Textile Finishing
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Lecture-30
Low Liquor application

Welcome back to our class on textile finishing. Let us see what do we do last time, we talked about interstate finishes.

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And what did we learn we learn that fibres can accumulate static charge static charge if accumulated is definitely harmful there is a process by which the charged can be dissipated the decay can be measured the strategies we try to understand how to make antistatic textiles. We also learn that antistatic finishing like for example soil release like from example softening their all surface finishing treatments the basically demand surfaces to be changed we did learn about chemistry of some of the antistatic agents and very interestingly.

We found that seponification can develop durable antistatic synthetic textiles that is say synthetic polyester and it can also do weight reduction which can give silk like properties. All right so what you do now.

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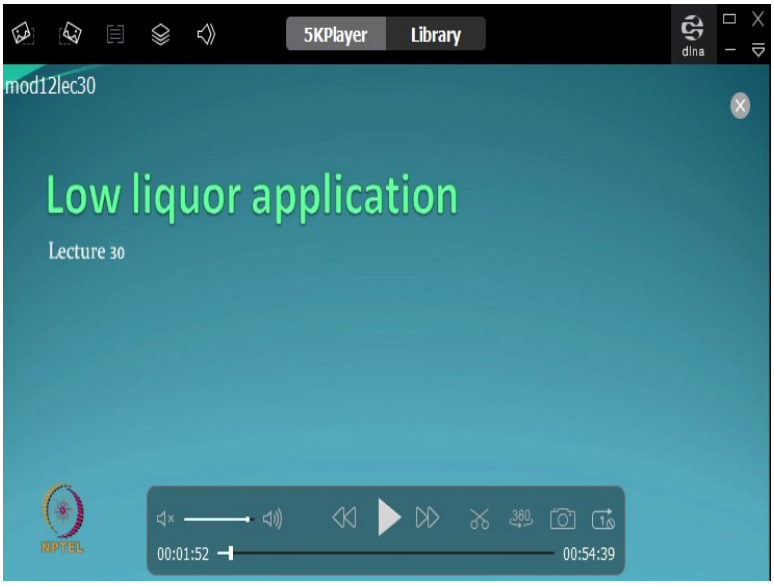

We will talk about low liquor application sometime this is also known as minimum application processes okay. Minimum application techniques this is how also it is known so low liquor what is low liquor business. So low liquor application actually means for example using less amount of water for application of chemicals in the case of dying you talked about M to L ratio alright. So if less is the liquor better it is made understood but in finishing be generally do not use any exhaust process normally we have a process of pad dry cure.

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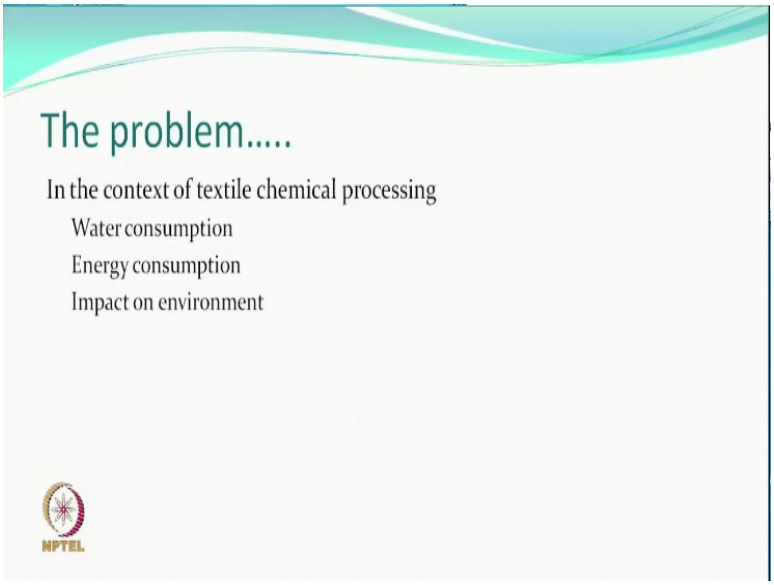

So what is the problem that we talking about in the context of textile processing chemical processing everyone talks about the chemical processing industry uses large amount of water starting from desizing onward discovering whether it is mercerization bleaching your dying and

a finishing everywhere use lot of water and because water requirement is very high is the water intensive industry and similar when you wash your dry so you use lat of energy to drive the water and so together these things if use more water people do not like it today.

The environmentalist if use more energy you are creating some carbon footprints people do not like it in anyway. So for it is for the benefit of everyone that if you could reduce the consumption of water and may be simultaneously you might have reduction in the energy conservation as well. Right, so if this is the problem of textile chemical processing industry. So today's discussion involves revolves around this.

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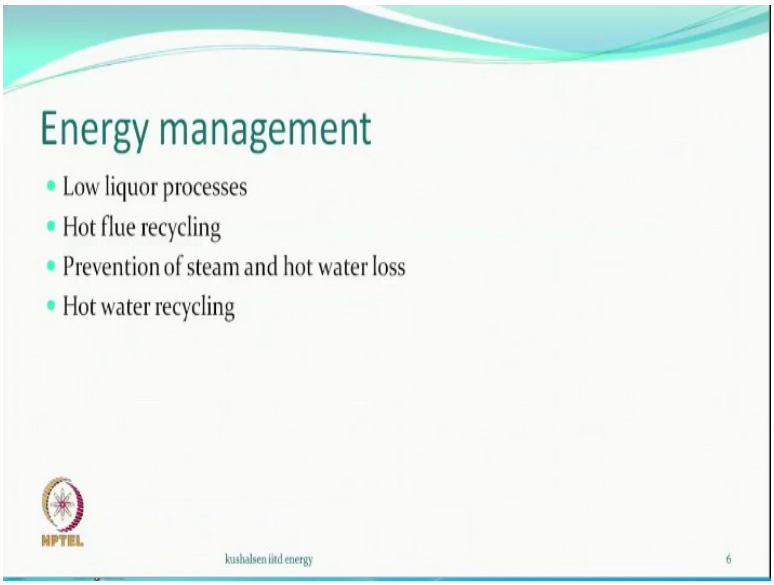

So in general this thing can be also related to what we called as Energy Management. Low liquor processes, if you use low liquor energy is saved why because you may be drying it. If you have less water you will try less water if use more waters you lives to drive more water for example in the case of our finishing systems will talk about that low liquor. Other Energy Management in the finishing.

We can think about is theoretically in any of the chemical processing part of the industry that every time we do drying there is some hot air generator hot flu generated and which is exhausted out can something be done to that can sometimes we let say after dying we wash off remove the hot water bath which is may be at high temperature let us say 90 degrees. So other than the water which is being used more the energy also is going out as a form of heat.

Right so recycling is one of the ways in which you do management of energy is always good or at least extract the heat out of the outgoing gases or outgoing liquids that also could be one of the part of the energy management system. The better management, industry would be obviously environmentally very friendly possibly they will save money also.

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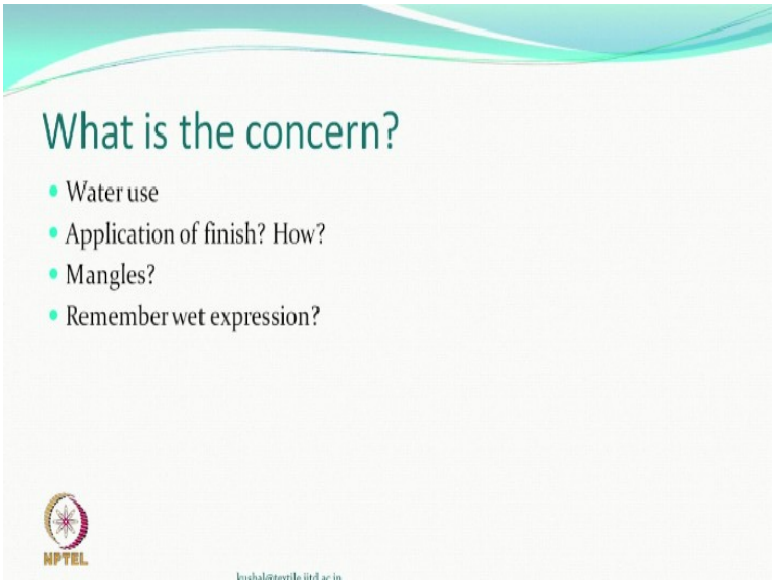

So in the context of finishing what we do pad dry cure something similar. So finishing the last process almost so in general women not the washing the fabric quit a lot. But we have a padding you have something called expression wet expression and then chemical is there. So application of all the finish and the chemical is done by dissolving in water that is one important thing. One can always the situations we can do in organic solvents to be used can be used for application but normally it is water which is being used.

And what do we use mangles that is our system padding mangle so remember the definition of the wet expression and present expression means the way to fabric has increased 100 percent in the sense that 100 gram is become 200 gram 1 kilo becomes 2 kilo. So 1 kilo liquid has been picked up. Alright that is what is the expression part of it how much is the chemical in that solution may be 2 percent may be 5 percent that what you require may be 3 percent maybe half a percent rest is water.

So what you do the water obviously you have to evaporate the water because you are interested in chemical which is a softener or is the cross linking agent or the flame retardent and what have you

so what has to be removed. So whenever we remove water you spent in energy. So energy water are related right. When we evaporate something let us say water we are talking about steam.

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We talking about steam when you convert steam the latent heat is very very high alright. And because of this the consumption of energy is high. So our aim should be to use less water so that you have to spend less energy in drying out. That is the aim so such type of application systems and processes which will use less water but do the same thing will come in category of low liquor application techniques or minimum application techniques.

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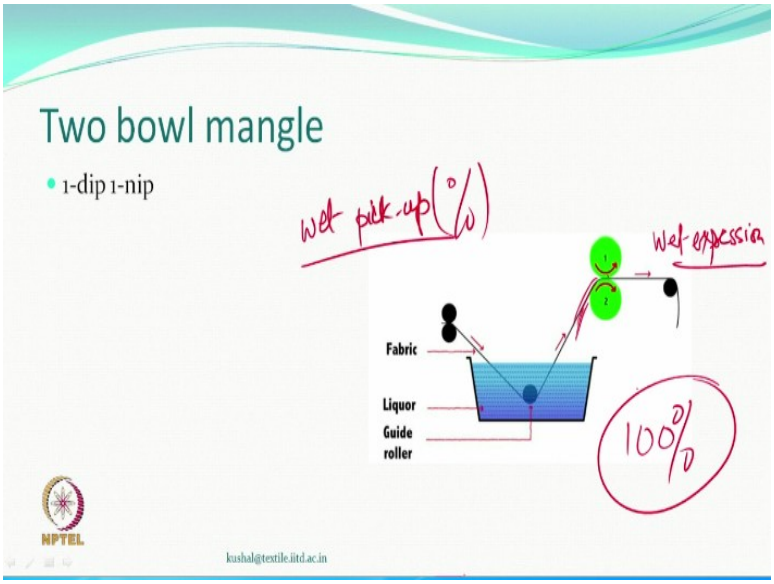

You remember this, 2 bowl pairing mangle what it does it does control the wet expression amount of liquor and the chemical taken somewhere here after this squeezing the squeezing occurs here, so some of the excess liquid will come out and what will go will be based on our wet expression. Sometimes also is known as wet pick up percentage so this 2 bowl mangle is used to that is the 1 dip, so 1 dip and 1 nip and you get control.

So uniform treatment and control of how much chemical and how much liquor is going. If let us say it is 100% you are picking too much liquor if you can reduce this pick up by 50% well how I can do this you need same chemical you can increase the concentration of the chemical in the bath. So at less expression also one can get the same amount of the chemical on the textile. But what will be the less there is the simple common sense kind of environment.

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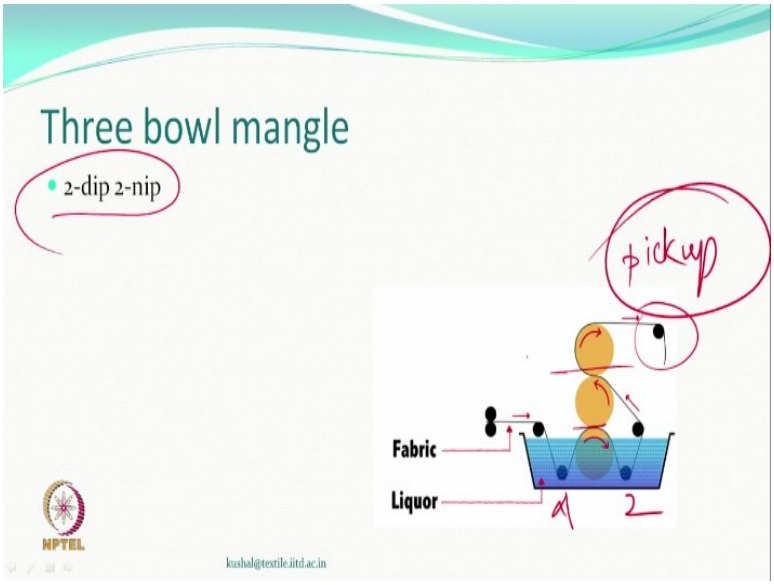

The other mangle that we know is called the 3 bowl mangle which we have seen it got a 2 dip 2 nip situation one dipper second dipper and 1 nip and second nip okay this is how this mangle padding mangle works. Obviously 3 bowl mangle is used when the fabric got high GSM thicker material you are not very sure that one nip would be able to do the job. So you got 2 dip and 2 nip and you got uniform treatment at the end of this you will measure your wet pickup you okay.

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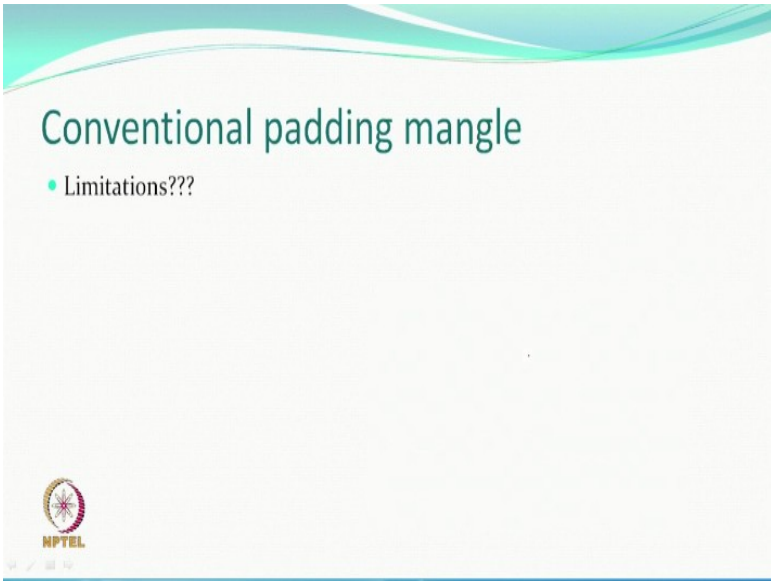

So what are the limitations of the padding mangle you say well I can decrease the wet expression wet pickup increase the concentration of the chemical and so there by actual water being picked up by the fabric could be less. So how do you do increase the pressure squeezes the pressure. For 100 percent cotton based textiles can increase pressure as much as you want. Because the water is absorbed not just on the surface absorbed it is in the interstice of the yarn fabric and some of it is almost chemically bonded which you called hydrogen bonding and bonded water.

It is very difficult to remove some of these water just by squeezing purposes it does not get removed. So if you squeezing too much the you actually may be damaging the fabric. So almost you can think about 65 percent, if it is 100 percent cotton material which is like a suiting material. There will be very difficult the reduce the wet pickup below 65 percent to so. You will be applying too much of pressure it will not happen. That means that concept that I can make the wake up pick up 50 percent does not happen in any if this mangles.

So there is the limitation you want to reduce you but cannot reduce because if you keep increasing you may be damaging the fabric by pressure but water still will not be able to come out because it is either chemically bound which is hydrogen bounded or it is too much in the industries in the capillaries fine capillaries then come out very easily okay. Which is the surface it will be easily comes out that is not enough. So you may not be able to achieve very low pick up values by just increasing this squeeze pressure.

That is not so good some people then suggested can we not do something where there is nipping but there is no dipping. So you do not dip the fabric but you may have some mechanism to pick up some liquid limited amount of liquid and then transfer on to the textiles. So textiles is here,

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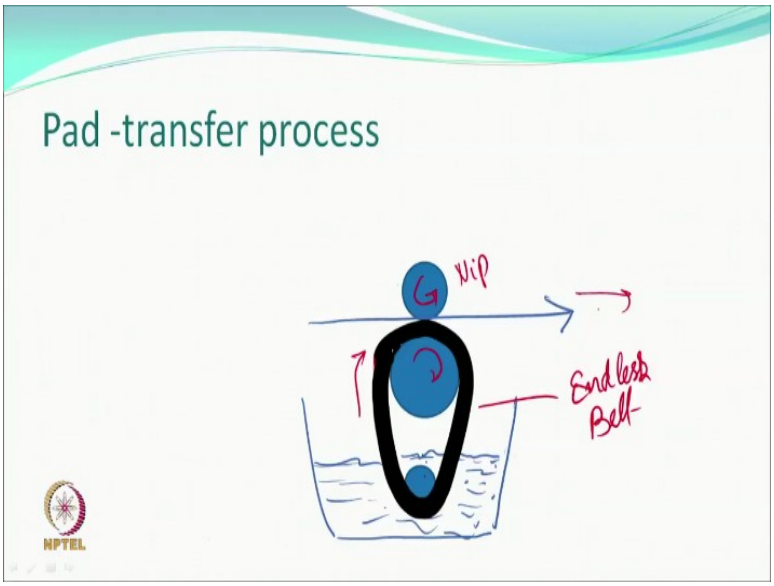

Moving in this direction there will be nip here and you can have an endless belt which can pick up some liquid that side is moving in this direction. This is moving in this direction, this is moving in this direction okay, and show it picks up some liquor depending upon what type of material what is the thickness the amount of liquor can be controlled and then it just transfers only whatever it has picked up.

So there can be some control based on the thickness of the so-called endless built the material of the endless belt and of course the nip pressure that you will create this can and this way you can reduce the wet pick up to some extent what are you talking about what we are talking is, if the water has not been absorbed so much then we do not have difficult in removing it. Because it is not been observed it when you completely dip it then it gets absorbed everywhere goes in the capillary goes into the chemically bond stuff.

So much before that happens if the fabric comes in contact with the liquor only at this point and gets out quickly. This is one way and nice technique which you can reduce the pickup close to 10 percent reduction not bad. If you can reduce pickup from let us say 65 to 55 percent is good. You

are reducing some amount of water and therefore less water will have to be evaporated. See this 3 ball mangle one can actually have very interesting possibility.

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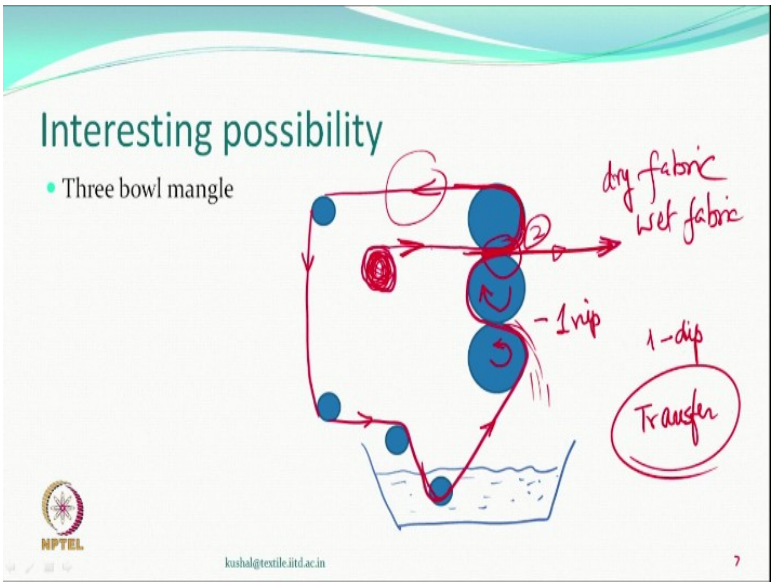

See what was the problem with the bad transfer is that lets you have applied a particular type of a chemical. This belt so called belt can get contaminated because it may absorb because it must be a bit absorb absorbing type material. So some of the chemical will remain and so if you want to add another chemical different chemical industry then some contamination could be seen which one limitation which people may not like okay is.

So but is a good idea if you are let us say not changing the chemical for a long period then may be you can think of washing it properly and then work it out. The interesting possibility with this 3 bowl mangle if you change the threading sequence in this system let us say you have some more additional guides 3 ball mangle but using only one nip alright. One dip using one dip and approximately shall we say 2 nips. One dip, 2 nips and transfer how do you do that.

Transfer principle let us see, if you have a trading sequence like this there is a fabric roll somewhere here and you are taking it out from here and this gets nip here and goes it has no solution it is not going in to the solution. The threading sequence has been changed so it is going from here up words then go all the way here then all the way here then gets the first nip. So you

get first nip first dip I am first dip. After this first dip then it goes to this process where this role is moving in this direction this role is moving in this direction you can see the difference now.

And this after this dip has now going to be nip and so additional for example liquor will fall here okay right. Additional liquor will fall and this wet fabric with whatever expression that it has is going to be taken out and taken in this way. So what happens here completely dry fabric is this is coming in contact with the wet fabric. Wet fabric in the second nip this first nip squeeze so you do wet expression that you can get. This wet fabric with whatever controlled with wet expression which was there whatever maximum possible you done it.

Then comes in contact with completely dry fabric which also wants to absorb moisture or the chemical for that matter. That means some transfer will take place now you have a third thing happening is transfer. If this happens then what means this pickup in this part which is going out will reduce further it was some pickup here which was because of the first squeeze first nip this will reduce further by doing this second dip where the dry fabric is coming in contact with wet fabric interesting.

And what we have done just change threading sequence and suddenly define this also can reduce the wet pick up by almost 10 to 15 percent interesting. Because there is additional material available for squeezing by capillary reaction taking the material out taking the liquor out from the wet fabric the dry fabric will get partially wet. Now it becomes partially wet so this fabric is partially wet here and this area is partially wet. Now partially wet fabric even if it is thick fabric now will enter into the pad bath and then go to the first nip get squeezed go to the second nip.

So where the second nip is this is the second nip and get out some reduction interesting same machine can be used for reducing the wet pick up therefore it is very interesting not much expense to be done but it will work. Will there be any contamination there will be no contamination because there is no belt which is the constant belt it is same fabric going down and transferring. So some transfer principle has been used but same fabric on to the same fabric same chemical which required by the fresh fabric also. So a bit of a giggler here and there can also do some interesting reduction in the wet pick up.

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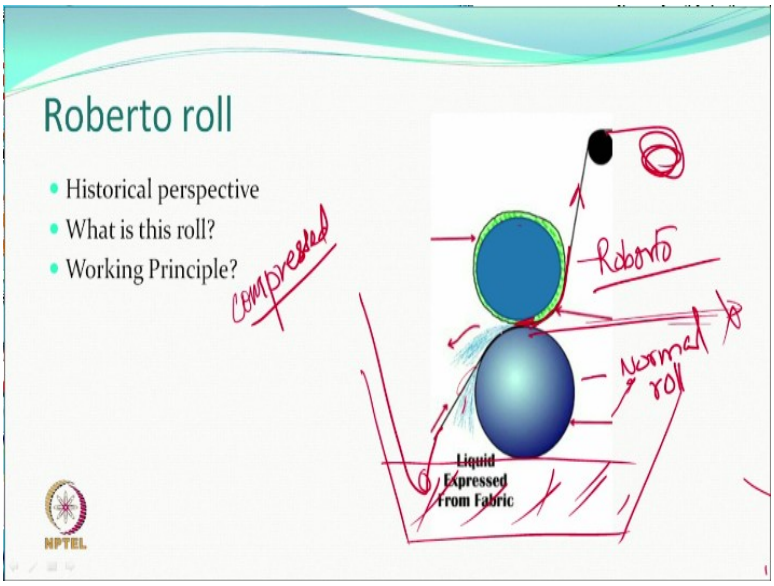

There is another important thing which is developed which is which can absorb more moisture that means a fabric which is been nipt and got certain amount of liquor can something more be taken out that is what is there. So in the pad transfer we try to apply less in this 3 ball mangle system where we redirect the fabric from different ways we are looking at the transfer but removing the water more from the fabric because the other fabric which was dry is also absorbent.

This one also is something based on similar principle talking about the history when we did not really have modern looking mangles where you have the metal roll over there is a rubber sleeve based on whatever hardness that you want. Before this type of material was there the people earlier used to do mangling on wooden rollers on which cotton fabric or was tightly wrapped around and so it becomes the surface become little cousin cousi and you know it could squeeze better without damaging the fabric.

Because it is the 100 percent wooden some damage of the fabric to take place so just to dampen that affect you had fabrics being wrapped on the wooden rollers they became the balls and then you go to the padding and squeezing process the problem of which you can understand because of the fabric which is wrapped on the ball will get contaminated by time alright and so slowly people change to the rubber sleeves which are less absorb tips and their purpose is to make sure

that the contact is softer pressure is enough damage is less and they do not get contaminated because they do not really absorb the chemical.

So you choose those rubbers which are not going to be will be non absorbing type right. Now this roborto roller is combining the properties of these 2 things that is a modern system which is rubber based but maybe it is micro porous rubber base system with does not interact with the chemicals that you use so we can completely remove them there is no interaction no damage no contamination maybe but is absorb it enough because maybe you have created pours on the surface if there are pours then the liquor can going to pours also.

So this was the interesting concept from the historical perspective where the so-called sleeve made from the fabric which were wrap was absorbing you want to use that property without actually taking in the liquor permanently absorbed or chemical permanently absorbs that it can come out it does not interact. So those 2 property you want to combine so it may be some like this. So you have the metal roll and you have a sleeve okay which is pours.

So design very nicely the poles are there but it still has and hardness to squeeze enough resilience when it gets compressed because whenever to such rolls will come in contact and press so there will be some compression. So once the pressure goes it must be able to come out and must be able to go back to its original position so this is important thing. Now this property has been utilized very nicely how.

So normally you may have in a padding mangle one roll which is the normal roll or some time it could be a metallic roll also now because the other one is softer but it could be the normal sleeve roll also. So this is this role then you have this roborto roll which has got a micro porous sleeve which is as resilient as non reactive as the normal sleeves are. So you have your bath the fabric goes in comes out goes and nip so called excess liquor comes out and the fabric goes finally for winding.

Now what is the difference between this and the previous one so first squeezing removes the excess liquor which normally would happen in any of the nipping processes okay. But at the

same time what happens is this micro porous system has got air inside obviously initially the beginning it cut air all of them voids are filled by air when it comes in the nipping area this role gets compressed but natural when it gets compressed what will come out the air will come out. Because the pressure excess liquor which has been picked up by the fabric will come out and what will happen this fabric is taken all along the surface of this role after nipping also.

Nipping is over normally if the nipping was over fabric would have gone straight somewhere else from here not this time so what you thing the fabric goes along this roborto role for sometime here there was a compression because the compression air head come out but as I said this leave which is micro porous leave is also resilient so it expands immediately after the nip is over of the nipping area it expands when it expands so vacuum gets created the pours because air is already gone out.

So how do you feel it once the air can come back sure but is the wet fabric is in contact with the surface as it is being filled the liquid gets filled are you getting the liquid gets filled in the pours so more liquor from the fabric which was nipped already goes into the pours portion of the roborto roll clear. When the same thing now it is coming back it is got water instead of air it has got filled with liquor. So when it comes air it gets compressed liquor of this fabric as it has been picked up comes out the liquor which was in the pours also comes out like the air came out.

Because it compressing so one liquor is in the pours which also comes out the liquor which was being picked up by the fabric also comes out and then as it goes out of the nip it again sucks more liquor so this cycle continues is it good think or not yes good invention very good invention.

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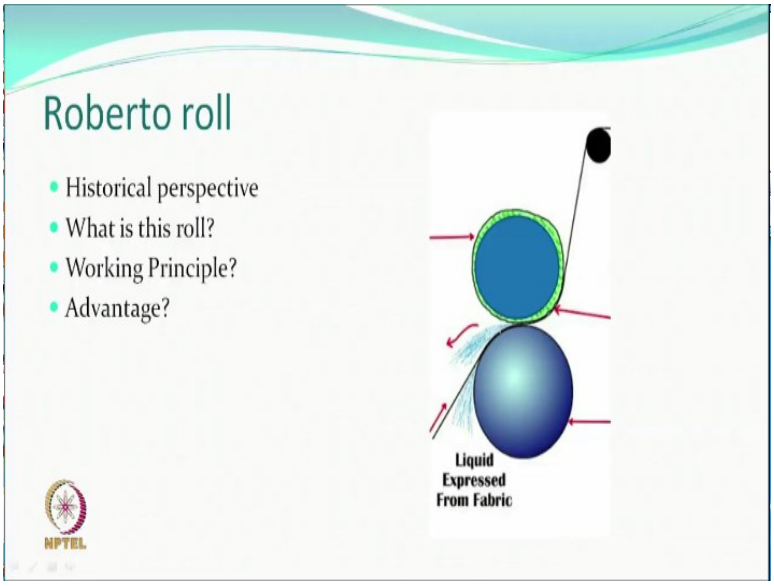

So the advantage is very simple you can get some 15 17 18 percent less pickup than the limit of the normal padding mangle right. If it can go up to sometimes 50 percent less than 50 percent also for cotton I am talking about if you talking about polyester obviously it much less because it absorb less. There is no bound water in the polyester is only in the intestine season surface water which is easy to remove alright that is the advantage less wet pickup means less energy to dry direct benefit there will be understand. There is another technique this is call it as spray technique.

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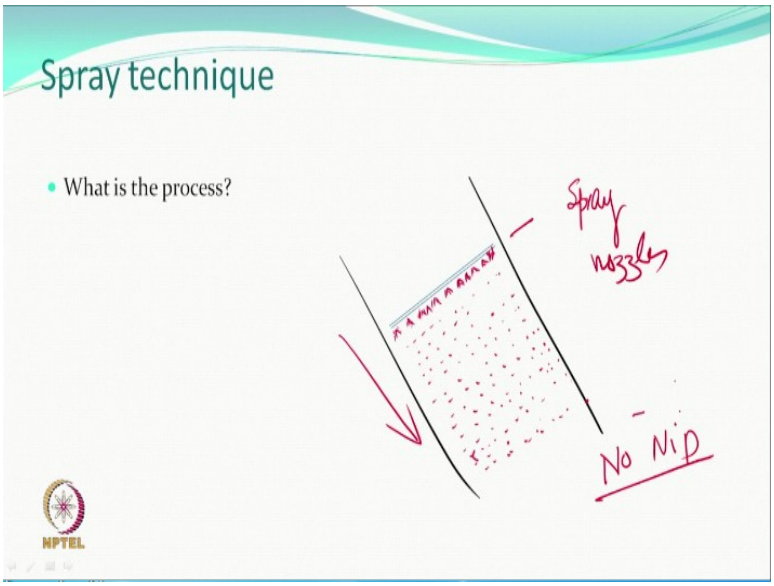

You know so instead of taking through the liquor and removing here there is the fabric let us say in this direction there is the bar or let us say pipe which is got spray nozzles lot of spray nozzles

and you spray the chemical on the textile. Textile is moving the spray is falling on the textile along with water and chemical and so you can apply the chemical. What is the important you can note from the previous one here there is no nipping. Because there is no nip you are independent the fabric speed is independent.

So you can move the fabric faster if the nozzle are spraying the same amount of liquor per unit time and the fabric moves faster the chemical or the liquor on the fabric will reduce true or not good technique. So the process is this spray nozzles all over the place the fabric moves like this and chemical is on the fabric interesting. So this is important concept here that the speed of the fabric can be changed irrespective of the nozzle velocity independent in the previous case.

Because there was the nip if you want to run the fabric fast nipping rollers also have to move fast you can not the surface speed of the fabric motion is also the rollers nip ball padding mangle balls cannot be different here there is nothing like that. So you can actually theoretically reduce the pick up to whatever level you want let us say at an x speed of the fabric you getting 100 percent expression. Increase the speed to 10x it will become 110th no limits actually whatever you want to can do that it can be applied on both sides interesting.

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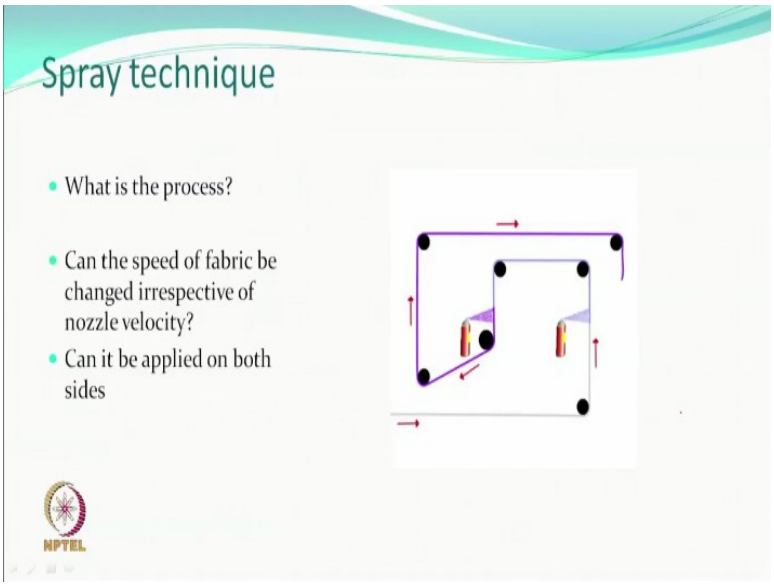

If suppose you are applying very less amount of material on one side water repellent finish on one side on the other side you want to give any other finish like a soft finish both of them can be

given 2 sides of course based on the thickness of the fabric you can apply the possibilities you can apply one thing on one side other thing on the side interesting so spray.

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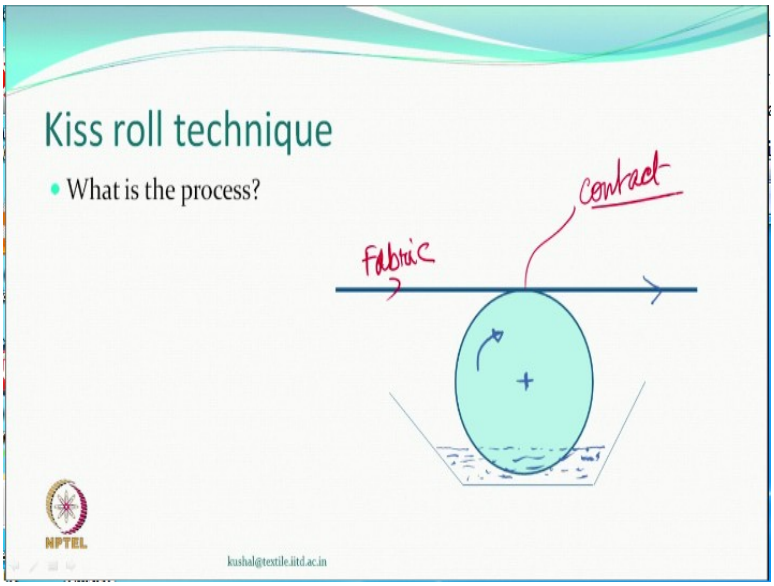

Another very interesting technique for minimum application is called the kiss roll technique. Where there is no nip but the transfer is taking place by kissing a transfer roller which is highly polished metallic roller highly polished metallic roller. So does not pick up too much liquor because metallic roller it does not get contaminated you can clean it up. You can change your dice can change your finishing chemical at no time at all you can just change them clean them start the next one right.

So what is the principle, principle is this highly polished roller and so it picks up like a very small thin film of liquor along with it and contacts the surface of the fabric moving on the top. So this is a fabric okay and here this is the contact point. So at this contact transfer takes place how much transfer will take place depends on how much can we absorb at what speed this roll is rolling at what speed the fabric is moving.

There is no nip here is there any nip here there is no nip because there is no nip so you can move the fabric at a speed with different than the surface speed of the kiss troll. So because that touches the name is kiss. Kisses it goes so somebody ask these questions can the speed of the role and that the fabric be different what would you say yes they can benefit.

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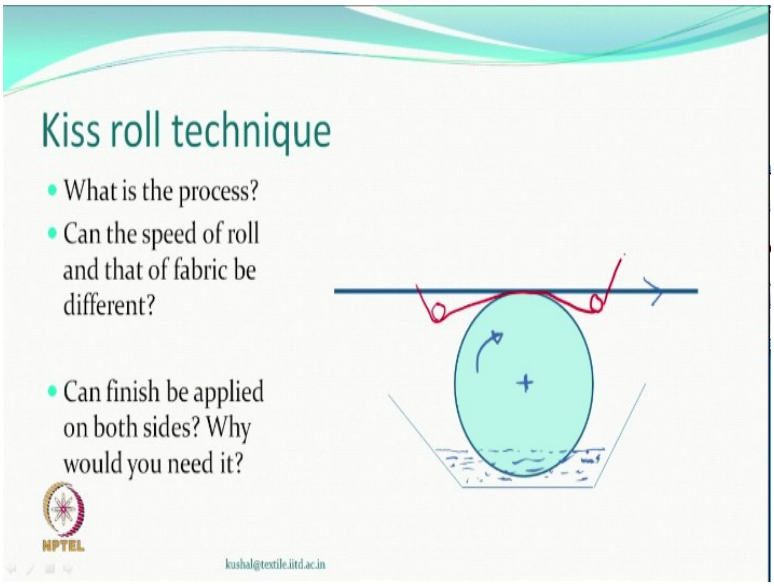

Here can you apply the finishing the both sides think about it can you play or not. Just have to worry about the threading sequence so just make the right kind of threading sequence you can apply finish on both sides in case if you want to apply 2 different types of finishes on 2 surfaces this can also do the job but at least what is happening it gets absorbed the surface but because hydrophilic material there are capillaries also. And so through the capillary very quickly the chemical gets transferred to the other side.

How much chemical can you apply what could be the pickup limit share no problem at all whatever the limits that you want, you want reduce move the fabric very fast or move the roller very slowly you want to add more you can move in the same direction it will be there if you move the opposite direction also yes there is some friction but there is no nip just it touches and goes that is only thing you can do right yes the thread or the fabric line may not be just horizontal line you may have to guide the fabric let us say by some guide roll.

So that it has it may touch little bit and go alright this can be increased by guide rules on the forces that the length of contact could be changed it should be 0 it will little more than zero just by little depressions of these guide the fabric and then move which ever you want to move right. That is the kiss roll technique for you very nice commercially available technique anyway. So I

just limit of a pickup is not there you want 5 percent possible only 5 percent this machine is not limiting.

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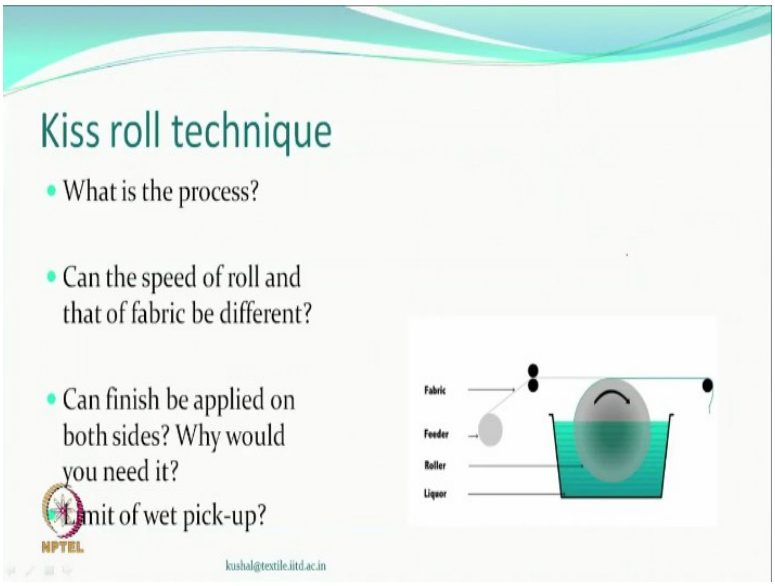

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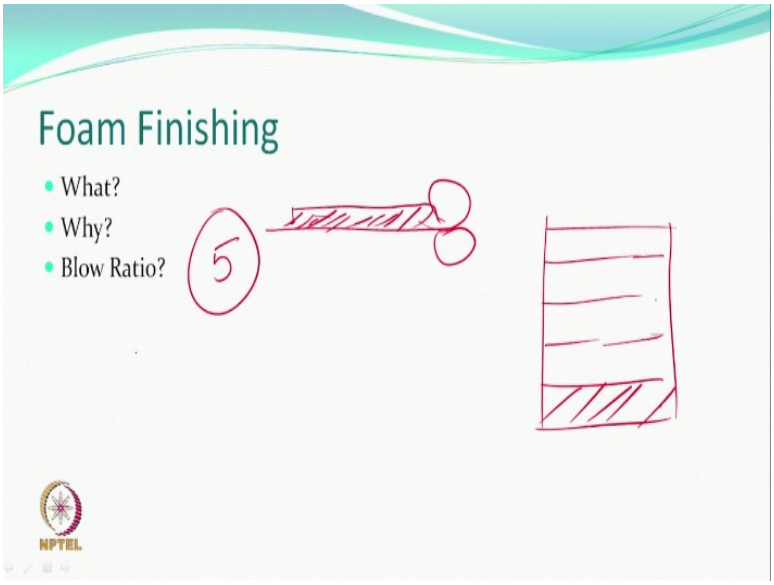

There is another technique which is called the foam finishing. At movement what are we doing we take the chemical dissolvent accrues make it in accrues solution of that dissolvent water and then apply and want the water come out. If suppose we say that this is not water but what we have created is the foam. Foam means what a large amount of air is in the bubbles. So what is the foam, liquid film with in the liquid film there is lot of air the size of the bubble obviously will decide how much air how much liquor.

So if we blow more air the volume can increase okay but the liquor will be very small so if suppose you apply this kind of a foam onto a textile surface let us say this was my surface and I have applied form and this form contains 80 percent more air. So as the liquor gets absorbed or you can put some roller here will break foam will break liquor will go air will where. Air will go out so liquor will be very less. So this is something called as a blow ratio so let us say you have certain amount of liquor you make a foam of this and the volume increases.

This is 2 times the volume is 3 times the volume is 4 times the volume is 5 times if the volume of this liquor become 5 times as foam because you are foaming right you are not doing anything just foaming like for example for soap solution just keep churning it quite a lot and also push air inside. This is suddenly the volume raising right. But what is the raising mainly not the chemical is not increasing the water is not increasing air is getting inside volume is increased. So if it becomes 5 times you say blow ration is 5.

Let us say have done the blow ratio of 5 type of foam with some chemical and now I applied because you have seen you have seen the foam is almost like a semi solid kind of environment which can based on what kind of foam. It can stay like a can I have a own structure all the cell setting for each other they do not flow just like a normal liquid. Foam can stay in your hand for a good amount of time right you gets liquor only in the film air is there inside so you apply what is the advantage application can be uniform because the volume is large.

If the volume is very small like if you say will I take only 20 percent of chemical I will put it in or I will take 10 ml of thing I want to spread 10 ml difficult to spread 10 ml uniformly it may get observed more somewhere you cannot do it have to the way to make sure that goes the other side. But it you have the large volume then you can easily apply errors are less uniform application at the end of the day everything goes in the air where is the little amount of liquor remains on the fabric.

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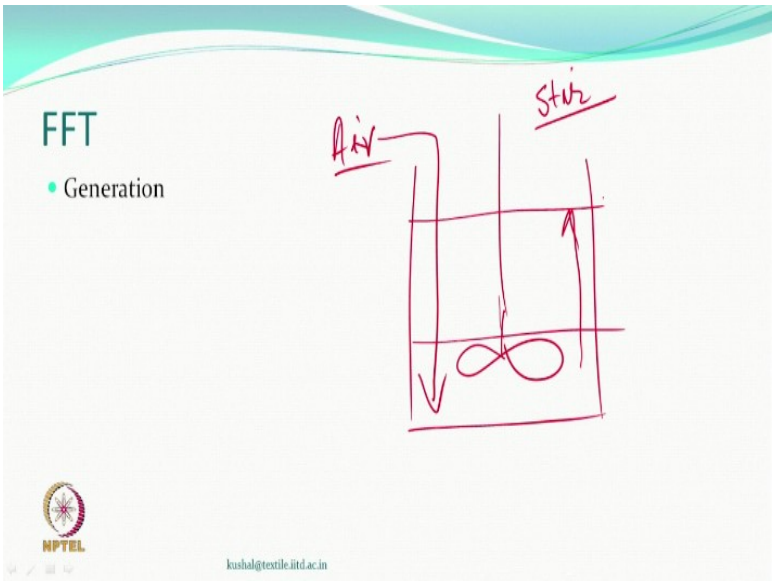

So how do you generate foam very simple you have liquor so they have something called as terror you would have some way to blow air you blow air and keep starring whatever RPM and suddenly will see if supported correctly because you may be have to add another agent called the foaming agent which is like you can say our simple soap which we also called surface active agent so we can add some of them you may have to add some polymeric compound to make sure the film is more stable and does not break very easily extra, extra all those thing can be done.

But if you do these 2 things the volume will keep rising you go up to the whatever desired blow ratio and apply. If you have lot of foam you apply how to we apply. Well we know this technique application technique coating technique knife on air.

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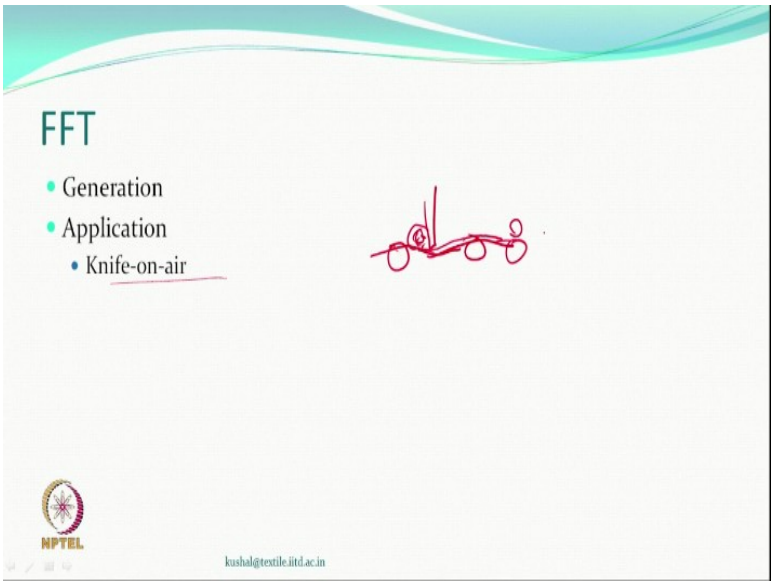

So the fabric goes like this the form is here and based on the gap that you leave the foam will be quoted and then you can break the form after sometime and do drying curing whatever you want to do. But imagine you reduce the water interesting similar in knife on role can be used as a coating technique so you make a foam and coat.

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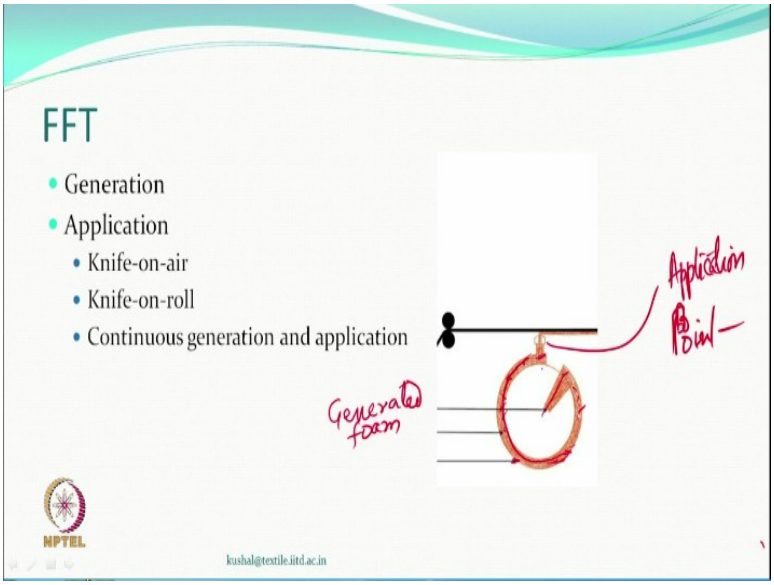

There is another process which is commercially viable process where you do not make a stable foam keep it somewhere take it out and apply you continuously keep generating the foam and continuously keep transferring the foam and then apply on the textile. For example her the generated foam is entering here this is the foam of a hollow system through which it moves and so this is the transfer area okay.

This is the transfer area so the foam enters here gets the pressure gets equalize or as it moves as it moves along this the pressure gets equalize and this is the application point. So they form generator somewhere which is transporting the form through this and in the chamber it goes all along the chamber okay goes all along with chamber and you did this motion the pressure gets equalize. So the continuous formation of generation of form continuous application of foam right.

So the liquor enters from there air enters from somewhere else the foam is generator turbulent environment and its pushed into the system and around the application area it comes this kind of a area where it is moving all along in some chamber the pressure is getting equalize. This is for control purposes and then the fabric in moving at a particular speed the foam is being applied at a certain speed so you can control your wet pick up as much as there is no nip air.

Also there is no nip then what happened speed of the fabric could be different the application volume of the foam could be different. So there is no problem of what level of wet pickup you want how much low wet pick up you want there is no problem at all can it be applied on both sides. If you want because you get low pickup is quite possible that the liquor is so low it does not get that migrate to the other side you can have so much low then can apply in the both sides sure it can be applied on both sides okay one type of finishes one side the another type of finishes on the site this is called the form finishing technology FFT, foam finishing technology.

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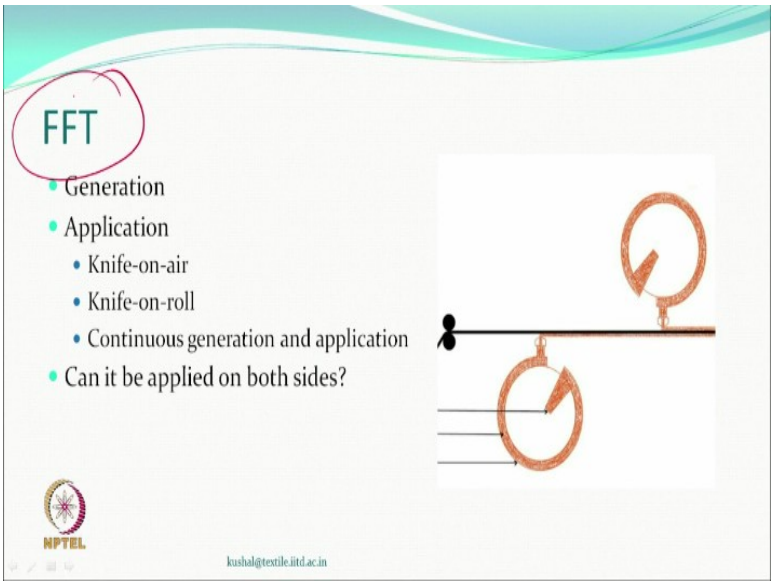

You can appreciate now the low liquor and therefore less amount of water evaporation the question that sometime may people may ask how low should be the wet pick up.

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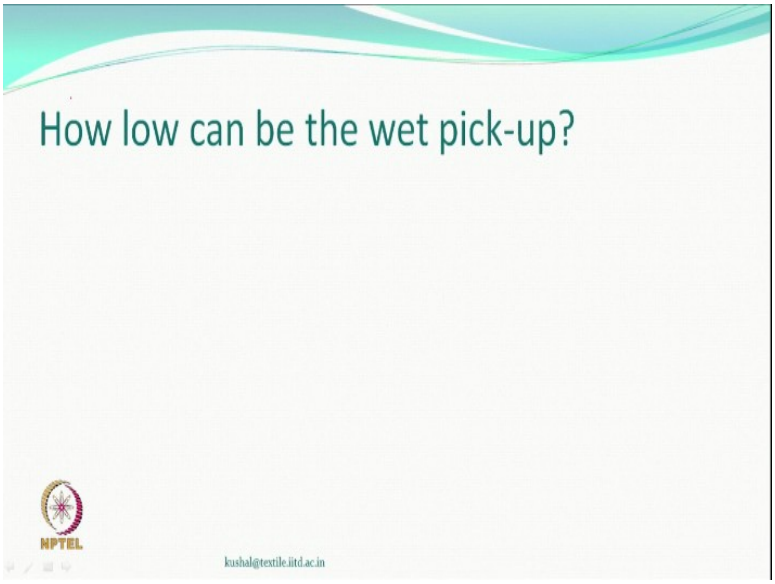

Now some of this technique can give you very, very low you want to 2 percent I will give you 2 percent pick up. If suppose I want to do a wash treatment if I do 5 percent pickup on a cotton you will you satisfied I can change the concentration that is not the problem but what you will find if reply from one side and expect the other side to get uniformly.

In uniform application it may not happen so if you want uniform treatment a bulk of type of finish not a surface type of finish a bulk type of finish and a uniform treatment although your

technology of application allows you to reduce the wet pick up to as much as you want but people say will be bad for you if you want uniform application for a bulk treatment like wash and wear flame retardancy in any want to use technologies these technologies then minimum pickup should be particularly on cotton base systems hydrophilic not less than 30 35 percent.

So that is because you want uniform application if we become less than that then it may not be uniformly applied on both sides it into the fibres within the molecular systems so that maybe limitation not the machine right. So what we have learn, we have learnt that wet processing industry is energy intensive it consume more water it consumes therefore more energy to drawing for drawing purposes therefore we have low liquor technique sometimes also known as minimum application techniques.

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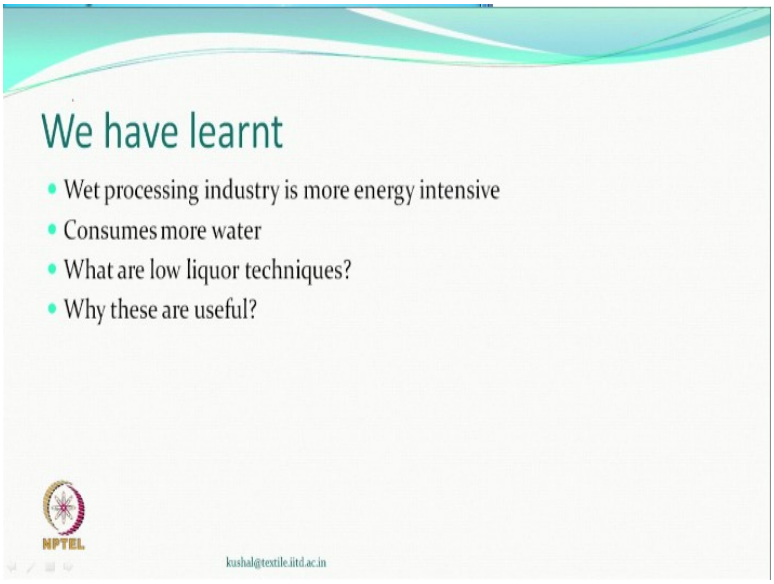

So we know why they are useful because less water means less water to be evaporated that means less energy to be consumed. So that is what it is from the energy management point of you in the next class will see some of the ways in which we can recovered the waste heat, heat which has been going which is going out with exhaust which is going out with the hot liquor can something be done recovered why should we not recover will talk about it in the next class till then all the best enjoy see you.