

Why was the tenacity poor they want to know even if you can handle something else I can put the texturing machine in the same unit, but still tenacity is not good. So, they found there is something called migration. And how do we find they did a stress strain analysis of the same textured yarn. I just trying to remind that the normal textured yarn when you actually want to study the property which is the tenacity etcetera you will de crimp first and then test.

Otherwise, the jaws are just moving you understand you understand. So, you do a pretension and then test right the tenacity. So, in the case of sequential draw texturing the curve was let us say like this approximately textured yarn. So, it would take the stress and after time just break. That means, there are 36 filaments or more they break approximately same time this is called a catastrophic break.

So, you keep stressing and then catastrophic failure that is one. When they did test the one on the simultaneous textured yarn they got a curve like this. Now this curve there said the stress strain curve is simple experiment can also give you information.

So, what this information say is a staggered break. That means, some filaments are breaking first, then the others are breaking; then the others are breaking; then the others are breaking, then the other breaking. But what you have done that every filament is a different kind of property. You know why we thought that twisting was a good idea.

So, that every filament on an average length around the length of the yarn would get the same treatment. That the fellow would be some time on the surface, sometime in the core, sometime in the middle all the filaments is the same opportunity that was called migration. So, filaments are migrating from surface to core and coming all of filaments were at the same chance.

Now when you used this simultaneous dot texturing what you are doing? You were also drawing together while you are twisting. So, they found probably the migration was not happening as good. The material which were on the surface probably had less chance to go inside, why? Because the stress that they were actually experiencing because of being on the surface because of that they would permanently extend.

So, tension was less reduced this migration was happening because of the tension differences on the surface yarn versus the yarns or filaments in the core. Now if it is drawn then there is no tension left, so there is no reason why somebody will give us you know space for it surface yarn to go inside. So, you could lead to a poor migration.

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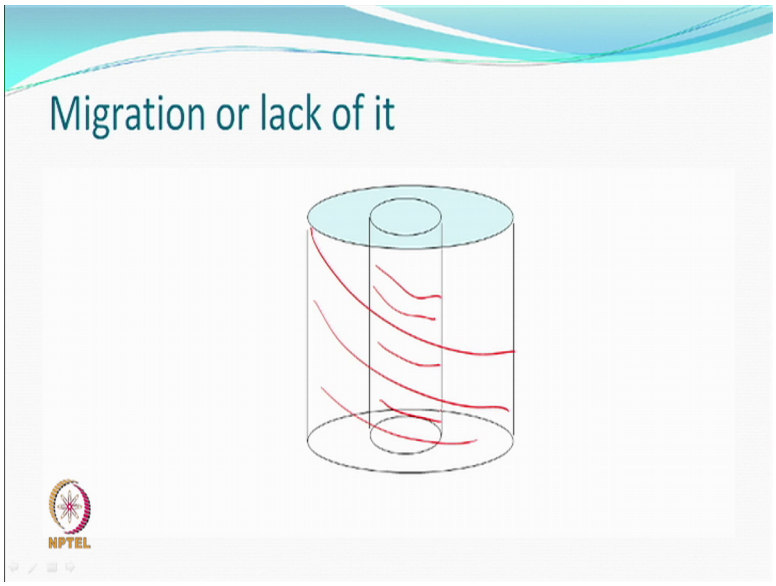

So, you have core some of them may be lying there, the others maybe lying here and they are not switching positions. If they do not switch positions then they have a different history. So, the one which are on the surface probably have already been extended compared to the one which were in the core.

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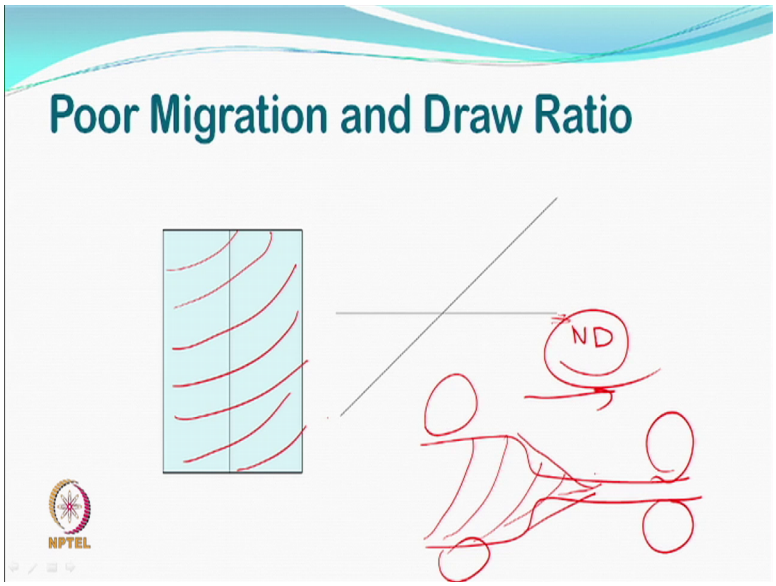

And then at top of it you are also doing some drawing you done a normal draw ratio. They given a normal draw it required let us say 3.5 draws or given 3.5 draw. So, what happens, if this is the normal draw value then some of them will be over drawn some will be under drawn all right.

So, one which are under drawn; obviously, are you know finally, when you extend them they may draw later or break at a higher extension value. So, whenever there is a situation when all the filaments are not taking the load or sharing the load properly. Then the overall registered tenacity becomes low other than the problem that you see.

So, you found one reason migration. And the other reason was necking. When you draw a filament parallel to its axis you draw stretch parallel to its axis. So, you have a larger diameter undrawn material as it is being drawn between two sets of rollers let us say one set of roller is here, other set of roller is here and you are drawing.

Then suddenly you see the diameter changes at one point it is not continuously does not change. And so this becomes a construction which helps the fibers to get oriented as if it everything on this side is amorphous mass and then your pulling through a construction. And so they get pulled and the orientation becomes better right this is how the normal drawing takes place right.

So, there is a necking, so necking is very important. It is not a gradual change of a diameter you can see it if you go to an industry or any other drawing machine if you keep looking at it will send there is necking happening at one point. And generally it will be approximates the same point if the material here is the same speeds are the same vibrations are controlled when you say necking is almost happening at the same point.

And this is important for orientation process and orientation is something do with tenacity right. But in our case the yarn which is actually getting drawn is not parallel they twisted. Now you have a twisted yarn which you want to draw. You can appreciate what is going to happen you anyway said texturing is a disoriented process.

On top of it now while during drawing itself we are creating another problem right, because of migration and because of the drawing. What they found was that in a twisted kind of configuration this necking zone was not sharp it was extended necking zone. So, pulling was not as nice as you would have probably loved.

And the yarn also being presented at the point probably like this, like this, like this, may be like this and like this so still not in parallel. So, all of them are leading to a material which is going to give you poor strength, poor migration and not the best way to draw.

So, a problem that you started to solve called Barre. Now lending up into another problem which is more severe very very times. So, we can appreciate hardly anybody who is working on a texturing machine would say I will work with it right. So, this was the problem so we stop here and next I will go further from here.

Thank you.