Module 25 - Lecture 11

Transfer Printing Machines & Other Transfer Methods (Autosaved)

So, in the transfer printing processes, we'll be taking this as a last lecture, this topic, we will try to wind up today.

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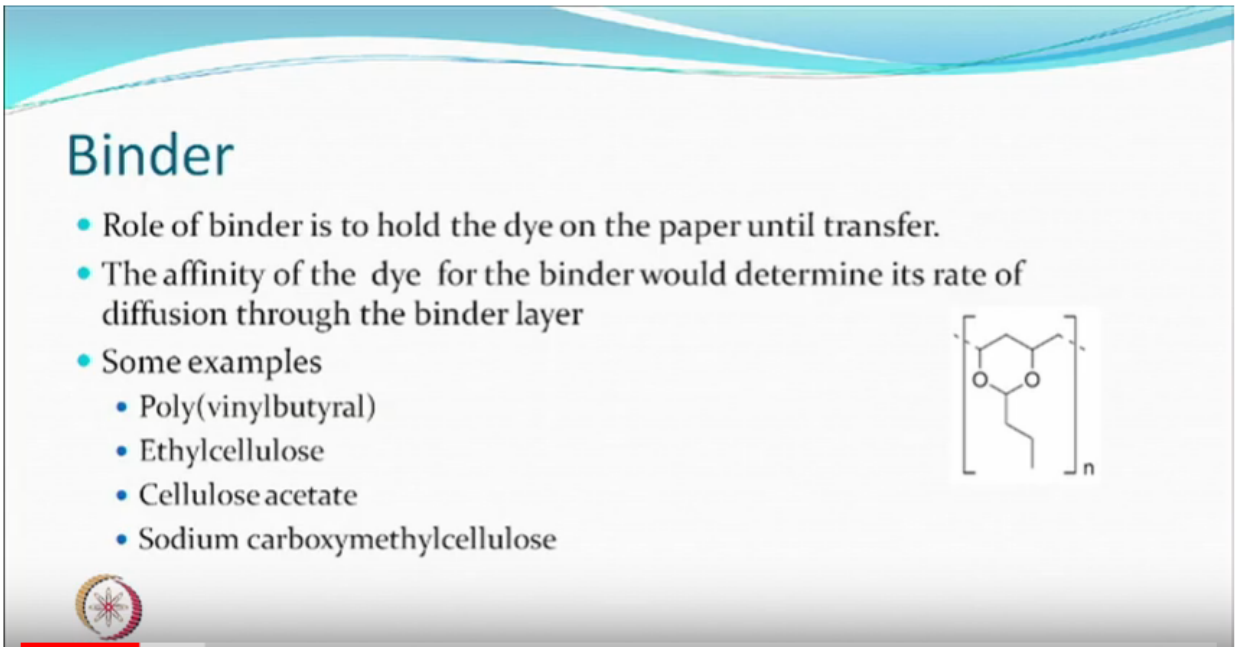

Before this, let's see what we had done and we had understood, in the last time how the dye gets transferred, from paper to the fabric and what is the mean free path. So, in the transfer you have the diffusion of ink from, layer to the vapor the diffusion, of the vapor between the air gap and absorption, at the fiber surface and then diffusion. So, these are the things which take place which are obviously, governed by the approximately, the ideal gas laws. So, on the paper, we have talked about what kind of paper, we have also talked about the type of dyes that we may need so, the binder also has some, role to play and the role obviously, is that till the dye is transferred, it should hold the dye, on the paper, in the design, in the specified area. So, it is also expected, that this particular type of a binder, would not have affinity for the dye and if it has no affinity for the dye, then the diffusion through, the layer, would also take place, in a faster way and much less will be retained, in the layer the polymer layer, which we have because our aim is only till the time, it has been, used for transfer but this time probably is longer than, let’s say in conventional printing, when we have, a binder or we have a paste, which has to be dried and, and fixing takes place, in this case this paper may be stored for a longer period, before somebody uses it but this binding is relatively, simple binding you're not really expecting, any cross-linking to take place it's just that there is a layer and unlike pigment printing where you had to wash your fabrics where the binder had a role of increasing, the wash fastness here, something like that is obviously not expected. So, in such as such it is a simple process, but still you need to bind, it and obviously it should not have much affinity, some of the examples, which we see here written as a poly vinyl boot Idol which has a structure of something like this, which is a polymer. So, you can make a polymer layer, other things, which you're quite familiar it I'll sell Lowe's or cellulose acetate and carboxymethlcellulose all of them can be used. And so, we hope that, transfer will take place, but the question sometimes, come how much of a binder and how much of a dye, I mean if the ratio, of binder and the dye changes, then obviously the film layer, become thick if the binder is more, that means if you have lighter shades versus darker shades. So, the percentage transfer or transfer efficiency can change, you may like to have such type of binders, which would be relatively more, independent of the this concentration, of a color ink in the binder, which may not happen always, would you like something to happen.

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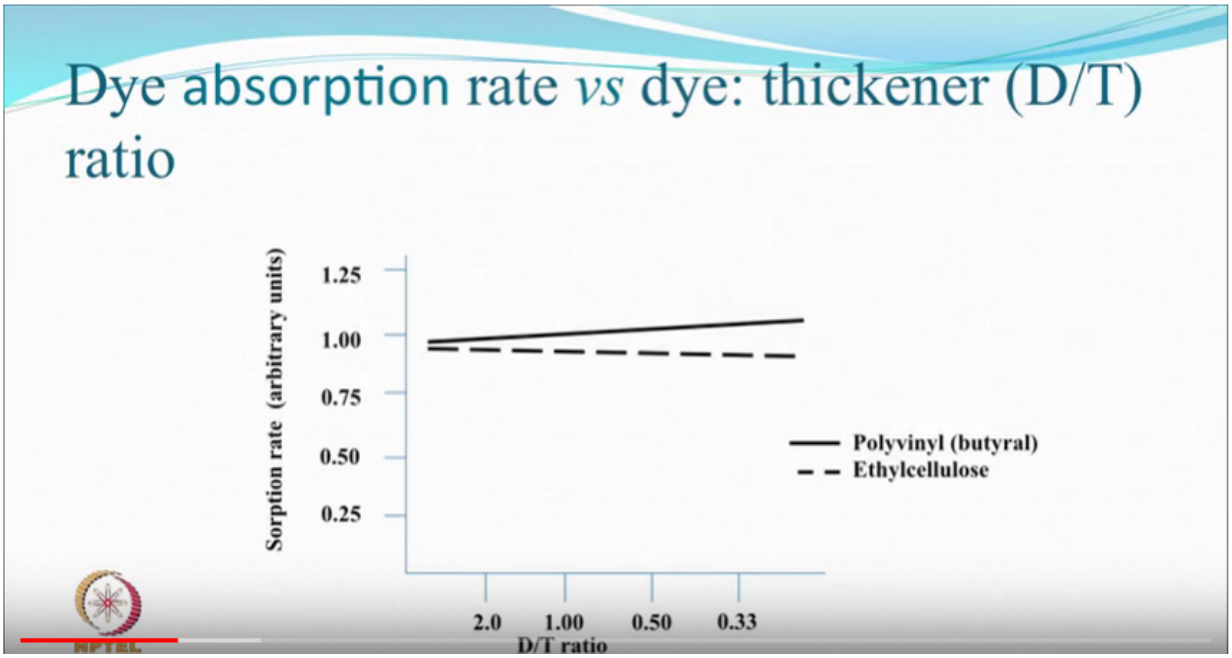

Between these thing one reported study, says the dye absorption rate, versus the dye and thickener ratio, that means how much is thickener, which is basically this minder, which actually drives on the thing, that these four we're talking about and they die, if you see on the x-axis that you have, die taken a ratio, where in the first is 2 is to 1 and goes up to 1 is to 3 and so, what you generally see is at least, from the look of it, these two types of binders are relatively more, inert to this ratio, the change is not very high. So, when you do a print, which may have different shades where the dye may be very low or very high, you will still have the transfer, I mean if the transfer rate, is same then this can happen, if the transfer rate becomes very different, then the time of transfer you are keeping fixed, 30seconds or whatever, then the expected, tones, which are supposed to be on the paper may not get transferred exactly in the same manner, the way you would have expected it, because the rate of transfer may be different and therefore the time required for a complete transfer, will be different. And so, things can change so, it would be nice that if you have binders, which generally are so, inert to the dye they have no direction and the film is also relatively more amorphous rather, than compact fill.

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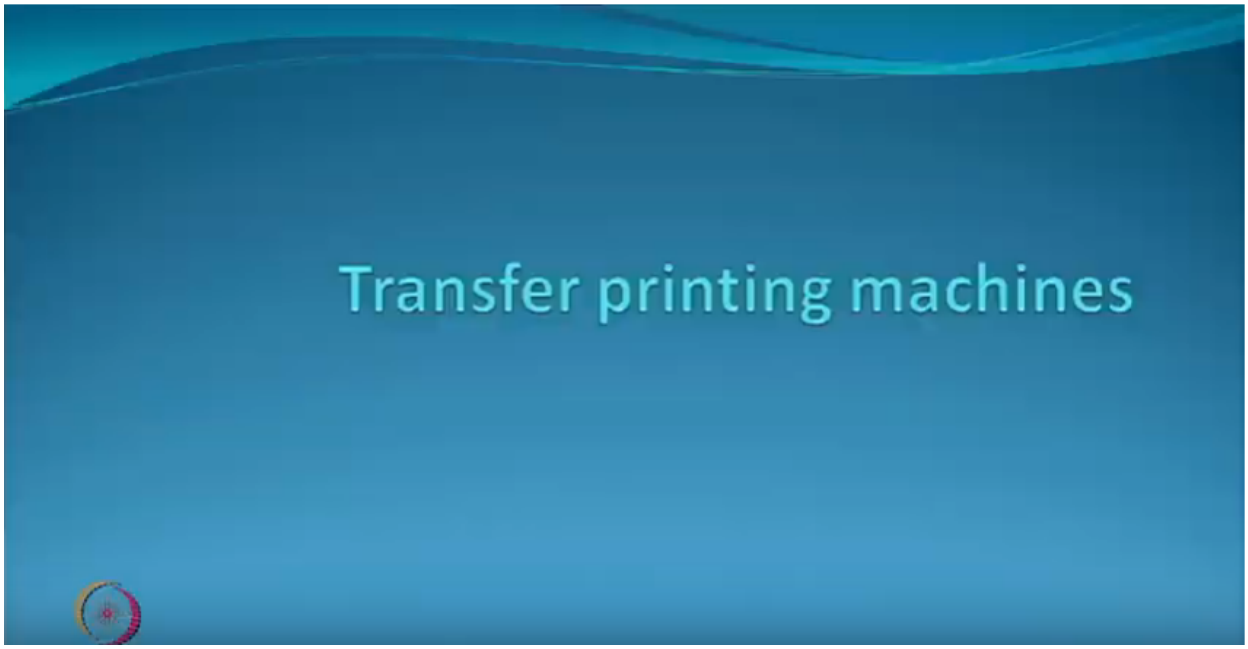

The machines, for the transfer printing are very simple machines, the only thing that you are required is, that there should be a plain surface, where you can put your fabric and the paper and you should be able to apply some pressure and heat, these are the only thing that are required and therefore in some cases the speeds can be also very high, in continuous machine, which speed you can never think, of whenever you do a commercial printing, which is quite interesting.

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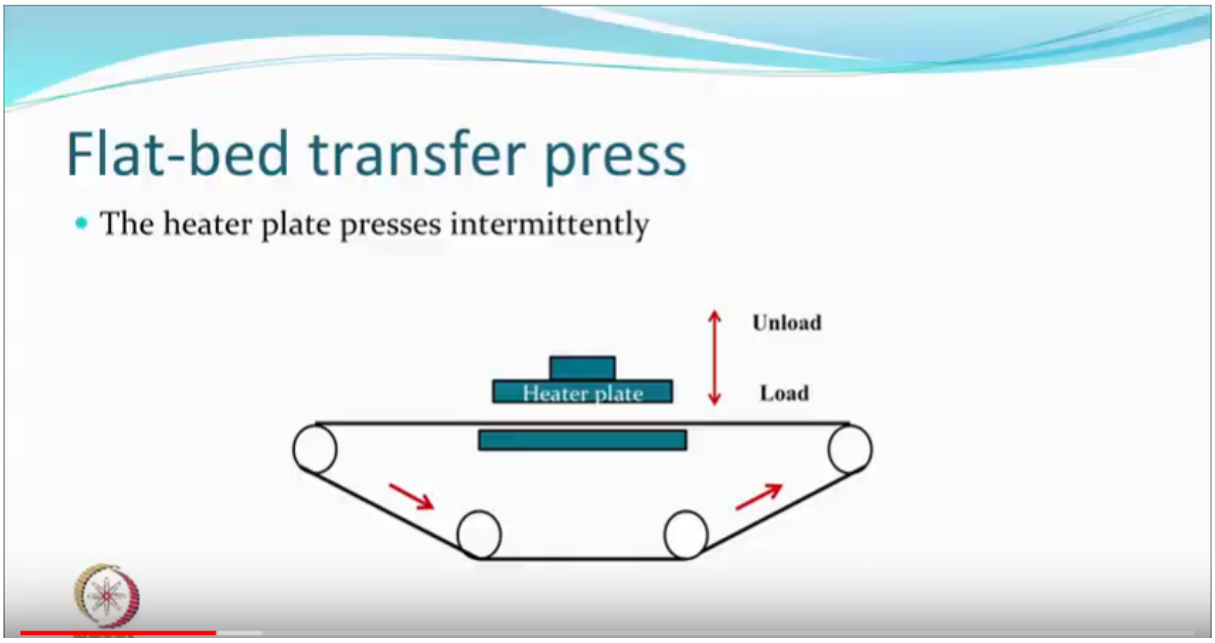

So, you can have something like a flatbed transfer press, which may be for garments, these Goods and because if you have, this type of arrangement where the pressure is applied intermittently so, you cannot obviously, have continuous flow. So, peace goods are there because transfer printing, also used for garments and peace goods, the sums of type of machines can be simple or sometimes, people only use your own iron and then put the design, wherever you want and then you can also get. So, this simple, way of looking at, but of course when you have a machine and some automation, you will have better control of temperature, which is obviously required now you know that, if temperature difference is there things can be very different and uniform pressure applied on the whole surface, that's an important part, if that can be done the life could be easy, simple process of a flatbed type.

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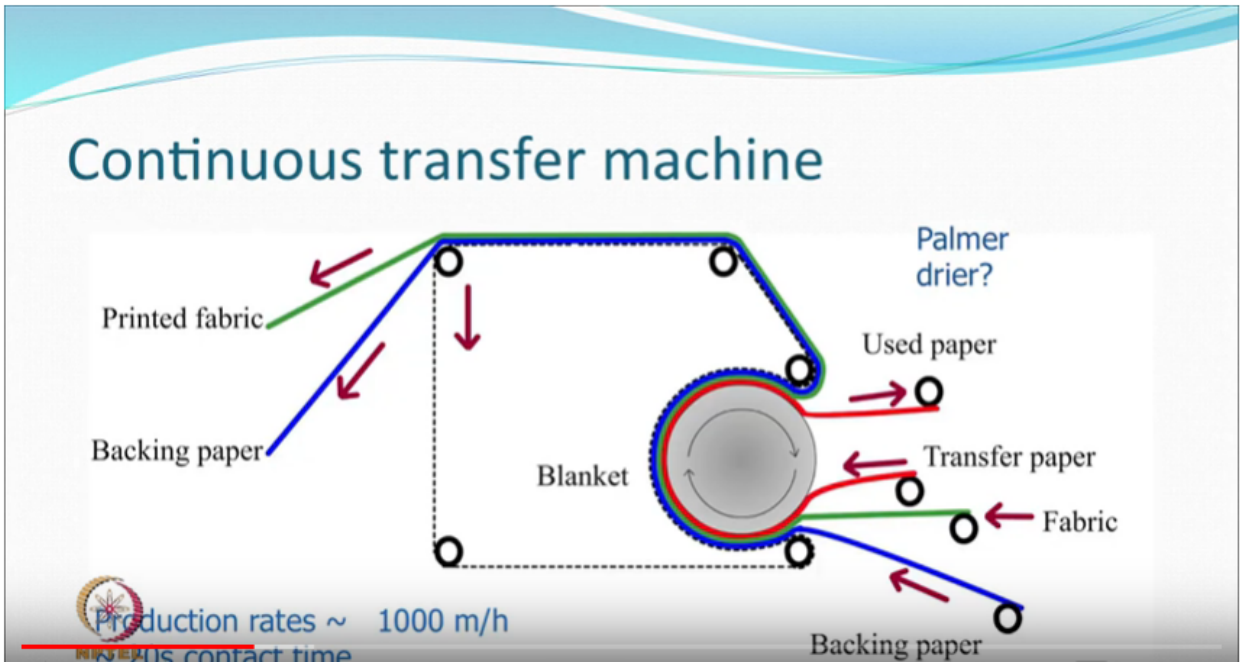

If you look at a continuous type, this print roller, which is a large roller, it looks like a familiar kind of a sight, a roller printing machine, also looks like this, but overall, this configuration is quite similar to a palmer dryer, where there is, material entering from one side and exiting from the other side and the roller is quite big and so, all the process gets completed, should get completed ,if you want to give 30 seconds or more it should be possible, to complete the process within this area. So, you have a blanket, you have a paper and you have the fabric, entering from one side, getting or to the other side, at a contact time of 20 seconds, some of these things based on the type of fabric and the type of design, you may be able to achieve, very high production rates, which you will never ever think of any other process, that you can think because you are at a higher temperature, transfer is in a vapor form and it's clean process. So, this advantage nobody can say, that doesn't exist in case this itself is the thing and if you have the same design, in the same paper and everything, is there you may just be able to make money, on standard designs, like if you have checks and dots and little small things, which are popular, then you can keep doing this at a faster rate.

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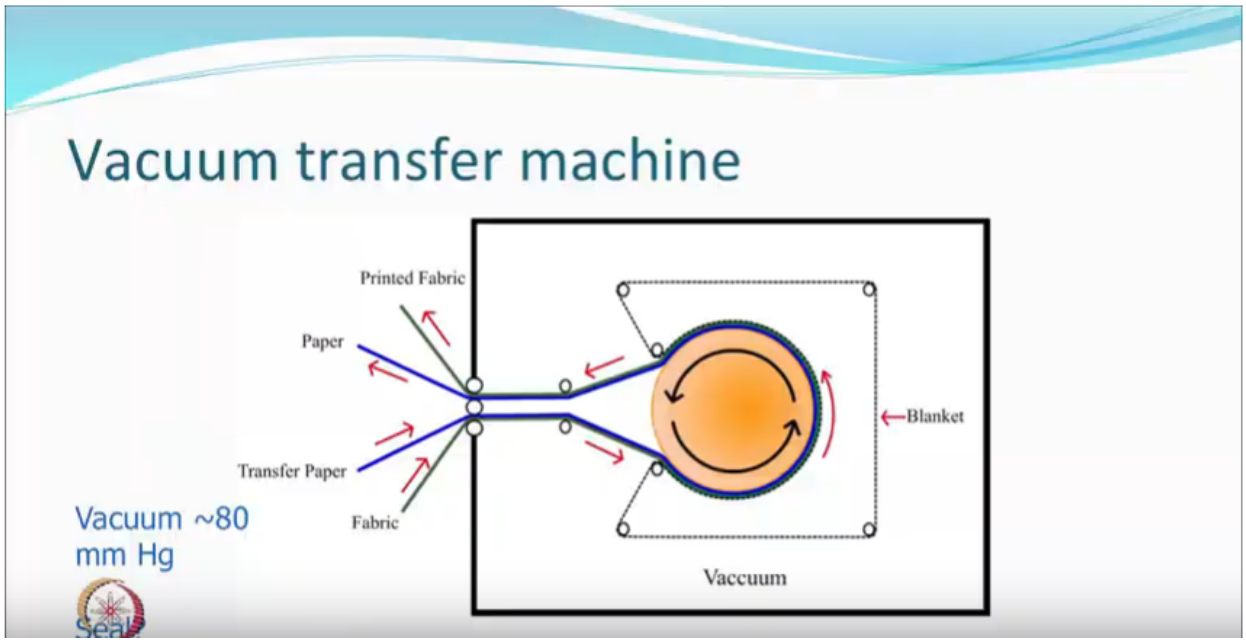

Sometimes if the fabric is thick the gsmis high, then you may, require some vacuum. So, that the dye, is facilitated to move in the direction of the fabric, sometimes not this machine but a flatbed machine could, be used also for carpet printing, where you may have to use vacuum, to ensure that the dye vapor go, in the direction in which they expect it to go. So, two things obviously these machines are doing is, reducing the air gap and of course maintaining temperatures, air one important thing, is that you keep some kind, of vacuum and you go to provide a vacuum seal, which means that this area, in the whole chamber, as it moves in and things move in and come out, is relatively more, stable point and there is no gaps. So, this itself is it in some sense, is a little more complex, technology because if something is entering and if you pressure, to put too much pressure, then also you have a problem of either paper, tearing or the fabric getting compressed. But if you don't do that, then you can't maintain vacuum. So, in there will be very few continuous processes, you may have seen, where the process is happening under vacuum, mostly, it is all atmospheric pressure, all continuous processes are atmospheric pressure, but doing anything, under vacuum obviously requires, special scenes, from where the fabric can enter and come out without, additional tearing pressure or torture to the fabric.

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So, that's what we had learnt about, sublimation transfer, which obviously is the most popular and in India, also there are smaller companies, not so big companies, who are making paper, transfer paper, in and around Delhi and other places as well and they're able to sustain their business and but we realized obviously, in this polyester and dispersed dye all other methods, have been fascinating or big challenges, actually to, to anybody, who's the technologist these are big challenges, which somebody would like to take and some people have taken it as a challenge. So, what it means is that fabrics, which are not thermoplastics, we do not respond to dry, heat and are hydrophilic to begin, with the dispersed dye obviously, cannot be used, but people have tried this wet transfer the only, thing one should appreciate in this is then when you dry in transfer and if you want to in a wet state the stability, of the paper and therefore the interface, of the paper and the fabric surface, may not be so, steady in case it is not, so, steady then there can be problem, in a dry heat paper is quite stable, the fabric anyway keeps working. And so, there are no apparent shift between, the two and if that happens in any case, then obviously print quality you're going to go down, that is one and of course there is a challenge, of finding such type of dyes and transfer systems, which do quick transfer, because this will not be very high temperature, it's not a very high temperature obviously rate of transfer, will be different and so, you may require more time sometimes. And then stability of the paper sometimes, can be an issue and so, theoretically speaking, this technology although, a lot of people have tried, has not become commercially very successful, textile wool, I mean it has-been tried on cotton also, has been tried on wool and some of the work, in fact some of the commercialized work, is white can look into.

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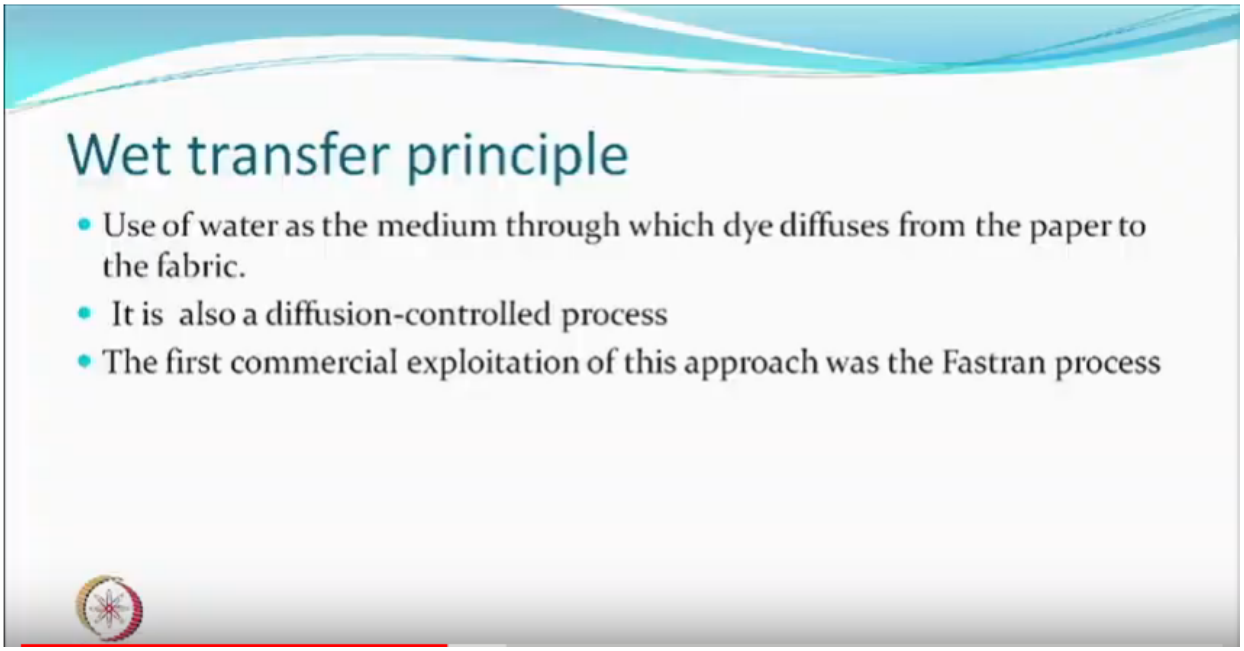

So, the principle basically remains the same, but the medium is no water, because, you are now talking, about hydrophilic material, which is the fabric and so, you have similar mechanism, as you looking at any other printing mechanism. So, diffusion control process and one of the processes, which was commercialized was called the,' Fast Tran Process'.

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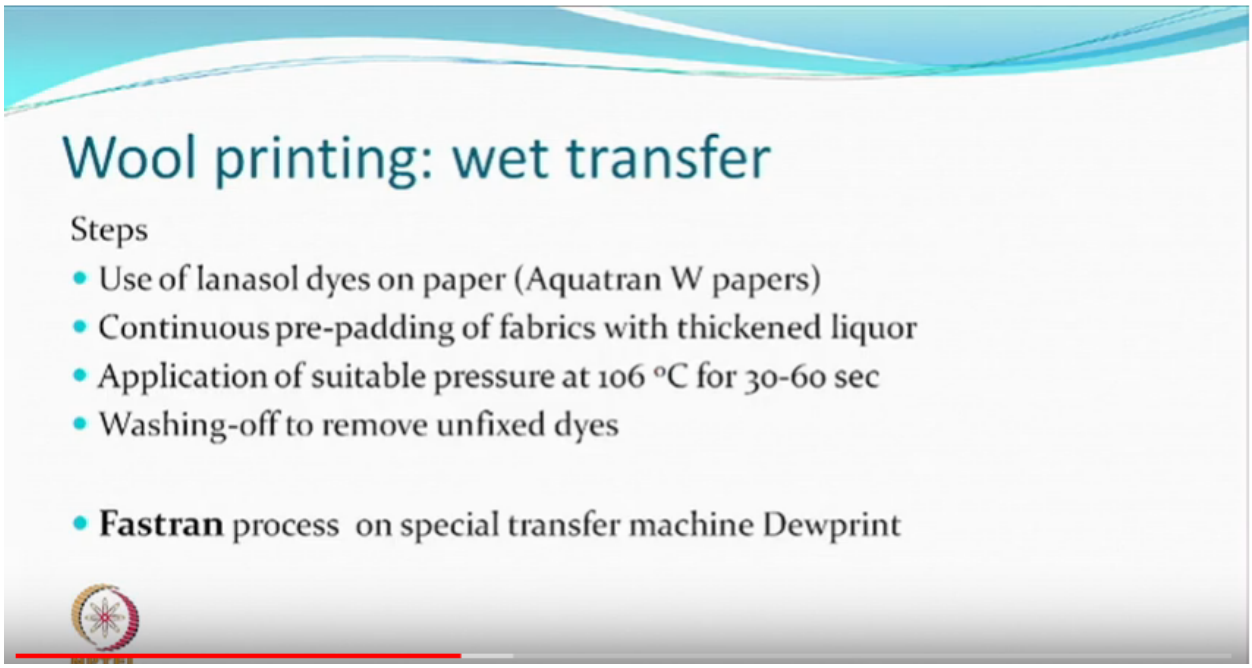

Steps of this particular fast ran process, they used first lanaSol reactive, dyes and the paper that were printed were called the', Aquatran W Paper', with a commercial one important thing, is that because sometimes, they will be coming in contact, with water. So, some putting etc was required. So, lanaSol is all dies, on paper, the fabric obviously, had to be prep added. So, there is liquor, some viscosity is increased, it is not very low viscosity but still, is a quite low viscosity and you this particular method, did the transfer, above 100 degree centigrade, which means a bit of a steam is get generating, 30 to 60 seconds and then washing off to remove the unfix type. So, any paper at 106 degrees, for whatever little time that you have in moist condition, can have an issue, of crumpling uneven shrinkage and so on. So, forth that problem, of course was there so, they worked on very systems and they also, tried to make, transfer machine specifically for wet transfer and the machine, was marketed as Dewprint. So, basically this condensation will take place and think that so, this is the way they marketed, this machine and the important feature of that machine.

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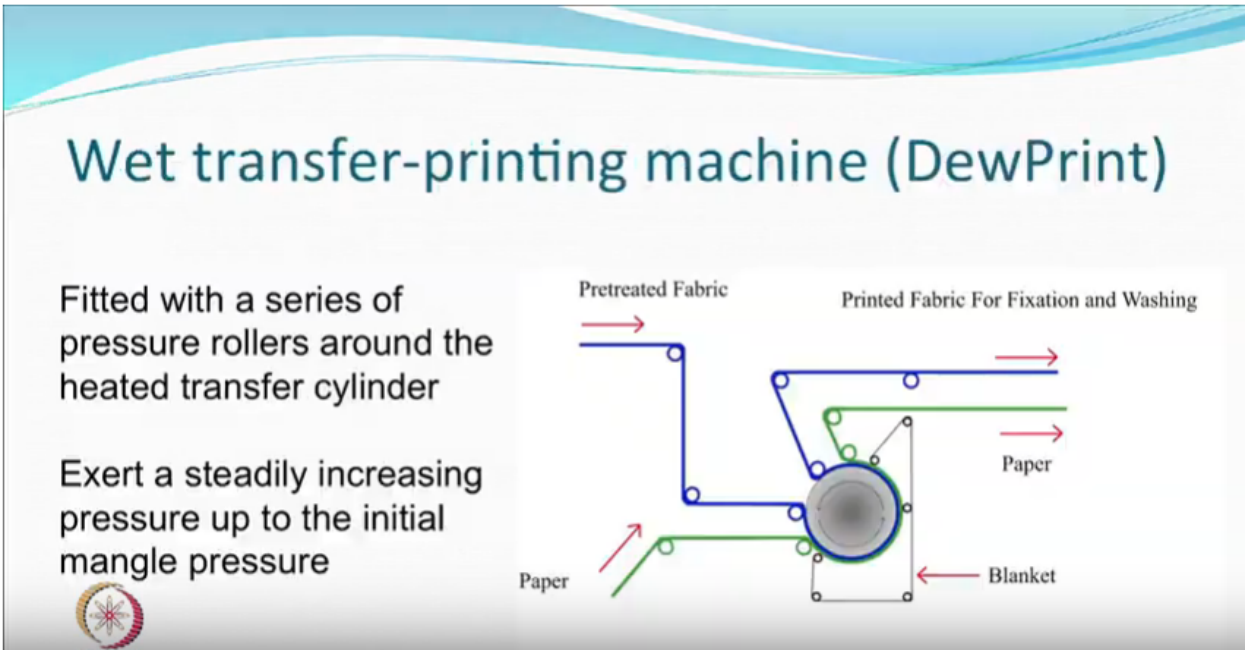

Is a set of rollers, see it is the same kind of a roller, which was being used for a continuous transfer of heat transfer, but then you had blankets, but instead of that this has series of rollers series of rollers, everywhere which we are applying pressure and this pressure, was also continuously increasing from entry, of the fabric to the exit of the fabric so, therefore the special machine. Right? So, exerting a steadily, increasing pressure, up to this stage, which was equal to the pressure of a padding Mangle, because there is a pre treated fabric. So, whatever you wanted to add to the fabric, you do a padding treatment so, you apply some pressure and get some expression. So, in the beginning the pressure, is less when the transfer is taking place and the pressure, increases as this fabric goes from this side to this side before exiting, just making sure that the initial pressure, not exceeded, that's all but hopefully you would have, transferred all the dye. So, this machine was special till that time, this machine was brought into the market, where transfer was not very nice and the people who actually, became more interested ultimately were the wool people. So, you have a good Research Institute, in Australia and of course, an ice work being done, in UK on wool. So, they were obviously quite interested, in doing this wet transfer printing of wool. So, there everybody was in a way fascinated, with that there are some branding. So, you wanted to have wool, being printed wool in any case is relatively much more a rougher surface, compared to any surface, but it was an attractive process. So, people wanted to work around. Right? Initially the material, when as goes the you allow, some water to get heated, some steam to get generated and then because, the concentration, of the dye on the paper is high. So, you expect the transfer will start taking place, by the time it goes the did I may have partly, gone and so you want more and more to go as, if you are squeezing the dye, in and holding the paper all along, also so, that there is no slip, that is one. So, at the end and not more than Mangle means, that you don't really if I suppose 100% expression is there, the transfer you want only of the liquid and you are not so, much interested in transfer of the water if, the water if you put more pressure, the water and the dye can also come out of the, fiber in Reverse squeezed mode. So, you don't want the pressure to be higher, than that this treatment, is just I'll give you the next one.

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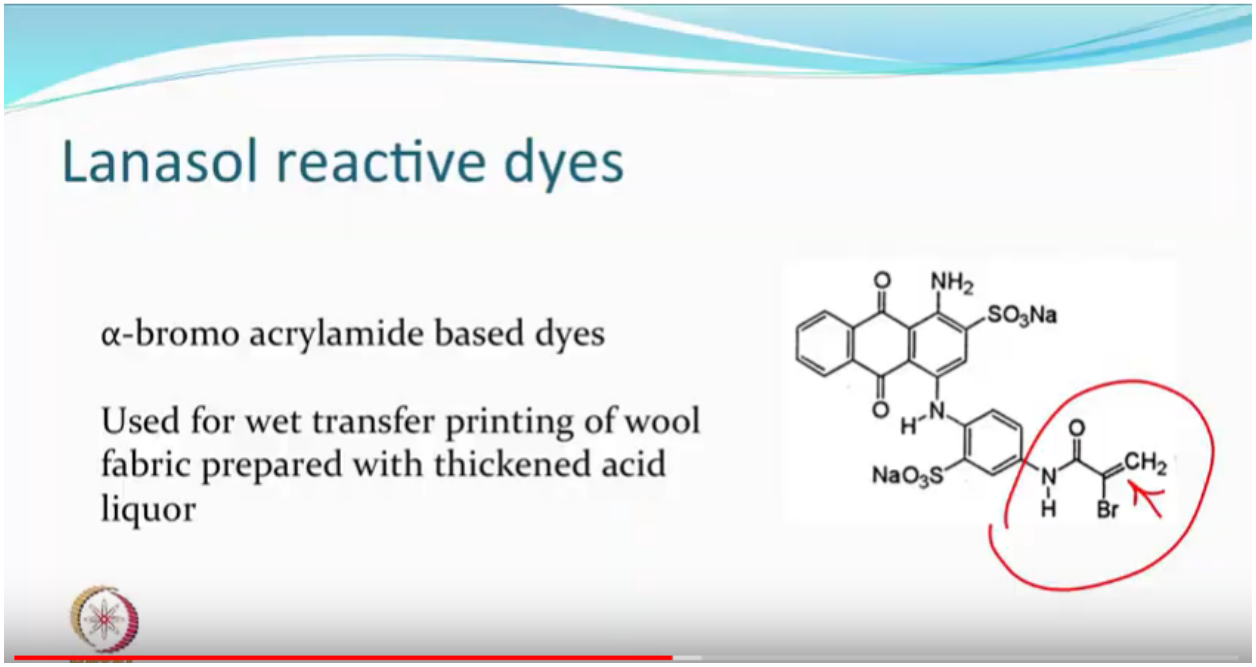

So, this is a reactive dye. So, you have basically an alkali and some viscosity modifier. So, that the spread it doesn't take place. So, much you see like, when you have a tailing effect, in a dyeing padding system, you add sodium alginate and some such high molecular weight compounds. So, that the tailing is reduced so, here also a bit of a viscosity modifier, but still it is a padding process and not a paste process and that's the kind of thing, basically Alcala is there because you will like to be fixed. So, would people, like this dye more which is the acrylamide dyes, which have this type of reactive group, which has got, a possibility there's a double bond here. So, there is a possibility that you can react from here there is also a possibility that the bromine can come out and also a reaction can take place and so, the fastness of these, was considered to be better. So, various reactions are possible, with this lanaSol also from the rule point of view, the one process which has been commercialized, was using these dyes so the challenge obviously, was to create all types of shades. So, that you can get all tones so, it means yes, that can happen and therefore they do some coating on the paper, otherwise to make the papers table, a certain coating which will be relatively more hydrophobic. So, that the dry transfer takes place more and doesn't go the other side.

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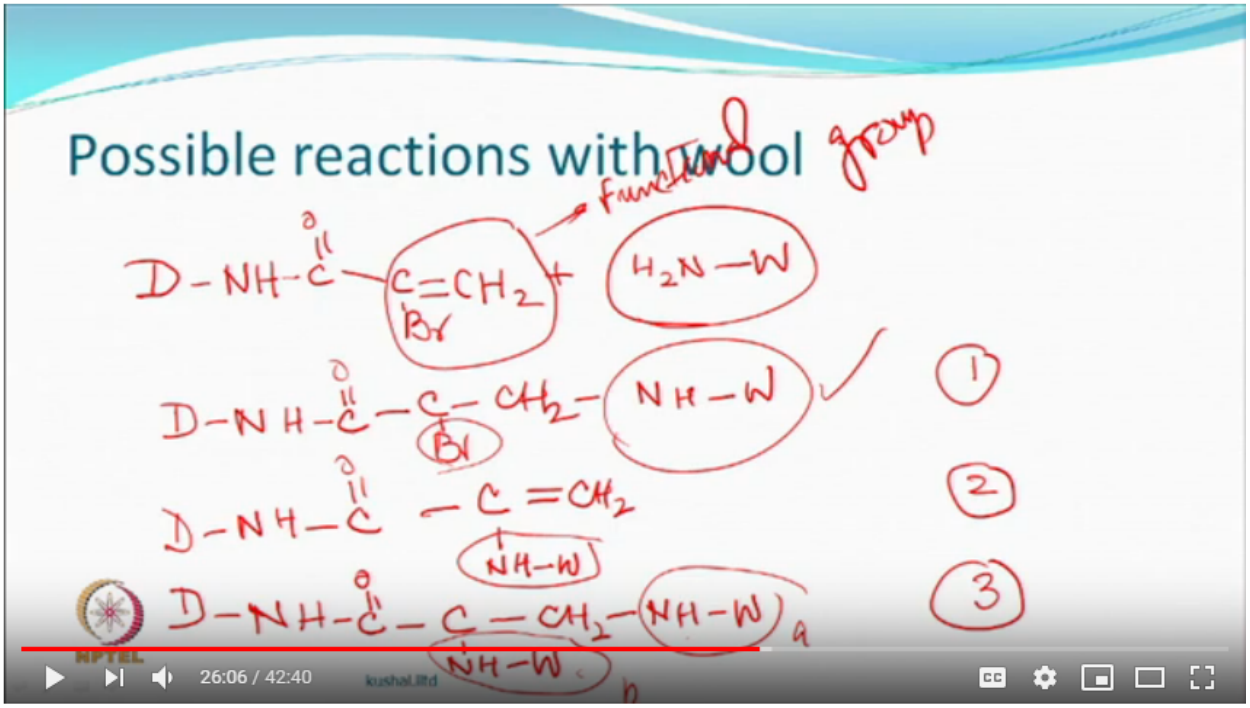

So, from the amino group amino and group of a wool one can expect, various types of possible reactions, one is the addition reaction, where the double bond, gets modified and you get, a link like this which call addition, reaction, then the bromine, can come out also and then double bond remains as it is and the wool gets a test in this manner, here the wool has been a test in this manner, there is also a possibility, of two wool molecules joining, A and B. So, sometimes it is considered, as if it's a bi functional reactive dye, but because the functional group, actually is only one this is the functional group. So, you have the same molecule, reacting with two end groups of the wool. So, two molecules of wool, could be actually reacting probability, is very less because the moment, first one reacts, getting the second one obviously has less opportunity, and the steric hindrances will not help, the second reaction very easily. So, either this or that is possible ,it is and then if double bond has to react then it can react and make, a toxic item a link or happy mean type of a link, which is more relatively more stable, compared to not exactly stable load say, but that reaction also possible but that means that double bond, but double bond can remain as it is it is better that the bromine goes out and from the reaction rather, than stays that way better, because the bromine is attached, to a by a single bond, to a aliphatic carbon and so relatively easy to come, come out. So, wool people were the one who first commercialized, this process and because of them, the dye manufacturers, also worked hard and tried to give many shades, to possible.

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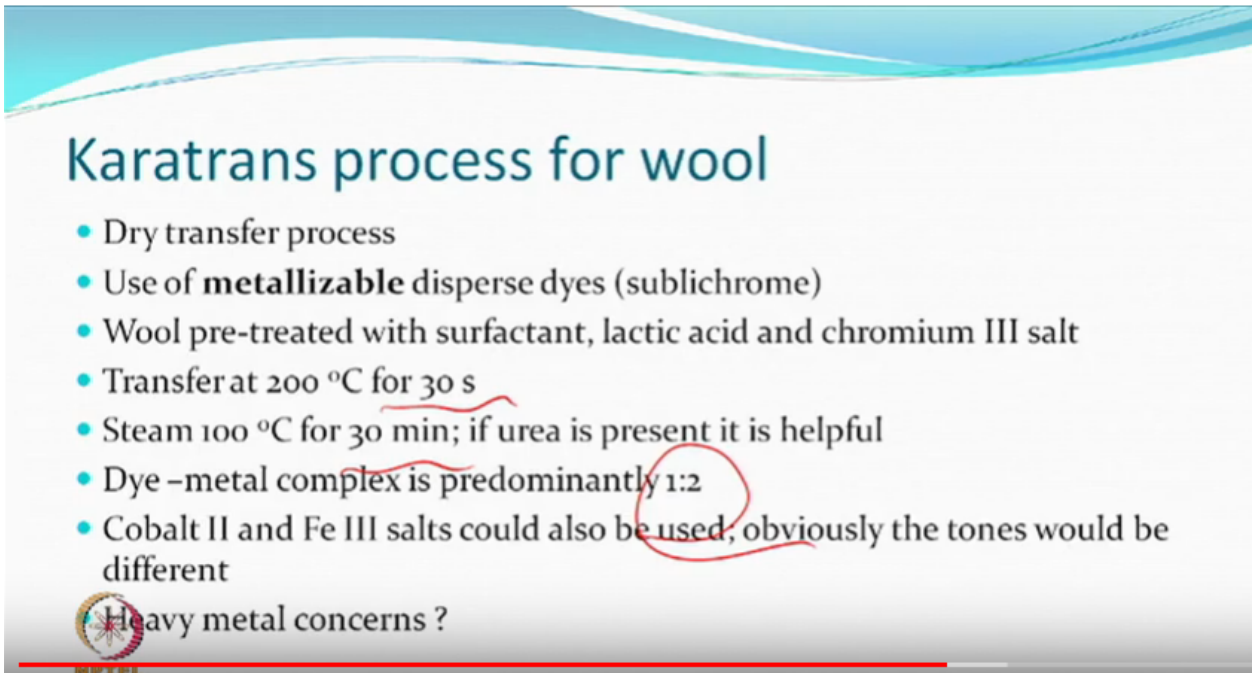

Another process which were called the,' Kara Trance Process', but this strictly speaking, is not a wet transfer, but it does combine, the both processes, in some sense. So, die is sublime able, the dye is sublime able. So, they are using in a way a dry transfer process, but the fabric has something else also. So, what they use that I which is sublime able dyes but they are also, in a way mordant or the one which can be completed, with the metals. So, if something can make a complex with the metal and the metal as are on the moon, for example, then the same dye after transfer can now be combined and so, wash fastness could be high if normal dispersed dye is used and it gets transferred also, because there's no affinity. So, it'll keep coming out without much problem, but in this case, if it is metalized and then it will not come. So, this was one process, which was also commercialized. So, wool is pretreated, with some surfactant, an acidic environment so, you have more positive charge, generally they found lactic acid was the one which was more giving, more positive results and chromium, they used chromium 3, they used some salt on the thing. So, you pre treat the wool with surfactants in this and thing and then you do the normal transfer, normal transfer, at 200 degrees, for 30 seconds or whatever and then further take it for steaming. So, there is a post treatment, which is a long period so, you can appreciate it cannot be the process, which is as fast as the dry transfer. So, after the transfer has taken place, you're still going to speak they look at the comparison, there's a 30 second, versus 30 minutes for fixation, urea may also be available in the pre-eternal material. And then wash it off so, Diane metal complex is formed, which predominantly, is one is two metal complex, one is two one also can form, but one is two do maximum, that they found so, once the metal complex is from the and one is to, to die is one and so, the chances of its getting off, are quite less because of the coordination bonds, that the metal complex is going to make. So, this collision is what happens here people, have tried using cobalt and iron also, for fixation purposes, again we talked about rule only, but the moment you change the metal, the tone of the die finally on the fiber is different because, they are also they once they coordinate, the amount the kind of light that is absorbed and reflected are different and so, you get a different shade. So, different metals I want to give you different

shades, if they are too different then you may not like it and therefore you can appreciate, will be very difficult for somebody to print, a photographic, print on this with this kind of die theoretically possible, but if choice of a metal, ion itself changes the shade, the photograph may be very different. So, but normal textile prints, you would not have any problem invariably color could be any so, light orange versus dark orange is as good as design, is concerned but not the photograph, is very difficult to print, photographic print by weight transfer although, it can be you can take a photograph and print, it but what would look, may not be same because in photographic, true transfer is required. So, this process obviously had some concerns of using heavy metals, but if you are using it for dyeing, then you can use it for printing, otherwise chromium and cobalt, are not very preferred material, although they found the chromium is the one which gives quite true shades, of whatever type, with these dyes metalize able dyes iron gives something else, iron from environment perspective, is acceptable, you know chrome and cobalt obviously not so, much. So, in some sense, it's a combination of a dry transfer completely, dry transfer and some wet systems also. So, modification, but they were able to actually make it a patent and actually, get the process there for some interest, were developed and the maximum interest obviously is in the Australia. So, the wool is concerned.

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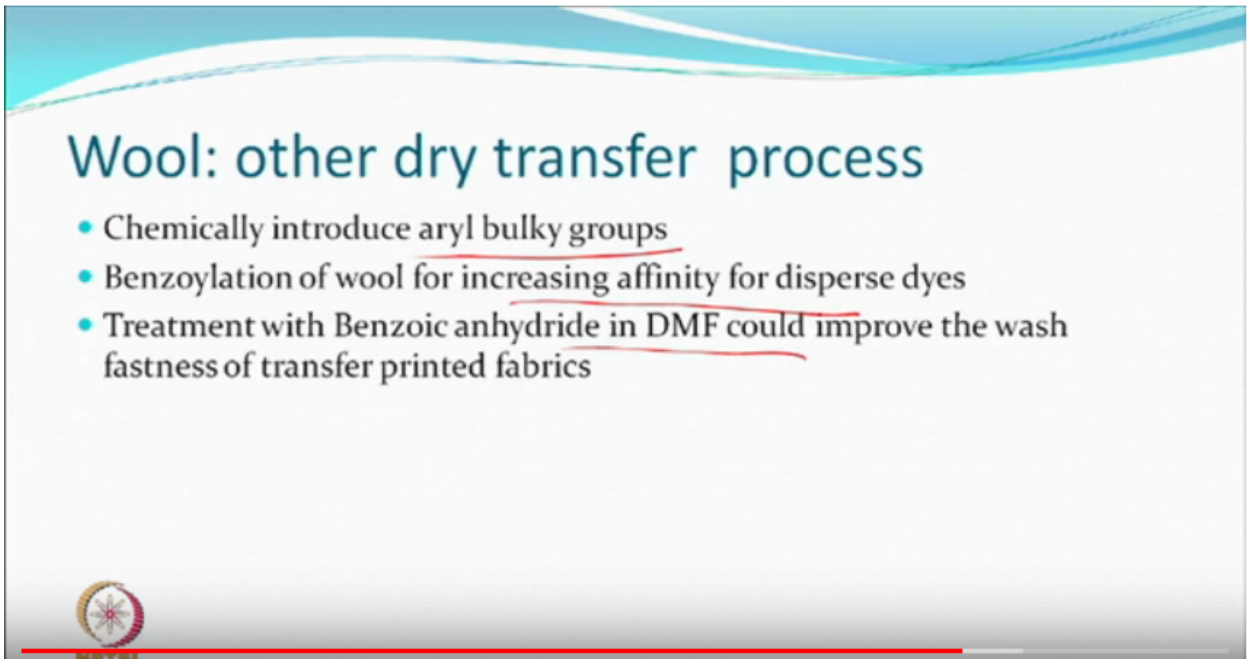

So, wool was important for them. So, they tried other methods also, which we had considered earlier also esterification, etherification of the hydrophilic fiber. So, for rule they tried ventilation so, one is that you have changed the hydrophilic group, to arrive groups. So, making it more hydrophobic so, reception will be more or one of the thing was bends all Asian to increase the affinity, of disperse dyes and one of the processes, used benzoic anhydride instead of benzoic chloride and used through DMF, which they found those giving better no but the important thing is using a, solvent which is not a regular solvent, in a printing industry, was always be a some challenge.

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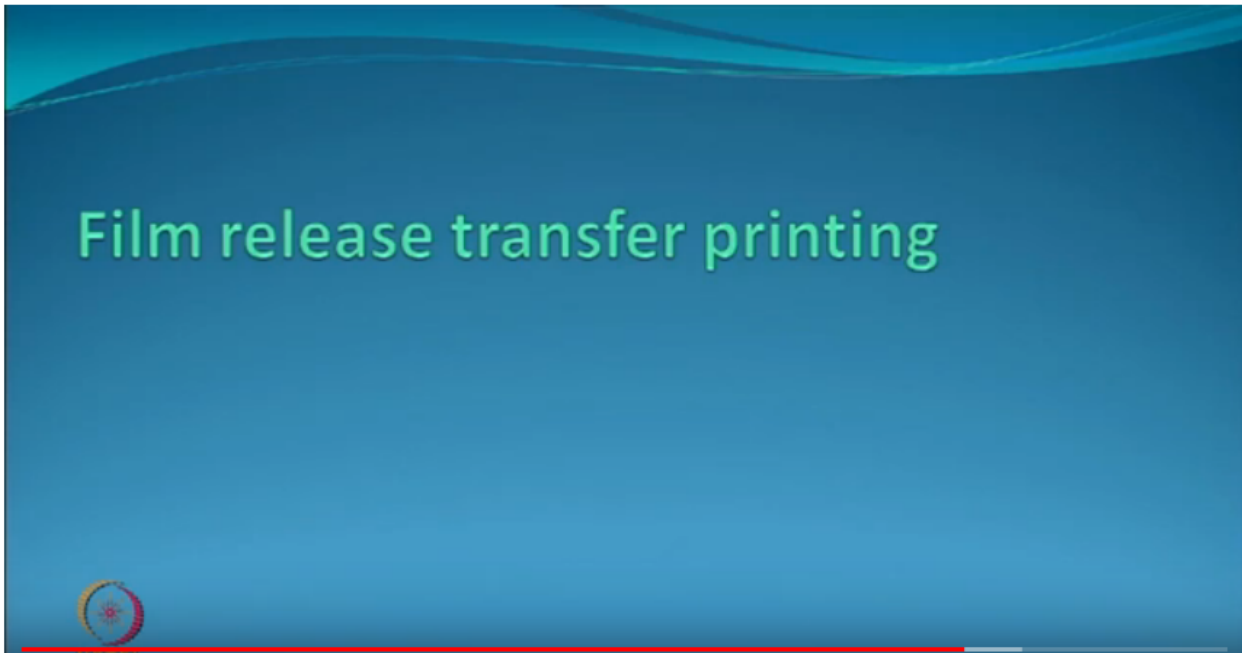

So, little bit one or two points, on the film release transfer printing also, again well release for purposes, other than the textile printing are still being done, at levels which are very high commercial success. But transferring film, onto textile, has been tried. So, these are also processes for textile, are not very, very popular, printing particularly because even if the film gets transferred, the textile has to be washed and then ironed we are and rewash clear and so, the requirements are slightly different, but for various reasons, people have been using, some kind of a binder some kind of film on the thing rubberized prints, for that matter where the abrasion resistance, is not so, high but for fashion reasons people do. So, some of that type of thing I believe, can be done by using a film release.

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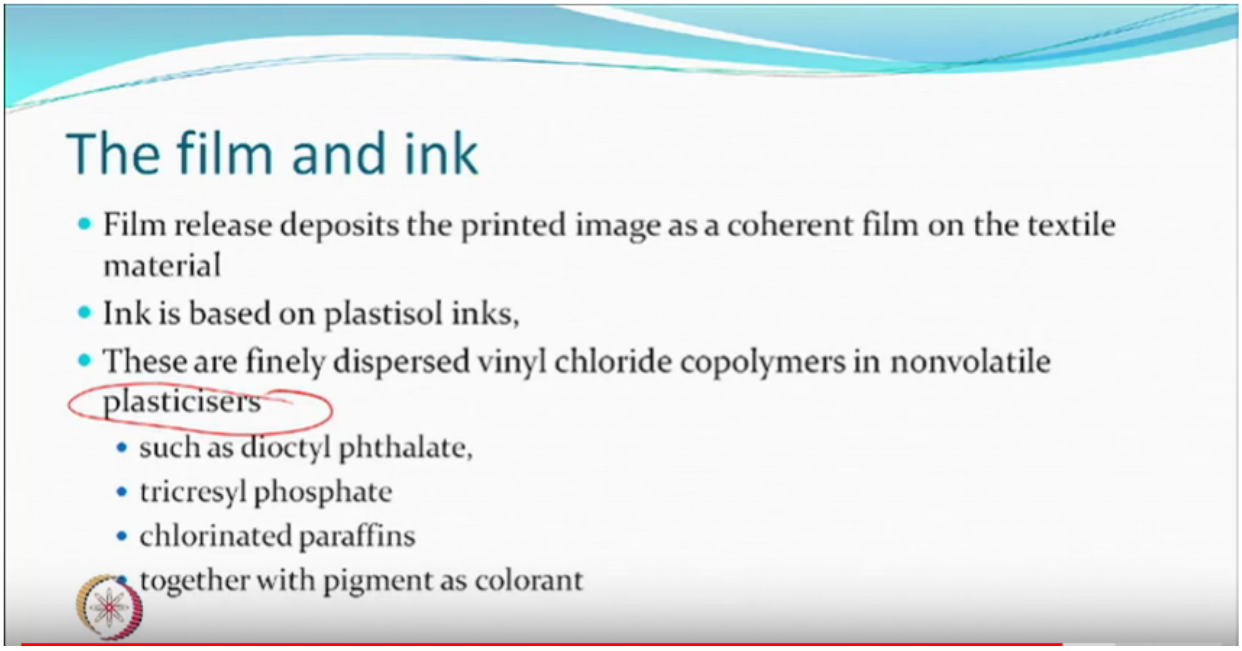

So, what it means is the film, is there and it gets, release and the whole, in some sense is being you have a transfer. So, this process means depositing the printed image, as a film onto the textile material. So, as long as the film likes the ink or the dye, it's. Okay? So, you're not really hoping, that the ink likes the fiber, as long as the film can be attached, because film is a high molecular weight system, if it can remain as a film therefore we have to get transferred, then the whole of it stay on to the textile as long as, it stays on textile you have the design and, and you find for various use and abrasion resistance, it is not there so, you don't have so, inks are also called,' Plastisol Inks'. So, there is a because, there is going to be a film formation and therefore it's like a plastic being made. So, plastic soles are there and you can use, polymers like when I will chloride copolymers, along with some plasticizers, plasticizer you know is a compound, which reduces the glass transition temperature, of polymer and film in this case. So, it remains flexible. Right? So, if you a large number, of polymers which are flexible polymer ,you have plasticizer in them sometimes, the plasticizer with time, can move out and you may have seen with time the polymers, the sheets they become rigid, with time because the plastering can move out and come. So, chlorinated paraffin's or seral chris'll phosphate or diocty l phosphate, these type of class sizes are there along with pigment, they are dispersed properly, to make a plaster. So, link which is used to print a paper.

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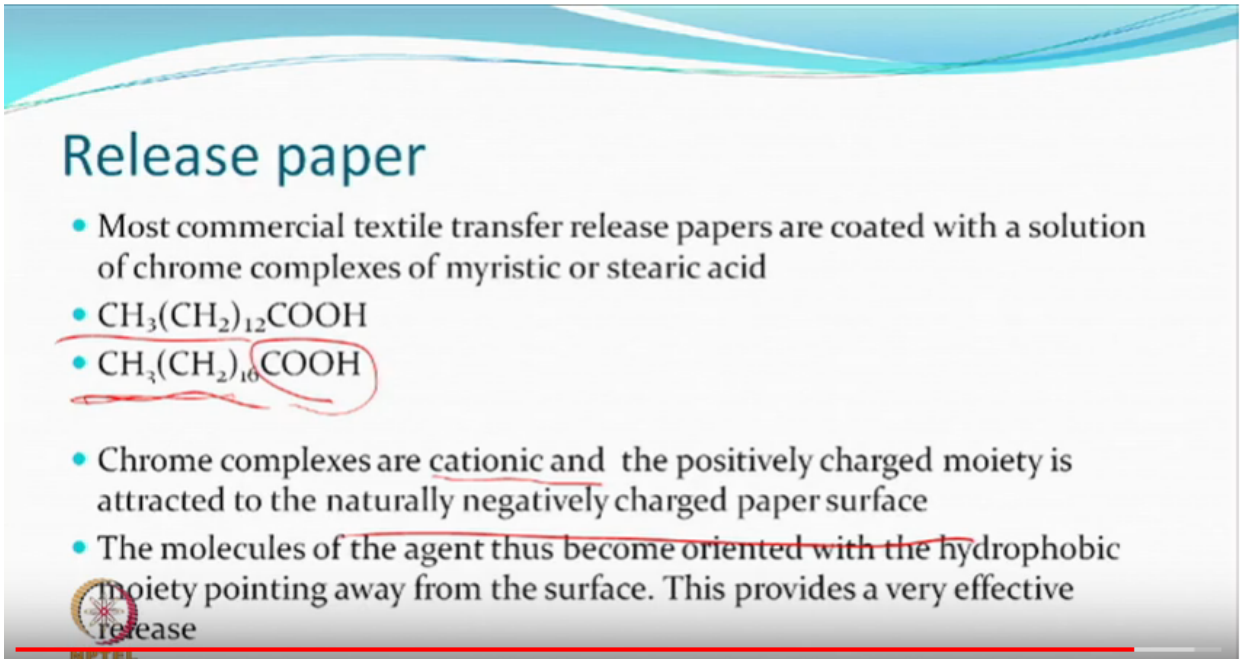

So, this paper, which is a release paper, must release the whole film should not have so, much of a problem and if that is true then things can happen. So, some of these papers, which are commercially used for such type things are coated, with complex, chromium complex, of steric acid or myristic acid and once it is there, then as somebody is appointed before also, the affinity towards the paper becomes, less the film may like to just get out of the surface whenever given an opportunity, of pressure or temperature. So, this is thec-13 type of an acid which is called the,' Myristic Acid'. And this is the common c-17 type, which is steric acid, but because they make chromium complex, you know something like this happens. So, chrome complex are cationic and this positively charged, moiety gets attracted to generally negatively, charged paper surface, you know most of these surfaces as you know are negatively charged little bit. So, the thing is that you have a hydrophobic, end here and a hydrophilic end here, if hydrophilic end through the chrome etcetera goes onto the surface of the fabric. So, what remains outside the surface of the fabric, is a very hydrophobic material. So, the molecule of the agent this becomes oriented, with the hydrophobic moiety pointing away from the surface. So, all the c-13 groups are pointing or see same thing moves up pointing out and because they're pointing out, they generally provide a relatively effective, release of whatever film that you've had. So, linking with the paper is least because it is now being covered in somewhere.

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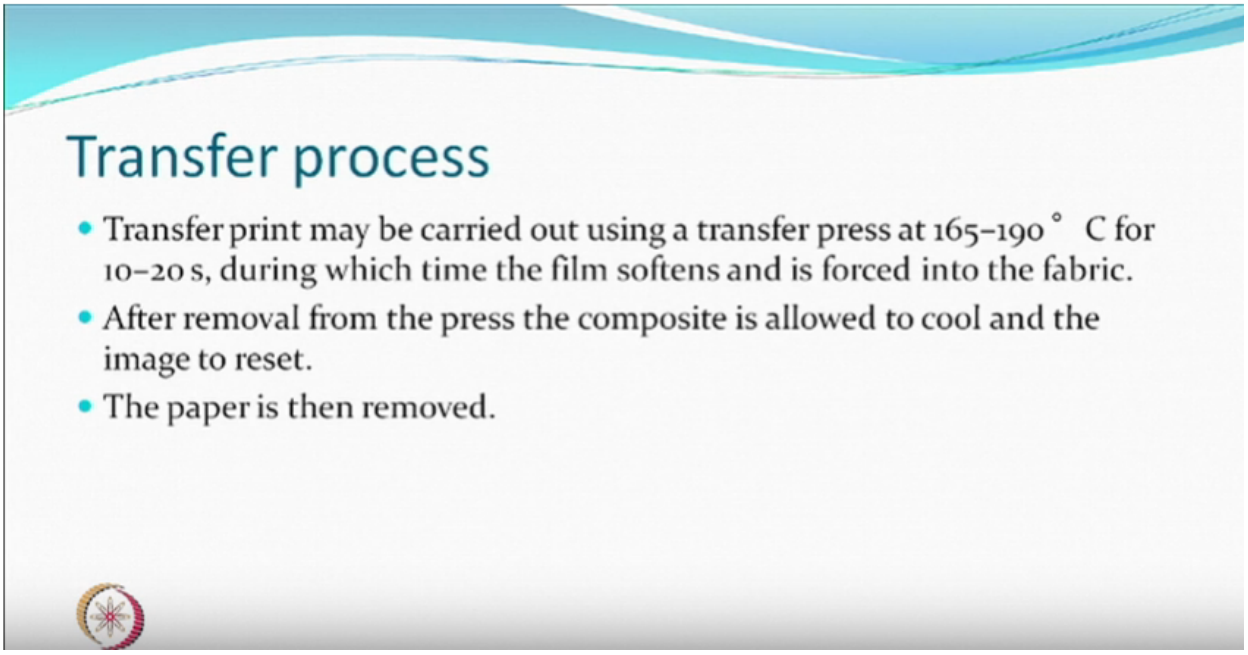

So, you have a release paper, then you can print actually by any method, people can use screens to print, sometimes it may have a additional backing layer, because the last is all print is very thin. So, you may have a backing layer, which can give a bit more stable. So, the more film could get a bit of a easy transfer, that's all I think we are looking at the possibility of transfer printing. So, this can be done, this kind of a thing can be done at different temperatures depending upon, what you're doing up 290 time could be all so, what happened the film gets, softened and forced onto the fabric, wait till everything gets cooled, and then you can remove the paper. So, simple process but we now, know that there is something called a,' Film', which is on the paper, which finally gets transferred onto the fabric, may not be able to withstand the rigors, of textile use, but it is done.

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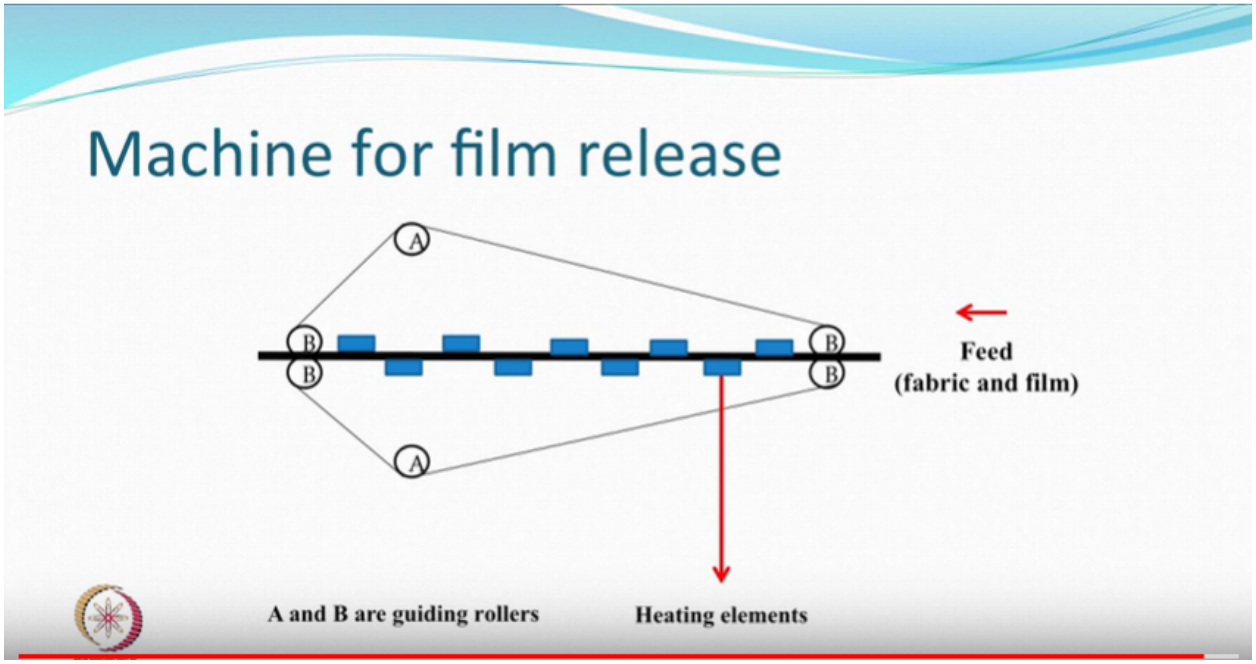

So, simple sequences, of this type where there are many heating elements, along the surface or some kind of a blanket, which is forcing, the paper and the fabric together and one can hopefully, get the transfer or release of the film from the paper. So, the whole thing the printed element printed part can come out.

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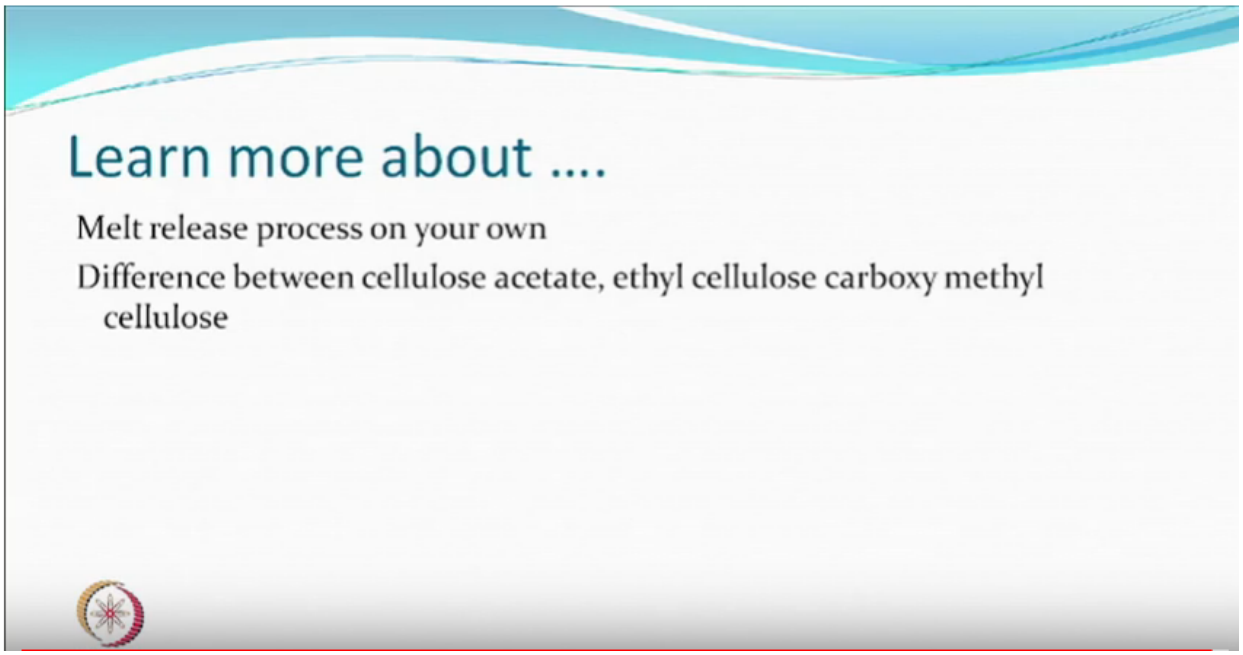

So, that's all we would like to talk about so melt release is not so much of a gonna use but people had tried, this you can try to get some papers and learn about it some, of the binders that we discussed this area where the city defiled cellulose carboxymethlcellulose, you can look at the chemistry of these materials. So, that you know what differences they have and you can try and correlate, with their effect on the transfer, rate during sublimation process Alright? So, this transfer printing, we are now closing and we can talk about. Next which we will call it a digital printing.