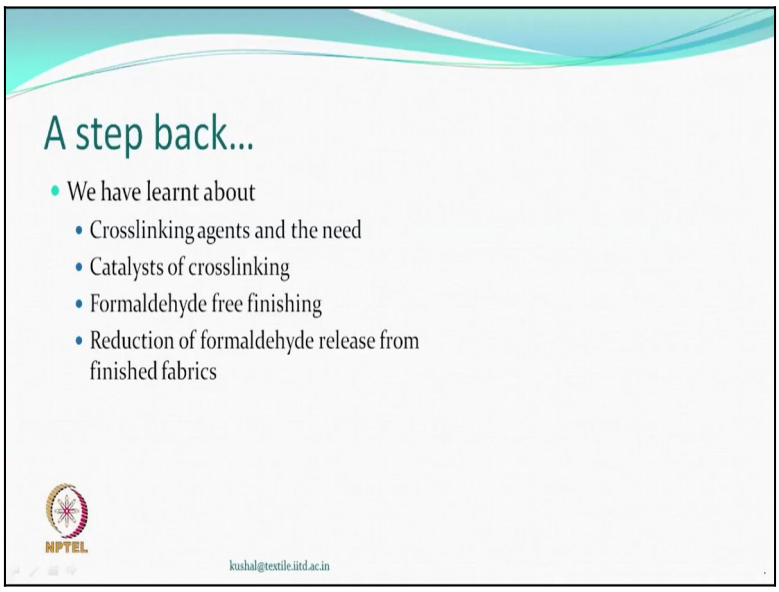
Textile Finishing
Professor. Kushal Sen
Department of Textile Technology, IIT, Delhi

Module No. #04
Lecture No. #09
Stiff and Soft finishing

Welcome back, to this class, on Textile Finishing. Let us look back, as to what we had done, till now.

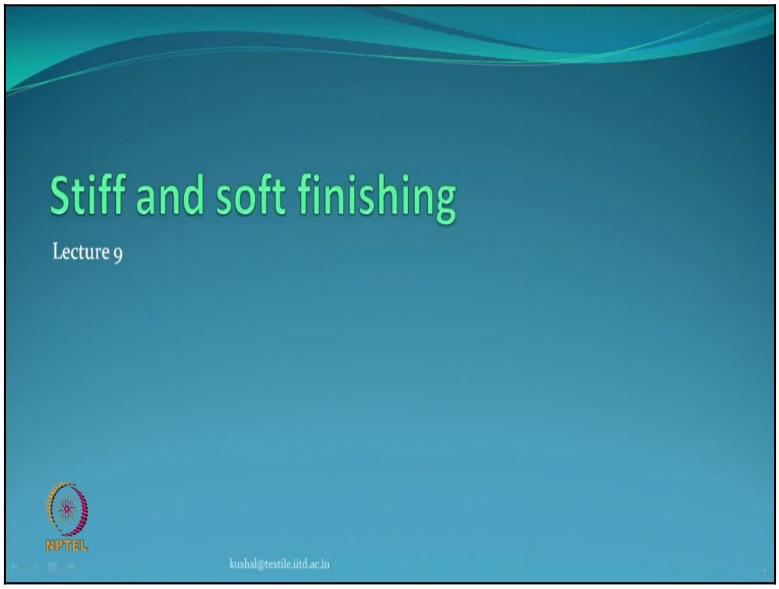
(Refer Slide Time: 00:32)



What we had learnt about was, various types of cross-linking agent, that can be used, to give wrinkle-resist finish. We also talked about, different type of catalyst systems, which are efficient, in various senses, a reduction of, let us say, the loss in tensile strength, you should be able to reduce, the temperature of curing, and so on so forth, we talked about them.

We also talked about, formaldehyde free finishing, which means, using agents, crosslinking agents, which are free from formaldehyde, they do not have formaldehyde, by themselves, or we could also, use some scavengers, which could reduce, the release of formaldehyde, in the finished Fabrics, which is good for the user.

(Refer Slide Time: 01:39)



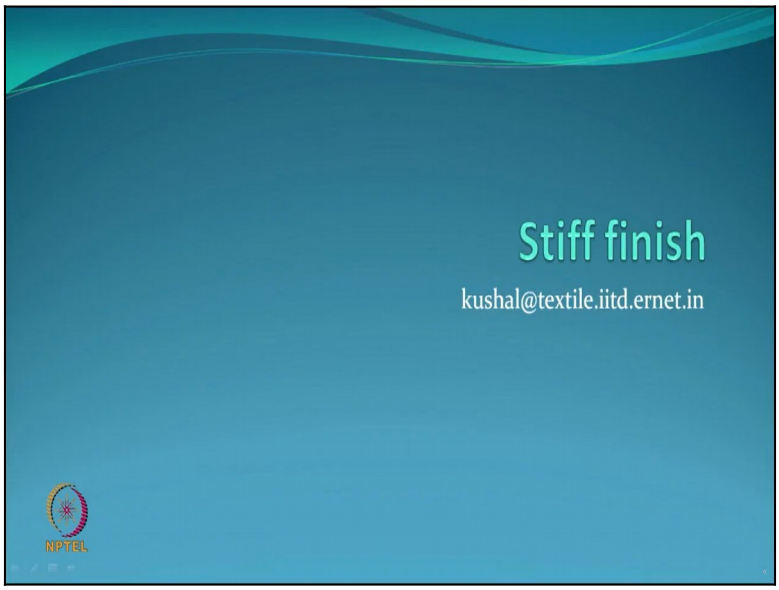
Today, we will talk about, another finishing process, which is called the, Stiff or a Soft finish. So, this is a very interesting area, which is slightly different from, what we had learned before. Here, the purpose also is different, although some of things, may sound similar. Let us say, we first discuss, is to what are we going to be doing, in the coming weeks. So, in the couple of lectures, what we will do is, we will talk about, the principle, the need, for doing a Stiff finish.

(Refer Slide Time: 02:15)

Any chemicals, that are used, which are sometimes called Stiffeners, we will talk about them. How it can be achieved? What are we supposed to do? Similarly, in next lectures, we will talk about, Soft finish. How, the Fabrics can be made softer, and so on so forth, what kind of

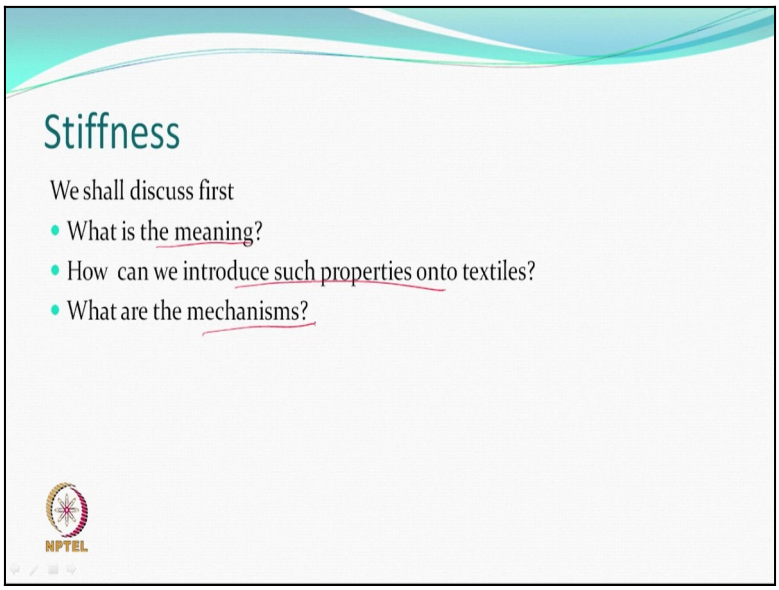
chemical, softeners, are used? What processes, people use, to give a softer hand? Today, however, we shall concentrate on, Stiff finish.

(Refer Slide Time: 02:56)



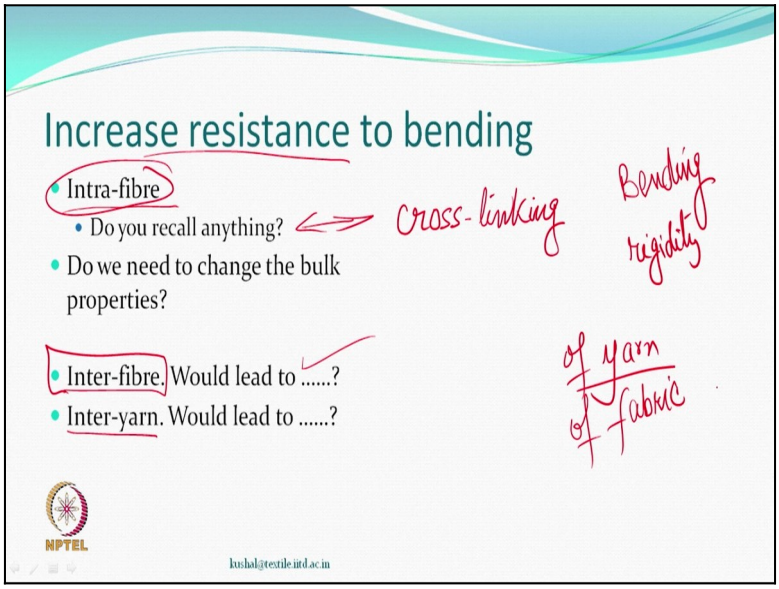
So, how to make, Fabric stiffer, appear stiffer.

(Refer Slide Time: 03:09)



So, we say, what does it mean? We will talk about it. We will also then understand, how do we impart, these properties on to textiles. And, approximately, the mechanisms, of course, wherever required, we will use chemistry. But, chemistry, in this case, we are not going to be, dealing in more detail. We most probably know, already, what we had discussed.

(Refer Slide Time: 03:40)



So, important thing, when we talk about stiffness is, increasing resistance to bending. Increasing resistance to bending. So, how do you increase, resistant to bending. Where do we, increase the resistant to bending. Let us say, you are talking about, some action to be taken, at the Intra-fiber level. Intra-fiber level, if you do that, then hopefully, you may see, increase in bending rigidity, or resistance to bending. Right. So, do you recall anything?

Whatever, we have done in previous lecture, do you think, something like this can happen. Yeah, you think so, or no. Yes, we have been talking about, cross-linking. We have been talking about, cross-linking, before. And, what is this cross-linking. These cross-links are, Intra-fiber, or Inter-molecular. So, in that way, if you remember, we said that, after cross-linking treatment, the stiffness of the Fabric, may increase.

That means, the rigidity, bending rigidity, can increase. So, change is happening, where? The change is happening, within the Fiber. So, if you can do that, we have already done, part of stiffening. If that was the aim, then we have achieved, a bit of it. However, we need not we need not, change the bulk property, to achieve stiff experience. Remember, crease recovery, improvement, wrinkle resistant finish, was a bulk treatment.

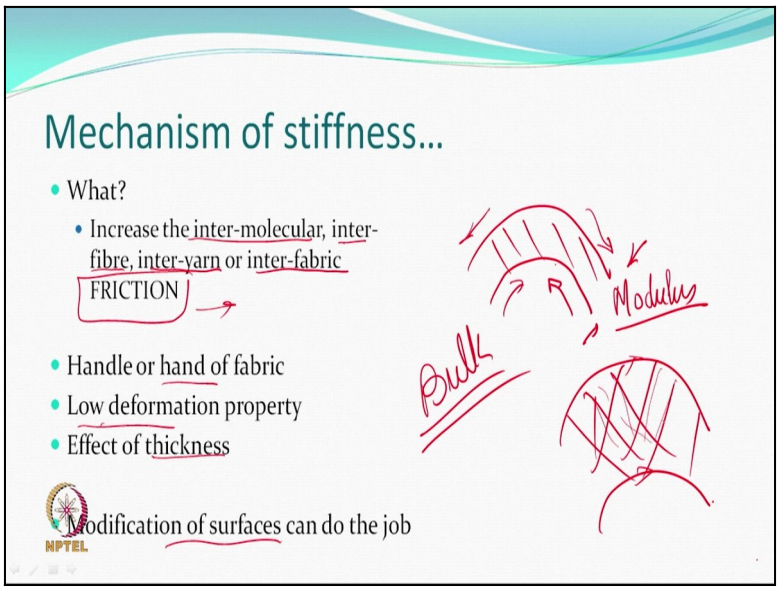
That means, you wanted, all the molecules to, diffuse into the Fiber, reach at various molecules, wherever possible, to complete a cross-linking reaction. So, that was change in bulk property. If you do this, Intra-fiber, then you are actually, doing the change in a bulk property, changing the modulus, the bending modulus of the Fiber. If, there were bending

modulus changes, the Yarns bending modulus will change, and the Fabrics rigidity, may also be changed. And, one can see the stiffness, happening.

But, in that finish, our aim was, recovery from bending, but, we may be interested in, Inter-fiber treatment, not Intra-fiber. That, you may like to have, some kind of a treatment, which can change the Fiber to Fiber interaction, which would lead to, what? It would lead to, stiffness of the Yarn. The bending rigidity of Yarn, can change, in case, the Inter-fiber interaction, interaction forces, could be altered, modified.

If you do the same thing, in an Inter-yarn situation, then what would it mean? It would mean, that we are changing, the bending rigidity of the Fabric. All right. That means, based on, what we do, for increasing the resistance to bending, we can do it, in the in the Fiber, in the Yarn, in the Fabric. So, invariably, we may be interested, in handling Fabrics, and changing the bending rigidity of the Fabric, to make it stiff.

(Refer Slide Time: 08:43)



So, how does this happen? Why would this happen? So, one important thing is, in the Fiber case, we are talking about Inter-molecular, in the yarn case, we are talking about Inter-fiber, and Inter-yarn, for the Fabric case. And, you can actually have, Inter-fabric also. That means, you can have, 2 layers of Fabric. So, and what do we change? We are talking about, Friction.

One is a permanent bending, or anything that you do, which resist, the motion, the bending, is going to, basically change the, rigidity, bending, moduli, and so on so forth. Now, this, in some sense, is related to Friction. If by any means, you can increase the, Friction between the

Yarns, Friction between the Fabrics, fiction between the Fibers, you will see, something happening, to the bending rigidity.

If you increase the Friction, bending rigidity increases. Now, what it means is? It means, interestingly, it can change, the handle of the Fabric. Sometimes, the handle, is a term, which people use, in the textile. What it means is, that you actually hold the Fabric, and try to squeeze, and you feel the tactile, you know, resistance, to this bending, and say, say well, this hand of the Fabric, or the handle, the Fabric handle is, you know, stiffer or softer.

So, that is what can change, if you change the Inter-Fiber Friction. Change means, increase, not decrease. Now, very interestingly, this hand, and the stiffness, etcetera, belong to, what we call as a, Low deformation properties. What are they happening? Say, let us say a Fabric, you are bending. So, you have again, the same extensive forces, and compressive forces, working. And, if these forces actually represent Friction, then also, there will be resistance.

When we talk about, Low deformation means that, the deformation is not very high. It is not like, tensile strength, or strength at break, elongation at break. You are looking at, modulus. Initial resistance to change, that will be interesting. So, that becomes an important part. And, interestingly therefore, things like, thickness, matter. If this, instead of being this thick, is more thick, you will have to probably apply, much more force to bend it. Thickness, becomes an important thing.

For example, let us say, this is a paper. Okay. It bends. It bends. I take 2 papers, together I hold them, they bend. I hold another paper, you know, three sets of papers, I hold them, they bend. Alright. But, if I do something different, I take the 3 papers, and put some resistance to bending. How? By putting, let us say, glue. Okay. I put a glue, then you say, it does not bend. 3 papers, with a little bit of a glue, compare this, with this.

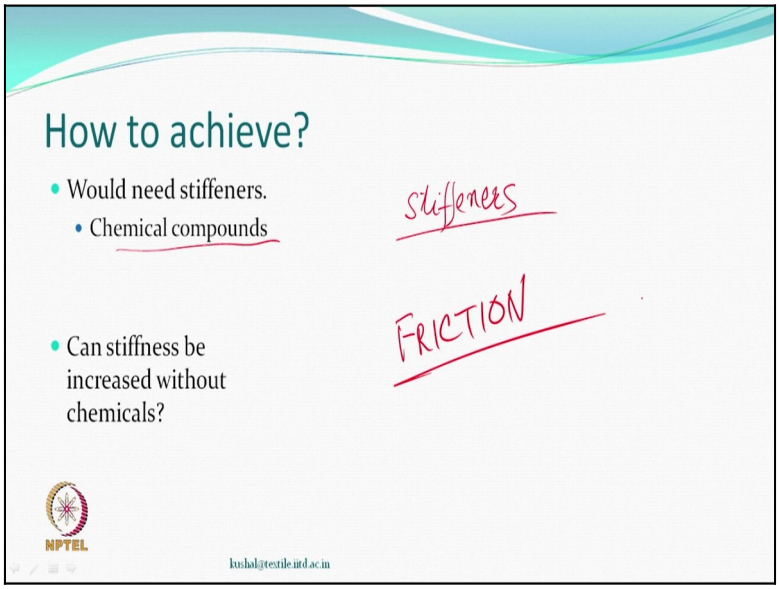
If I hold, these 2 together, both of them, are composed of three each. See this. The other three, have bent as if, they were single. And, once this becomes a composite, it obviously offered resistance to bending. So, what has happened? More important thing has happened is, that when we had no glue, during bending, if any slippage is required, they could slip. The top one, could slip, and bend in its own ways. The bottom one, would bend, in its own ways. But, they are not restricting, each other.

But, the moment, you find, that the top one, or the bottom one, cannot independently move, the Friction between them, has increased. So, you see, the bending rigidity, also increases. The result is, same 3 papers. Now, this becomes, therefore an interesting observation to say, that this increase in stiffness, may not have to change, the bulk property.

We may only, modify surfaces. And therefore, surface Friction, well, it could bind permanently, it could bind temporarily, it could bind with the low force, it could bind with the greater force. That is, different story, altogether. But, important thing is, if the Inter-fibre movement, you see, the stiffness of this, is more than this because, for this to move, there has to be strain, on almost all elements. And so, if you can bind them, then obviously, it will be there.

You can increase, the surface Friction, this will change the bending. Therefore, in some sense, if we say, that we are not here to modify bulk property, but if you change the surface, or do whatever to the surface, Inter-fiber, or Inter-yarn, or Inter-fabric, in this case, that we showed was Inter-paper, you know, resistance to slip. If the elements are not allowed to slip, then stiffness would increase.

(Refer Slide Time: 16:21)



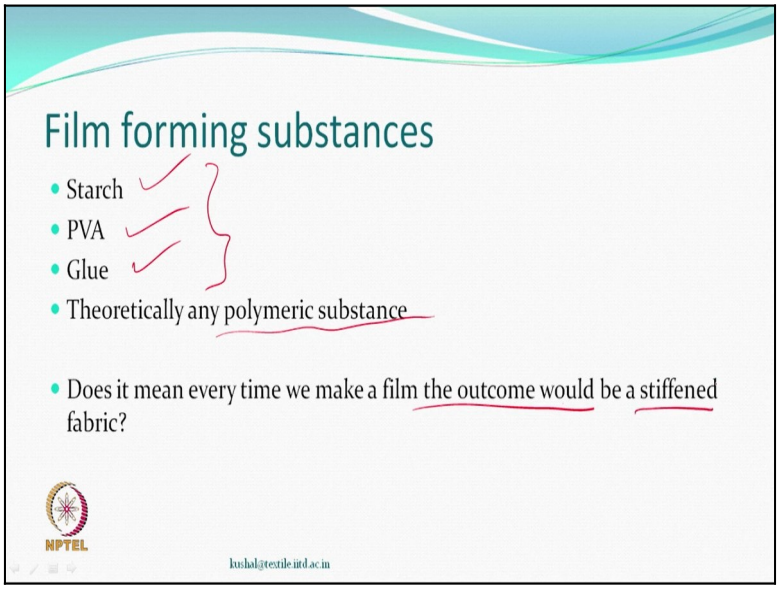
So, what do we do? Like I said, I done a glue, I used a glue, between, the three sheets of paper. And therefore, a glue, is like a chemical. So, you would require, some chemical compounds, which can be called as, stiffeners. We will do some bonding, whichever type of bonding, they would do. And, at the end, you will have the stiff fabric, theoretically, stiff

yarn, as well. Okay. So, to get a stiff Fiber, obviously, you have to go, in the bulk property change, which, we may not be interested. Because, this process of stiffness will be, relatively simpler.

If somebody asked this question, is it possible to increase stiffness, without uses of chemicals. You think so. Is it possible? You think, it is possible. Well, it is possible. We said about, Friction. Friction, between the Fibers, between the Yarns, if you can increase, by whichever the way, they are on. Have you ever seen, or felt, or experienced, if you dry a Fabric, after washing, even line dry, or let us say, you have dried to an extent, in a good sunny environment, and the most the moisture has gone out, will feel the Fabric, which otherwise, appeared to be quite soft, is little stiffer. All right.

But, you do a little shake, and you will find, well, those small bonding, which may have been there, because of drying, of the moisture, now gone. And so, it can wear. So, over drying. Over drying, if you do, for example, you do curing, or drying, to a higher temperature, higher time, so that the Fabric, becomes a zero moisture regain, comes to a zero moisture regain condition, if that happens, then you might find, the Fabric becomes stiff. But otherwise, to help the cause, we would require, Stiffeners.

(Refer Slide Time: 19:23)



Some of the things, which people have been using, and you may have also experienced, you may have used it also, things like starch, common one. Dip a Fabric, in a dilute starch solution, dry it, and you will certainly find, the Fabric is become stiff. Of course, other such materials, which are polymeric. Starch is also polymeric, right. Or, glue, or other polymeric

substances, if you have solutions of them, take the Fabric through this, dry it, and you will certainly find, Fabric becomes stiff.

Why? Because, you try to bend, the different layers, different Fibers, are not able to slip, during bending. And because, they do not slip, they offer resistance. So, this is, remember again, it is generally a change in the surfaces, and not the bulk property of a Fiber. So, if you can just handle the surfaces, which your way, it can still work.

Suppose, these things, as we say, are Film forming substances. So, they do make film, either in the surface, or between the Yarns, or between the Fibers, some kind of film, can be obtained. It does not have to be a film, absolutely visible, on the surface. This can also happen, based on the concentrations, that you use. That means, if we every time, there is a film, which is formed, does it mean, that it will be stiffened. Yes, in general, yes. But, there is one criteria. It is related to, Glass transition temperature.

(Refer Slide Time: 21:19)

So, when we talk about polymers, we talk about their products, we talk about last transition temperature. What is a Glass transition temperature? What is the Glass transition temperature? So, Glass transition temperature is, approximately a temperature above which, the material behaves like a rubber, and below this, behaves like a glass, it means rigid body. So, the rigidity is linked with, the Glass transition temperature.

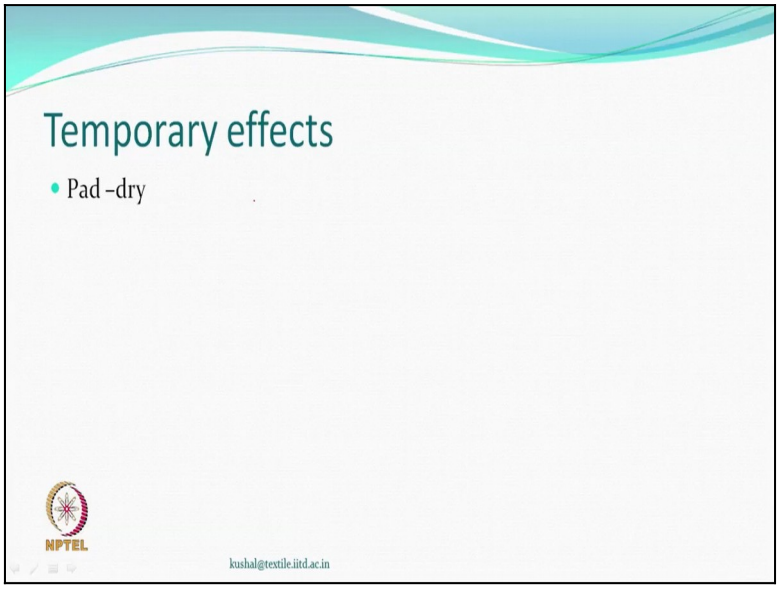
Like the rubbers, they have a Glass transition temperature, below room temperature. Some of them, below, 0 degrees also. Polyester, for that matter, as a Fiber, has the Glass transition

temperature, around 80 or more degrees centigrade. So, at room temperature, where we work, where we feel, where we look at the drape, where we look everything else, at that temperature, if this temperature, is below the Glass transition temperature, of the film that is being formed, then definitely, you will see, stiffness getting higher.

So, what it means is, higher is the TG, higher would be the stiffness. However, there can be cases, where the Polymer TG is much, much below the room temperature, therefore it is already very soft. It is like a rubbery. For example, if the Glass transition temperature is, -10 degree centigrade. And, we are working at room temperature, it is very soft. In, such a case, and based on, in such a case, and based on, let us say, the quantity that has been applied, you may not see, so much of a change, in the in the stiffness.

Because, whenever the bending forces are applied, this polymer, instead of resisting, extends it. It is malleable. It is ductile. So, stiffness can be less. So, there is a possibility, that you can actually have, film forming substances, applied to a textile, and still may not increase the stiffness. And, we will see, in later, whenever is required, to be discussed.

(Refer Slide Time: 24:07)



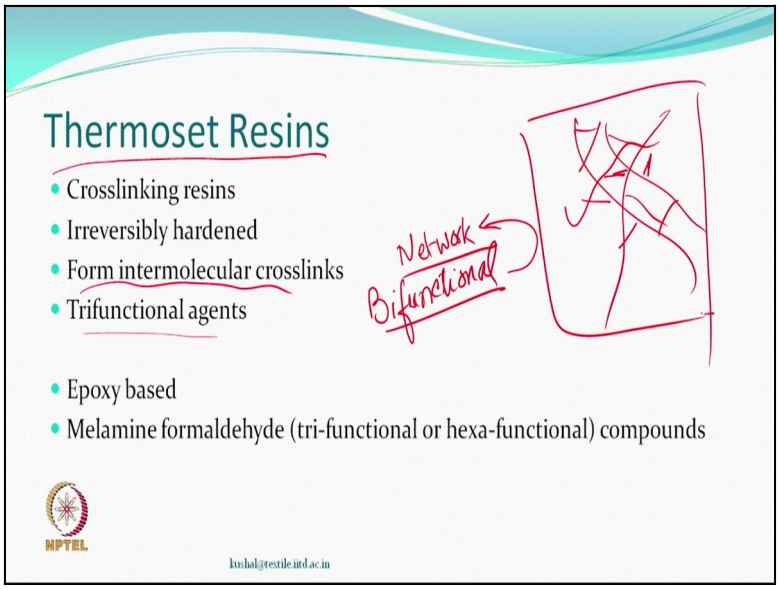
So, as you said, apply starch. Saris, shirts, trousers, made of Cotton, particularly, you apply starch, pad and dry, obviously in conditions, which are stressed out conditions, they remain as such. Of course, there will be always a situation, when you bend it more, crease formation can be more.

Because, this film can break. But, as long as, you are not going to sharp bends, you are going for milder smaller bends, then it will stay as an, effective stiffening agent. So, they can be temporary. You have a next wash; the chemical has gone out. And, when you do it again, apply again, and use it. So, cheaper chemicals, can be used as stiffeners, without any problem.

(Refer Slide Time: 25:15)

Little bit of permanency, that you want to give, to this stiffeners, then probably, cross-linkable agents, can be used. They do not have to be, going and diffusing inside, but they themselves, may be film forming, but the film can be cross-linked. If also, at the same time, between the film, there is cross-linking, you know, some linkage can happen, with the fibre, the permanency can increase, further. So, after every wash, you still find, well the material is, still stiff. Okay. Because, it could not be washed off. Alright.

(Refer Slide Time: 26:01)



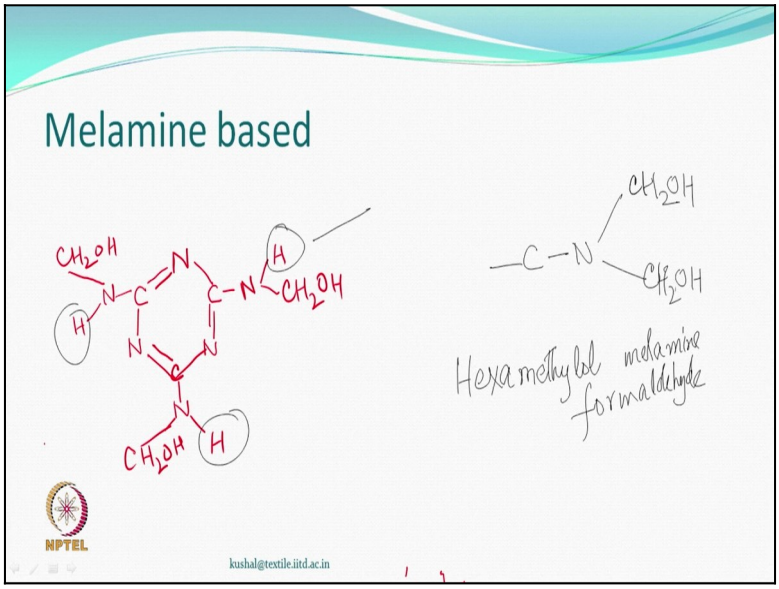
So, some of these compounds, which are called, Thermoset resins, are in a way, cross-linking type of resins. Have you heard of Bakelite, have you heard of Melamine, Melmoware, you make utensils out of them. Saucers, cups, so on and so forth. Sometimes, they were known as, unbreakable plastics. So, Thermosets are the ones which, once they are formed, then they do not change. Because, within the within the polymeric system, they can make lot of network.

So, we are looking at, forming of Intermolecular crosslinks. And, this Intermolecular networking, right, so not just a crosslink, we are looking at, network formation. So, you form networks. And, if you can form networks, then, the rigidity of the film, increases. And, by heat, by wash, it may not change much. So, they could be, Trifunctional. You see, we remember, cross-linking agents, normally we talked about, Bi-functional crosslinking agents.

But, they can only crosslink to molecular, but they cannot form network. So, if we form want to form a network, in a three dimensional system, so you got to have, a crosslink there, or a crosslink there, in not 2 dimensions, but in three dimensions, molecule themselves, the film molecule themselves, are crosslinking. And so, the film can be, rigid and tough. So, you can have various types of agents, which can be used, other than PVA'S.

And, we talked about, Starch, Glues, and Gelatine, and so on and so forth, which could be temporary. But, if you use them, and do the cross-linking there as well, by any means, it could also become more permanent than, otherwise. So, network based crosslinking, with multifunctional agents, can work out, which we call, sometimes, a Thermoset Resins. They do not change their form, by heating, reheating. The first, you have the cross-linking reaction, after that, they do not change their form.

(Refer Slide Time: 29:00)

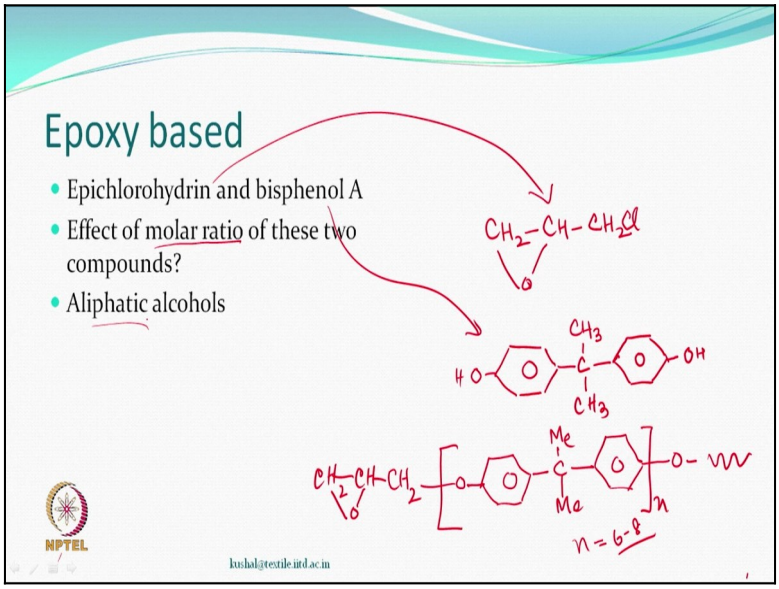


So, Melamine based, if you remember, Melamine, for example. So, lot of Nitrogen, here. So, you can have, this type of a structure. This is, what is this? This is, Trimethylol Melamine. Because, its three functional groups, it can form, network type of cross-link. But, you can, theoretically, replace this as well, replace this as well, and replace this. And, if that happens, H goes, and you have a situation where, every Nitrogen has got, 2 Methylol groups.

If, every Nitrogen has got, 2 Methylol groups, then it will be Hexamethylol Melamine. Looks as, if we are still in the, cross-linking zone. So, you can have, Hexamethylol, more networking, Trimethylol, some networking. And, if this curing is allowed to be done, then you can get, permanent effects, permanent stiffness in Fabrics. What do you do with the Fabric, is a different story?

But, to get permanent effects, you would require, some kind of a chemical, cross-linking to be happening, on the films. And, if it also reacts, with the textile, it is okay. If it does not, it still will be a very large molecule. Because, it is cross-linking with itself, and making a three-dimensional network. If it makes, a three dimensional network, stiffness will increase.

(Refer Slide Time: 32:39)



Then, there are other compounds, they are called the Epoxy resins, Epoxy based hardening systems, which also can be used. They are used, for many other purposes. But, theoretically, based on what you want to do, this can also be done. For example, if you have Epichlorohydrin, you remember, Epichlorohydrin, what was this? This is an Epoxy compound. Okay. And, you also have another compound, called the, Bisphenol-A. I think, you probably know this compound, as well.

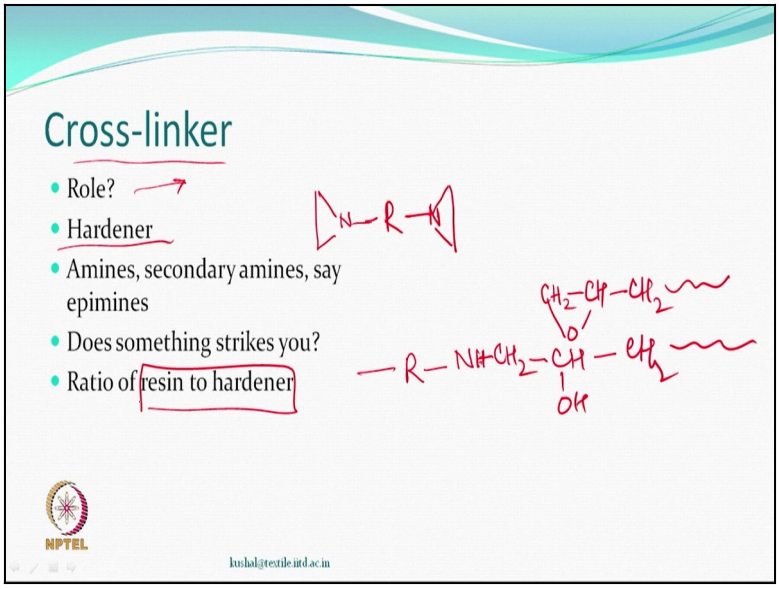
And, a Methyl group, here. So, this becomes, the Bisphenol, this A. And, this is Epichlorohydrin. Okay. So, these compounds can react, based on molar ratios. So, if you have different molar ratios, different type of compounds, and regions can be formed. If suppose, you have a situation, where Epichlorohydrin happens to be, you know, in certain proportions.

So, based on that, you can get a polymeric substance also, which will be, let us say, a Bisphenol-A, may be more in in cases, then then you will have a compound like this. You can have, n units of Bisphenol-A, reacted with, on both sides maybe, with our Epichlorohydrin. So, some Epichlorohydrin, maybe, on this side also. And so, you can get, some Oligomeric systems, which can be used. You can understand, this this compound, has a larger molecular weight, based on N, it could be 6 to 8.

So, large molecular weight. But, this whole complex, can also be chained in. Different ways. Molar ratios, if they are changed, so you can have, more of this, less of that, it is possible. Instead of Bisphenol, you can have, Aliphatic alcohols. Therefore, the flexibility of the film,

that the Glass transition temperature of the film, could be then changed. And, that manipulation can be done, by changing the ratios, of these 2 co-monomers.

(Refer Slide Time: 37:09)



You may have heard, of something called a Cross-linker, being used, in in this whole game of Epoxy resin, plus a Cross-linker. Sometime, these type of two kind of things, are available. And, you apply one, or just before applying, you mix the two compound, and then apply. It takes some time, even at room temperature, the reaction can take place, and becomes hard. Now, so this cross-linker, obviously has a role, to increase the stiffness, of the film.

If you do not use, cross-linker at all, then the stiffness will be very, very low. So, based on the application, you may use, or use very less amount of thing. And sometimes, this is also called a, Hardener. Now, these Cross-linkers are also called, Hardeners. Some of them are, secondary amines or amines, which can react. One of the interesting compound, which you have studied before, which also does the same role of a cross-linking is, Epimines.

Remember this compound. So, these are crosslinking agents, as we know, they were used, previously also. They can, link with hydroxyl groups, is again, linked with, other groups. Let us say, in this case, if we have an Epoxy group, which we just saw, in our Pre-polymer resin, this and this, can react, a ring will open, and then what you will get is, let us say, you have R, you have N, CH_2. So, this will become, NH. And then, CH, OH, and CH_2. And so forth.

So, you can make, links. And, if they are crosslinks, so they will, wherever there is a possibility, of availability, of an Epoxy group, it will react, with one compound, with the

other compound, or third compound, and so on so forth. And, you can create a network. So, here also, we can produce a film, which can be networked, between the molecules, and therefore a stiffer Fabric, can be obtained. Now the, how much stiff, that you want, it will depend on the add-on.

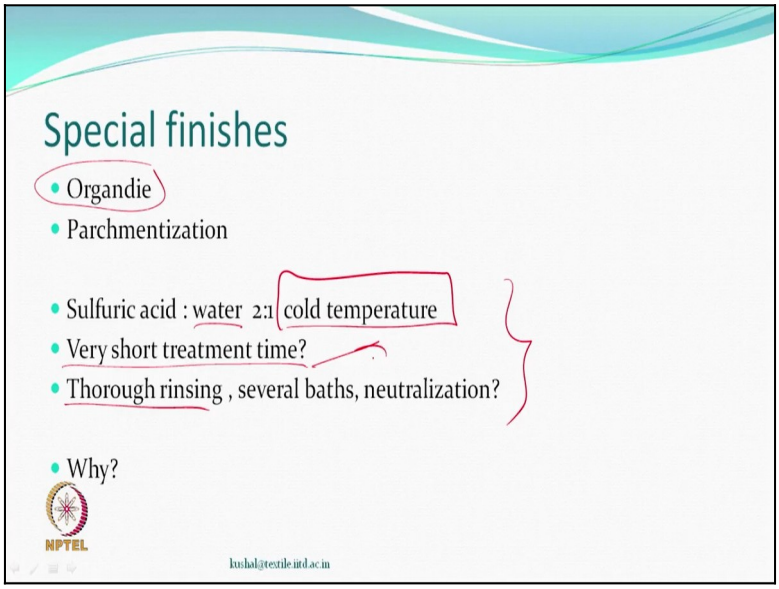
And, in normal usage, you may probably require, very, very less amount of, these type of agents. But, if you are looking at applications, which are different applications, then you may use, more amount of thing. Then, this resin to hardener ratio, will depend, will decide, the stiffness. As we said before, that the Aliphatic versus Aromatic components, the ratio of these, can also change, the hardness. Similarly, here also, one can use, more, or less, or no hardener, can also change the stiffness.

(Refer Slide Time: 41:16)

Then, there are other materials, polymeric material, which are Thermoplastics. Thermoplastic means, they change their shape, with heat. You apply heat, if they were in a creased form, you can remove the crease, if they were plain, you can push the crease, and that can remain. So, you can set them, and you can change their position, by reheating. In the previous case, by reheating, could not change, some of these things like, PVC. You must have seen, some time, textiles, on one side, you have a PVC applied. So, if you apply a PVC, you will find, the whole thing becomes stiff.

Of course, it gives, different properties, other than stiffness also. But, these Thermoplastic systems, can be used. They can be used, on the outside, one side, both sides, in between, like Polyethylene, Polypropylene, they can be used, in in different ways, either laminates, or Coatings. So, they can change the stiffness of Fabric, which is interesting enough. But, after you have made them, you can shape them, reshape them, and then again heat, and again, get the new shape, as well, stiffness plus moulding.

(Refer Slide Time: 42:36)



There is one very interesting Stiffening finish, which is very special, to Cotton Fabrics, very fine Cotton Fabrics, they go through this process. And, the name of the finish was, Organdie finish. This Organdie finish, is based on a process called, Parchmentization. So, like you make a parchment paper, which is little stiffer, you do the same thing, similar thing, on a textile, which is otherwise very strong.

But, this is a very interesting process. And, it is a very delicate process. And, it is very, very critical, that you control the parameters, very nicely. Otherwise, things can be very dicey. And, what do we do? We do, Sulphuric acid treatment. You know, in this new thing, you have a Sulphuric acid. If you remember, 75% weight by weight Sulphuric acid aqueous, can dissolve, Cotton. Right. So, you are taking something like 2:1, which we inverse 66% or so, so it would not dissolve, the Cotton, by itself. But, it is concentrated enough, to do a lot of damage. Right.

So, one important thing is, it is concentrated, quite concentrated. Temperature should be low, as low as possible. Room temperature is high. You can go for, little lower temperatures, if possible. You treat for a very short time. And, we will talk about very short time, you are talking about something like, seconds, you know, 4 to 5 seconds. That is the kind of treatment, that you give, it is pretty concentrated. And so, we give this treatment, and suddenly, changed beautiful, beautiful things happening.

But, immediately, you must go for a thorough rinsing, maybe several baths, go through them. And then, obviously neutralized, by whichever treatment, that alkali you can use to

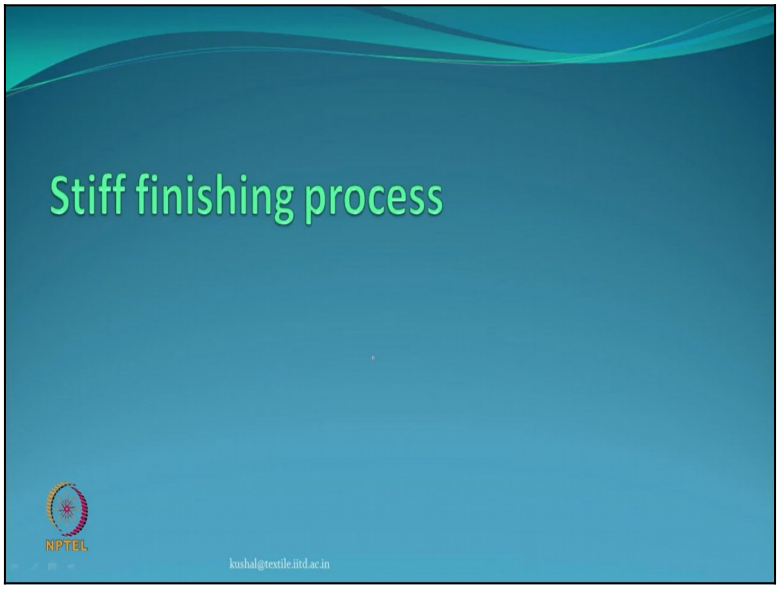
neutralize, so that, no-more acid is left. Because, acid, and cellulose, or Cotton, together, is a dangerous combination. Particularly, when you dry. Because, the concentration, keeps on increasing. And so, the acid becomes concentrated, there is a degradation, happening. So, it is a very interesting process.

What it does? It makes, gives stiffness, definitely, which is relatively, more permanent. And, almost like a translucent effect also, is seen on the Fabrics. And therefore, Organdie, particularly for Sarees, and so on and so forth. Or, even Shirts, people used to like it. But, it is a fine Fabric, twisted Fabric, a twisted Yarn, highly twisted Yarn, not so much twisted, that becomes a crepe, but, it is fine Yarn. Why does this happen? Where would it happen? What do you think, is happen? Sulphuric acid.

So obviously, in the short period, the Sulphuric acid is going to act, on the surface. Okay. If it acts on a surface, then what happens? Some of the cellulose, may dissolve. But is, it does not get a time, to get out, into solution. And, the moment, you put it in the Washing liquor, this so-called Soluble cellulose, which may have broken down, to the relatively smaller molecule, but still very long molecules, immediately coagulate back.

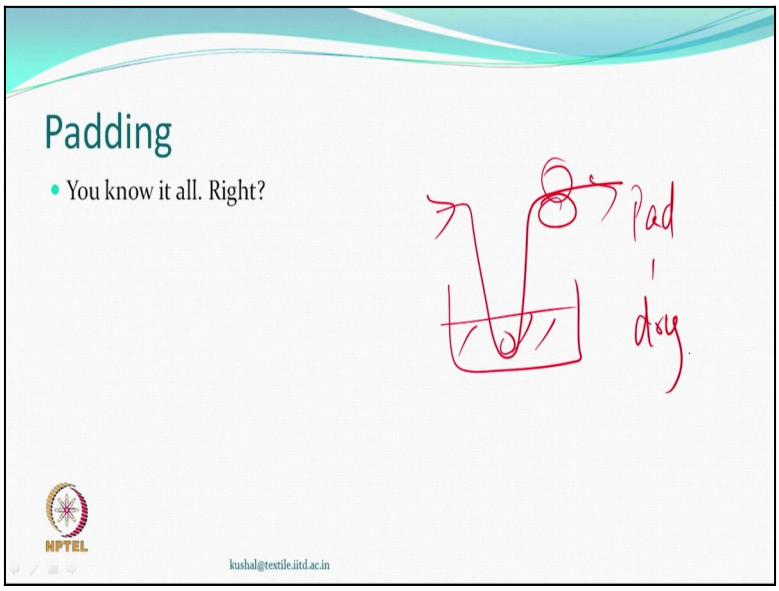
And, if you see this happening, so Cellulose is binding, Cellulose itself. So, we have the solution of a cellulose, may be little jelly. And then, if you can also calender at the same time, which would look quite difficult. But, if you do that, then it will be a very nice, sheet of Cotton coming out, very stiff, translucent, almost permanent. Very interesting. But, of course, if you alter somewhere, in the treatment time, or increase temperatures, you may not see, your Fabric at all.

(Refer Slide Time: 47:24)



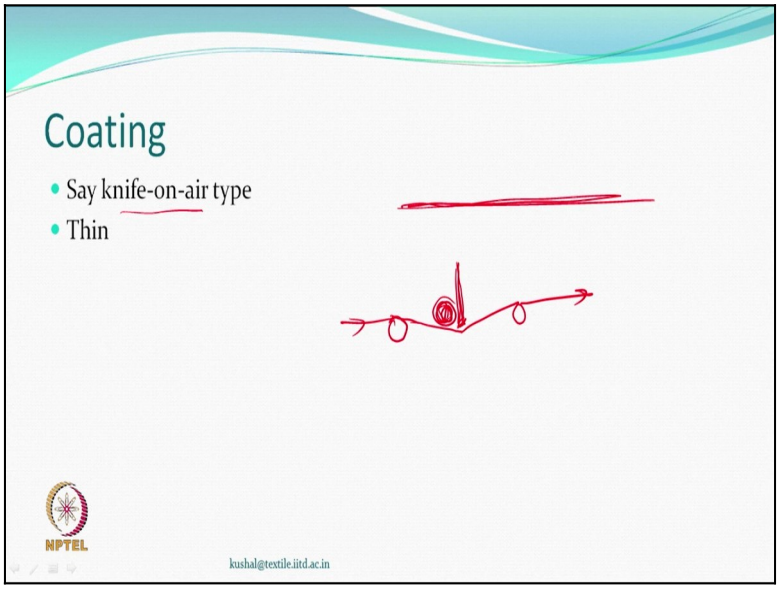
So now, we have some processes, for applying Stiff finishers. So, how do we do?

(Refer Slide Time: 47:32)



Padding. You know, everything about Padding. You take, starch solutions, pad it, dry it, and you are done. So, all temporary finishes, up to drying, can be done. In case, you want to do permanent finish, you will have to go, up to the curing. Right.

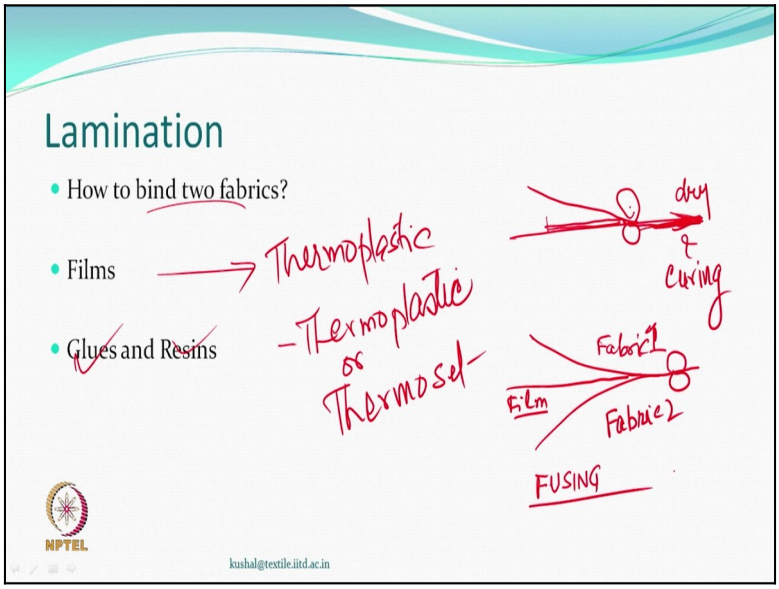
(Refer Slide Time: 48:08)



Coating. Coating means, this is the textile, and something on top has come. So, the coating means Padding means, everything goes inside, from both sides, in the interstices, between the Fiber, between the Yarn, and then it dries up, or gets cross-linked. But, in the case of Coating, only on one side. If you have, a knife-on-air type of situation, which means basically, a knife, the Fabric, touches this, and goes. And here, you have a solution of the polymer, which you want to coat.

And, after Coating, you here, knife on air, because it, the knife touches. So, after the Fabric, there is air. That is the way, the terminology is there. So, very thin Coating can be obtained. And, based on the, viscosity, that means, the how much solids were there, the amount of such material applied, could be very small, and so, you can control the stiffness, in this way. And, of course, the Chemistry, if it is required.

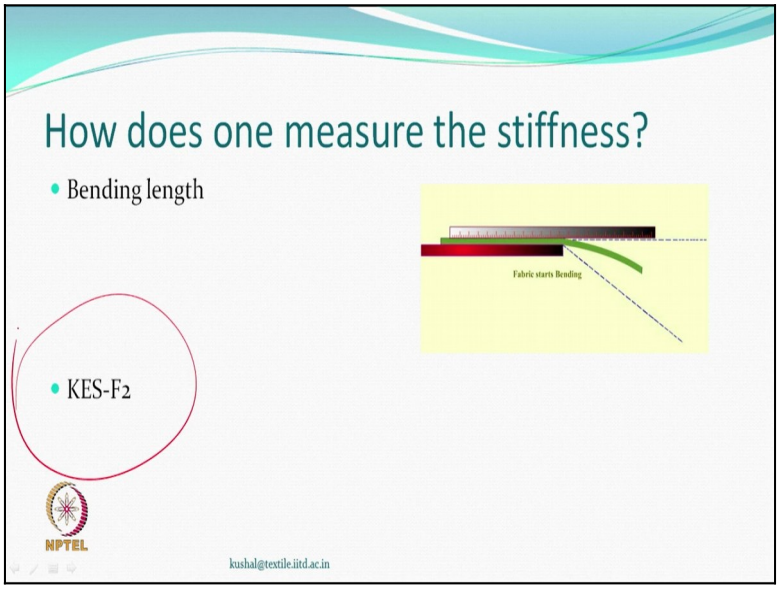
(Refer Slide Time: 49:47)



Lamination. The example of the, 3 papers, that I showed you, was a kind of a Lamination. So, what you are looking at is, you bind the two Fabrics. Okay. And, how do you bind the Fabrics. So, you can use Films, which could be, let us say, Thermoplastic films. Or, Resins, which are Thermoplastic, or otherwise, or Thermoset. And so, what you do? You coat, Fabric,1 Fabric goes like this. Then, you coat. And, the second Fabric, meets. You have a nip. So, there is binding happening, if you do, drying and curing, whatever is suitable.

So, Glues, Resins, could be used, or you can use Film. 1 Fabric, comes like this. Fabric-1, the Fabric-2, and in between, if there is a Film, let us say, this Film is taken like this, and heated, in a Hot Calendering system, fusing takes place. So, if 2 layers, the Fabric get fused, so binding occurs. And, this is called, Lamination. And, you can get, a very stiff material. If you have, more than one layer, it can become, much more stiffer. And so, Thermoplastic, or Thermoset, whatever you use, you can do effective Lamination. Well. We know, how to measure, Stiffness?

(Refer Slide Time: 52:40)



So, there is bending length, you had learned, before also. So, the same thing, can be used, to measure the stiffness. So, what will happen, if the Fabric becomes stiff? What will happen, to the bending length? What will happen, if the bending length at the Fabric becomes stiff? It will, increase. So, there are other, Kawabata based instruments, which are called, KES-F_2, can also be used, to measure the stiffness of the Fabrics, which you can read yourself, or maybe, you have already read, in your, Textile testing and characterization.

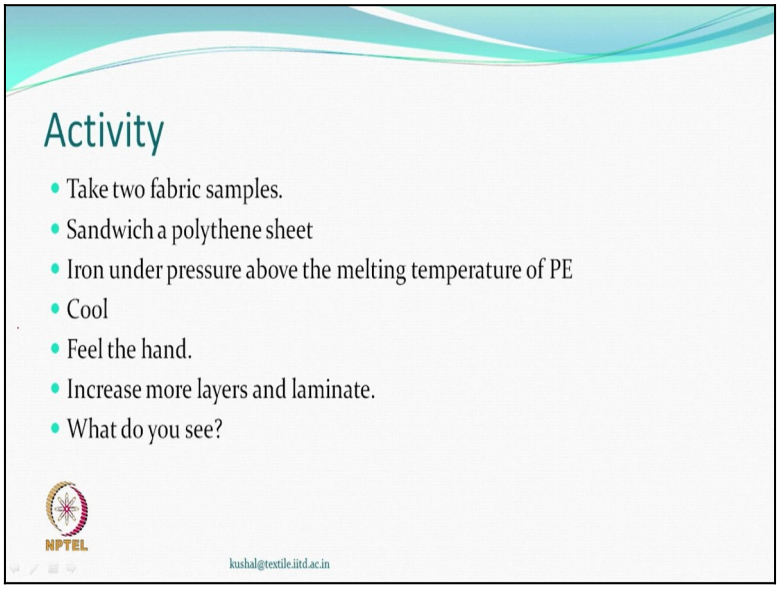
(Refer Slide Time: 53:20)

So, what do we do? Where do we use them? One is the, Aesthetics. Like I said, saris can be made, temporarily or permanently stiffer. Some people like, stiff Fabrics. And therefore, you like them. Cotton shirts. You want to wear Cotton, and you want stiff. So, this is the way. So, this is the aesthetic aspects of it. Then, the collars and cuffs, probably need a little stiffness. And so, you may use them, at that places.

Decorative products, that you want to make of textiles, which can have a shape of, one type or the other, let us say, Lampshades, and so on so forth. People may like to have, stiff material. So, it does not become limpy, as it is being used. Wall coverings, we do not require, flexibility so much, can absorb sound, can do good decoration, and feel, they can use them.

Embossed products, where, the shape of the embossed, design, impression, also you want to make it permanent, so you can have, relatively crosslinking based resins, which can give permanency also, whether you coat it on one side, or you make a laminate, and then emboss, does not matter, it will take the shape, that you want, desired shape. So, you have some application, which are interesting.

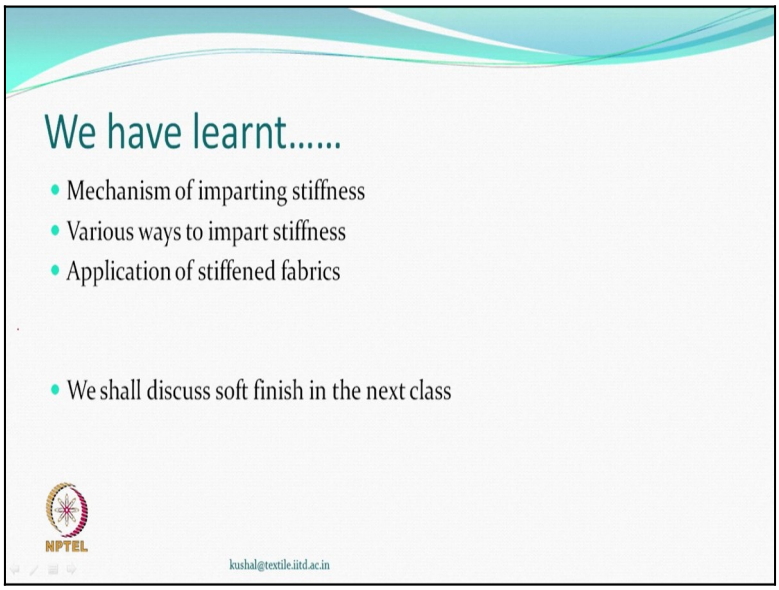
(Refer Slide Time: 54:46)



So, why do not you, actually do something, at your own end. Take two Fabrics, put a polythene sheet in between, take a good hot iron, give them enough time and temperature, so that, the polythene, which is a low melting point, actually fuses, if it is a Cotton Fabric. So, you will see, bonding happens. You can go and check, its stiffness. You can also have, more layers, and then see, what happens, as the thickness increases, what happens.

Check it, yourselves, and feel it. Now, permanency, washability, durability, etcetera, would depend on, how nice the fusing has taken place. This is an example of, Lamination. Otherwise, you know, take Starch solution, pad in your Fabric through this, stretch and dry, you will get stiff material. So, what have we done, today?

(Refer Slide Time: 55:48)



We have spent some time on, looking at mechanisms, how stiffness can be important. We understand, if you can just modify surfaces, big surface bonds, things can change, to your advantage, in some sense, increasing the Friction, between the two surfaces, Fiber to Fiber, yarn to Yarn, Fabric to Fabric, temporarily or permanently. So, methods we have seen, some chemicals, which we have talked about.

But, these are not only chemicals, theoretically, it is so simple, you can add any polymer, it will make things stiff, if you like both things. Well, after this, next time, when we meet, we will talk about, Softening treatment. How to make, the Fabric softer, which is obviously opposite to, what we talked about, called the, Stiffness. All the best, thank you.