Module 25 – Lecture 8

Sublimation Transfer Printing:

Paper printing

So, we will from where we left last time.

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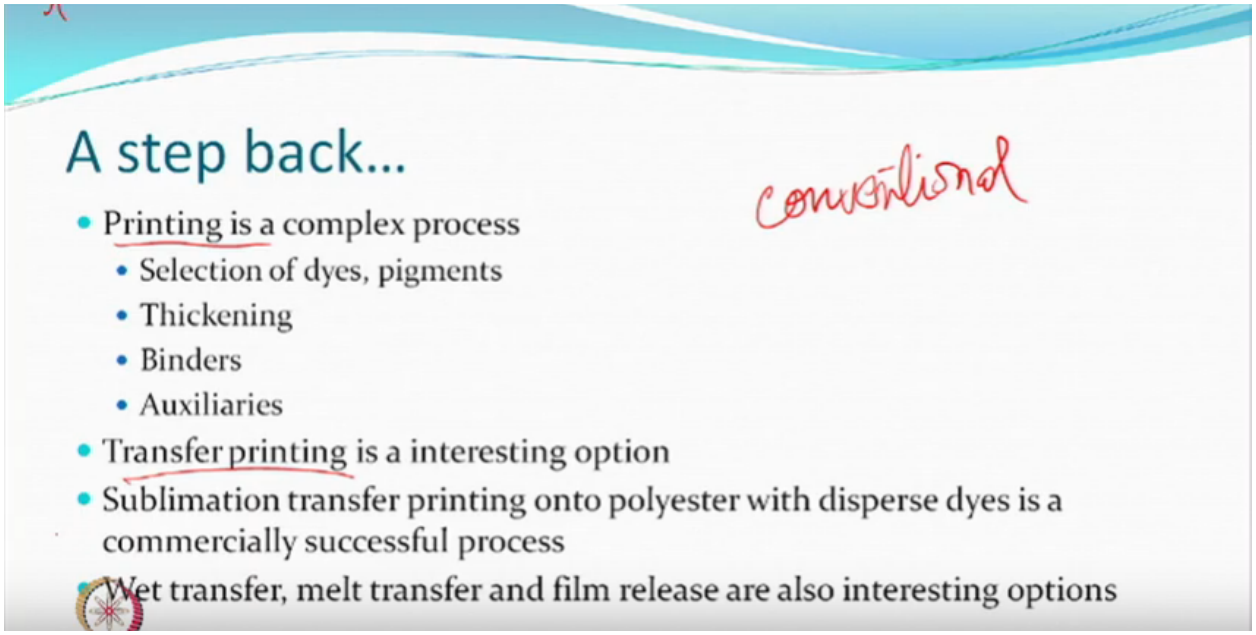

So, we see, what did we do? We understood that, the conventional printing, the conventional printing is a complex process. Because it requires a lot of things, so there can be another alternative, which is called the, 'Transfer Printing', which means you print somewhere else and then transfer the print. Out of these, there were many options that we thought, but Sublimation transfer printing, which sometimes also known as a 'Dry Transfer', is more commercially successful. Particularly with the disperse dyes, that also printing on polyester. Because polyester cannot be printed with any other dye, the, other than disperse. Although dry transfer printing can be done on, Acrylic or Nylon or any other such material, which can take, disperse dyes. But nylon can be printed by, ac dyes, metal complex dyes also. Similarly, acrylic can also be printed by, cationic dyes. And therefore, it appear, as if the polyester disperse and the transfer printing, sublimation transfer printing, made for each other, well suited, kind of question. So other methods, also available as we learnt, there are, Wet transfer, melt transfer and film release techniques are also available, for doing this transfer printing. And so we will learn about them. But as I told you, the sublimation or a dry transfer printing is the most popular and commercially successful process.

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So we'll spend some time on, printing of paper. Why should the printing of paper, be any different than printing of textiles? One of the interesting things, which we can appreciate, is that the textile is something which is much more stable; it doesn't get affected by wet conditions, alkaline, high temperature. So generally, very, very, flexible and more durable, in that sense. Compare this with paper and paper if we refer, to a paper made from cellulosic material, you can appreciate that, this material is not going to be as stable to moisture, tear resistance etc, are not going to be very high. But from the point of view, of printing the paper, there may be advantage.

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One of the advantage, obviously you can expect is, that this is going to be a very, smooth surface. So if you want to print any details, then on a smooth surface it is easy to, design, develop prints, which have fine lines, finer prints, which is more difficult, as far as textile is concerned. Because textile surface is a very rough, undulating surface. And so, from that point of view, there will be some advantage. So one important thing is, essentially whatever is being used for transfer printing, as the paper is cellulosic product. So and because of this we are also lucky that the cellulose doesn't have any real affinity for a disperse dye. So if you print a paper with a disperse dye and then, as we understand, there is sublimation involved, so we are going to be increasing the temperature, of the paper and fabric combination, so the dye is going to be vaporized, the dye can go anywhere. But, because cellulosic material does not like the dye affinity low, so the most of the dye is going to be transferred to the polyester, which is a fabric.

And therefore, efficiency will be also high. If suppose instead of that we take, let's say a polyester film or make a paper, of polyester, if possibly and then print that and then try to work it out, you will find that most the dye will also be going to the polyester part or any other material you can think of. And so this is an advantage, which is, interesting advantage. So disperse dyes get, you know, the sublime and then get fixed on to the polyester, which is actually what we wanted. Obviously because the context is going to be very close and therefore, the boundaries of the print are going to be almost replicated on the fabric, as it is. So it appears, as a very simple process, as long as, you're able to get a printed paper. So if the printed paper is good, then the transfer will be easy. So generally, this is the principle which people thought, should be able to attract the commercial interest, which happened also.

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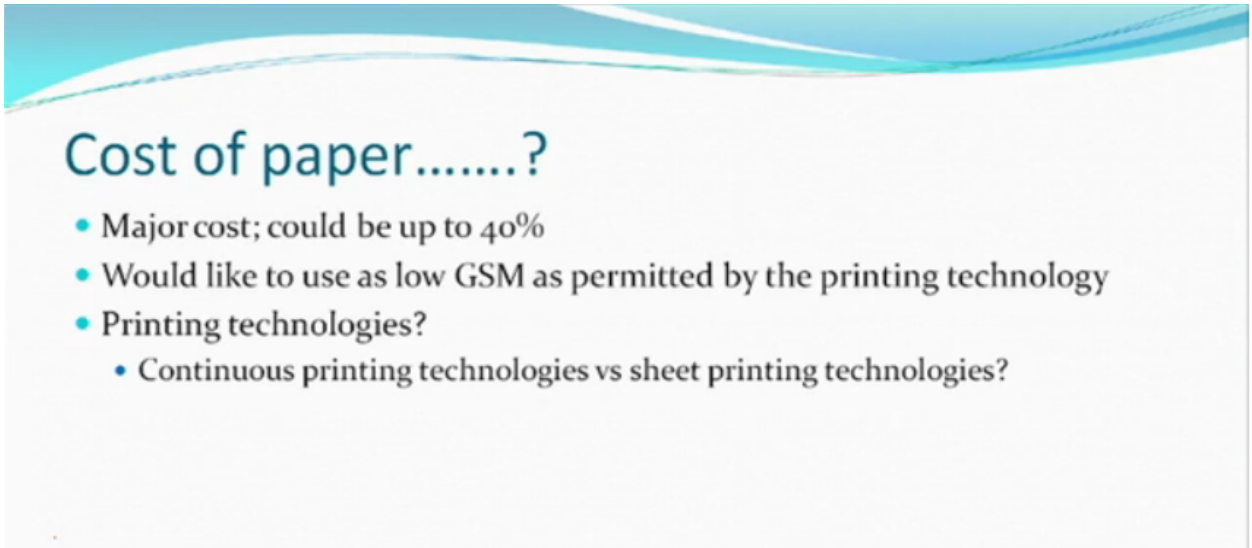

So interesting part is, in this process, there is polyester, then there is a paper, which is a printed paper and then you have, machines which will be to compress, pressurize and then heat it up. Right? So it appears, this raw material which you're actually going to be using, is costly. And so, when you talk about the cost of printing, paper cost, pa, printed paper cost is the, one of the major costs. And so, people should be concerned, as to, right kind of paper, right kind of printing, to be done, so that you do not have a waste. Once you done, once you have finished printing paper correctly, then life will be easy. So, people will ask, 'What could be the GSM'? GSM is, 'Grams per square meter of the paper'. Higher is the GSM, higher is the cost. So one would have tendency to use as low GSM, as possible, which is suitable for a printing technology. So it is the technology which will say, 'Well this requires higher GSM, this requires, probably medium GSM', and you can work around and so because the cost of the paper is important, so people like to use. But, printing technology, paper printing technology is the one, which are also have to be seen, whether they can take up. For example, you can have a machine, which is printing in a continuous manner or you have sheet printing, where you print, one sheet and the sheet is removed and the next sheet comes. And so, if this kind of thing is there, the paper has to shuffled, moved from one place to another and therefore the GSM cannot be very less. But if it is a continuous sheet, maybe you can afford to have a low GSM, as long as the tensions are adjusted correctly. Because, unlike the textile fabrics, which can sque, like knitted fabrics can sque more than the, Owen fabrics. If you do any squeing in paper, it will generally get torn. So it is important that, alignments are done correctly and so, the only thing that goes in favor of the paper is that, it is a stable structure, generally no squeing, so printing can be good, but care has to be taken, so GSM, probably will be decided.

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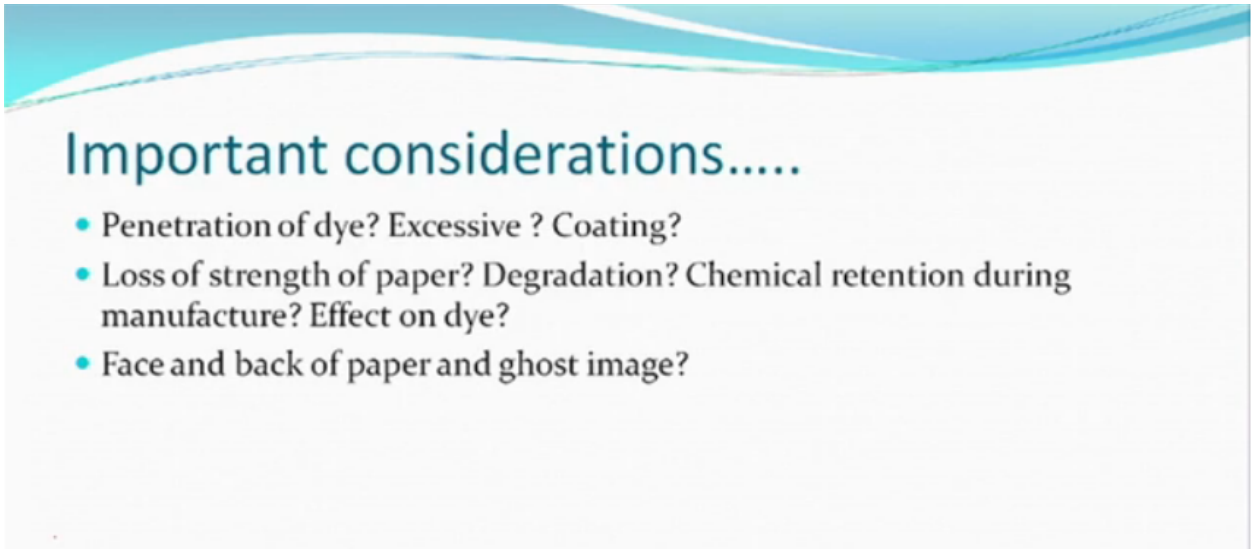

Some other considerations which one may like to keep in mind, the penetration of a dye. Now how much dye, should be there on the paper? So invariably, one may say, 'I don't want any penetration, let the dye be on the surface.' 'Yes, that's good'. But because of various capillaries that may be available. And while you're printing, there may be, it is, it is called, 'Ink', for example, is liquidish. It will have its own source. Whenever you put anything on the paper, something will go inside as well. But if it penetrates too much, then the dye has to traverse all that path back in the vapour form and come out and then go to the fabric. So you would like to have as less penetration as possible. But if there is no penetration, it may be, because they may be available as rolls, when you open, close, wind, unwind; you might find there is a scratch and the print is gone also. So you would not want that as well? So there is going to be some amount of penetration, which you like, excessive you don't want. But, you can't say that, there is no penetration. Sometimes, to make the surface still smoother, people may say, 'Well we can apply some coating'. So is a glazed surface, very nice, but, sometimes people say to still have more clearer prints, you may like to give a coating. For example, if you have photographic paper, which people use for, you know, making photographs, it is a coated paper and so it is expected, that the ink when it drops, will obviously, not spread and stay wherever it is. So those kind of considerations can also be done. So paper may not be just a simple paper, maybe aquaria's, treated paper. And therefore, the cost can also increase. The what is, of course, GSM is one, but strength of paper. If it is from the cellulosic material, they always call as a, 'Fiber Length', you know? So, you make it from bamboo, you make it from any other tree or whatever.

So fine, nice papers, as they say the fiber length there is, larger, so strength also comes from that. Generally we believe that, cellulose is not going be degrading very easily, not at the temperatures that we're looking at. But still, yellowing can take place. So one should say, 'Well it does not have any impurities as such'. So you, let's say, you say, newspaper, with printed newspaper, if you look at the color of the newspaper, it's not white, but it's good enough, because the purpose is, you read and you throw. But in this case, suppose, it is not a white paper, that means, there is some pigment there, which is giving color, based on whatever happens, it can get some impression otherwise, or some oxidation kind of thing can also take place and then yellowing. So it will be interesting that, the strength is high, it does not degrade very easily. Obviously we expect that the, during the manufacture, let's say, you've done a bleaching, it should not happen, that the bleaching chemical or the one, after wash or whatever, in the pulp, formation, are still continuing. Because in that case, based on their ac dc continuing or alkaline continuing, so it's a basically neutralized paper. And expected that it is not going to be interacting with dye and will not affect any way, characteristic of the dye. Which in our case, most important character is, sublimes. So you don't want any interaction. Then the face and the back of the paper, like your face and the back of the textile fabric, so face is always good and the back you don't care so much. Similarly here also, the face will be the one, where you are going to be printing, has to be more smooth, more uniform in every sense and back you can probably, still may have a little rough. Because the smoother is the surface, the better, is the, you know, details of the print. Then, there is this, ghost images means, that during printing, if there is a slippage, for whatever reason, then a secondary image can be produced. Or when you reverse it when you transfer also, if there

is a slippage between the fabric and the paper, during the transfer or when you are removing the paper. Paper has to be removed from the, fabric surface at some stage. So if there is any slippage, you might find, another image which, may be lighter, but it still appears, like a ghost image, a secondary image, being produced. So these things have to be seen, during printing of the paper, as well as, during transfer. So both times, if anything like this happens, then obviously it's a bad quality print, whatever you've done good, before, has no meaning.

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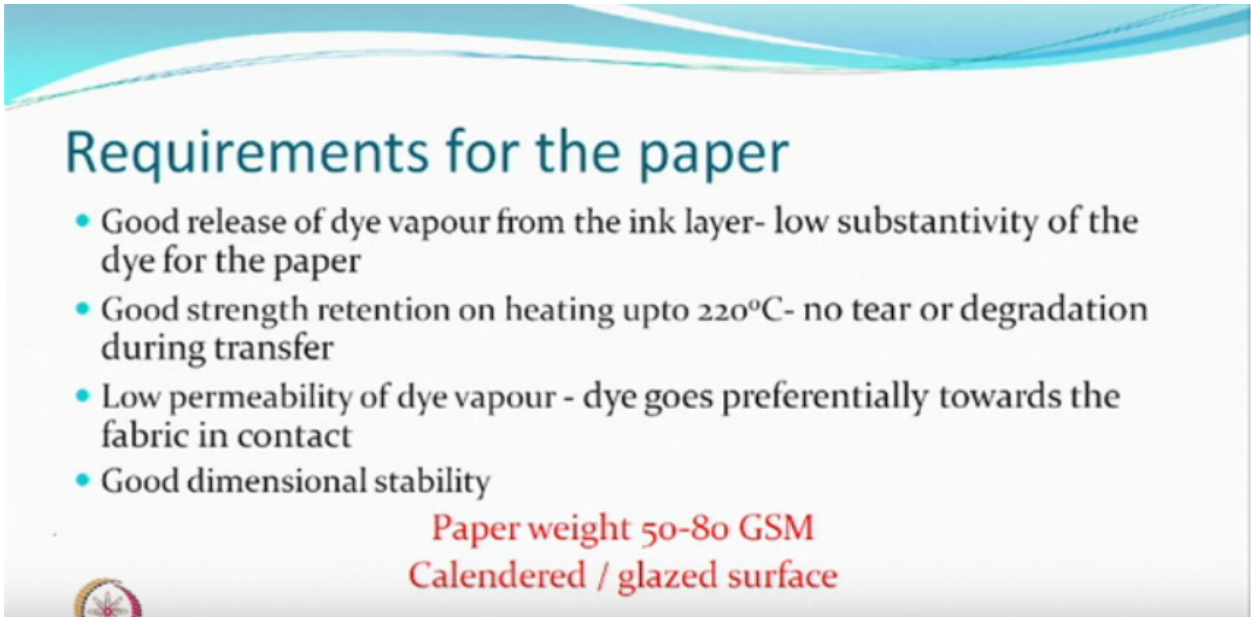

So continuing with the paper only. So, expected thing is that, it will have a good release of a dye vapour, from the ink layer. So there is a layer of ink. So there is paper and there is ink, now you can start accepting, the textile people call it a, 'Printing Paste', the paper industry calls it a, 'Ink'. Not only that, the viscosity of this ink, when it's being printed much lower, compared to, what we use in textiles. Because, technology is entirely different, which is, acceptable technology, which is, commercial technology is different. It is expected that should have low substantively, fortunately, cellulose and disperse dye, do have. But, from the point of view of a principle, it could be any paper, any sublime, sublimable dye, any textile, could be the one this accepts, that. Some heat is expected, that you will be heating, up to 220, because you wanted to sublime. Polyester transfer and stability is good around this temperature. So its melting temperature may be 250 to 255, but the transfer that takes place, at this temperature. So we expect, that during this period, which may be very small, the temperatures can be high and these temperatures will also depend on, what type of dye that is used, because this, every dye doesn't have the same sublimation temperature. But, you still have to optimize, it would be expected, that there will be no tear or degradation during the transfer, as far as the paper is concerned.

So permeability. So, if you have a low GSM that means, at the molecular level, because now you're talking about molecule of a dye, which is in a vapour form and not a particle. So if you look at any paper under, high magnification microscope, you say, 'Well it, it said it's a very smooth surface, but it's not as smooth'. So from a point of view of a molecule, there are force, everywhere. You know? And so, how do you remove, reduce the permeability? Is either by coating or by high compression and glazing, that is one side is highly glazed and so you should have, low permeability, so that dye goes only in one direction, in a vapour form. Obviously one is substantively towards the fabric, other is the permeability is low enough, that the dye is not, is not low enough, that it goes, through the paper on the other side. Good dimensional stability is what we expect and generally it's there. And that is where the GSM comes into play. Higher the GSM, stability, dimensional stability is better. But higher is the GSM, the cost is also an issue. So one can probably be thinking of 50 to 80 GSM type of a paper, which may be used for printing. So it is calendared. So calendaring, we understand? So calendaring means, at least once roller, is a very smooth roller. So that becomes the face of the paper, which finally is going to be, printing and you give a glazed surface.

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So how can you print? Yeah? I've written Rotary, because, this could be a commercial kind of a. But any screen printing which you have used for textile can also be used for paper printing. Alright? So in that sense, if lab, if in lab you want to do any kind of a paper printing, you can do it. Alright? As long as you have a good recipe, so you can actually think of, going to the lab and actually making a paste, for a disperse dye, make some kind of thing and test it out, whether any

transfer takes place or not and how much is the transfer taking place. So this process is well known to the textile industry.

So if tomorrow, the industry itself wants, where we will put our own paper printing system, this machine probably can give, except, that if it is a rotary screen, so how the paper roll is going to be opened and how is it going to go, printed, dried and rolled again. So what we not do? Obviously there will be nothing called a, 'Fixation'. You will do print and dry, but there is no fixation. Drying itself is, okay. That means, either ink is such, which actually makes a small little film or it just gets little absorbed and so that is it. So in house manufacturing, cutting out for a commercial printing, could also be, thought of. Those who want to do. But toward to screen printing, they are not so fast. Otherwise, textile people believe, rotary screen is fast. Alright? For paper industry, they say, too slow. You know, it should go much faster. And so, you may or may not like to use. Therefore, in general, the people who print the textile actually do not print paper, although they can do that. So that's is one important thing and the paper printing industry, generally have their own different technologies. So while screen printing can be used, as it is and you can do printing, of course, the cost is will have to be adjusted, while you're printing. But then they will have their own ways to print.

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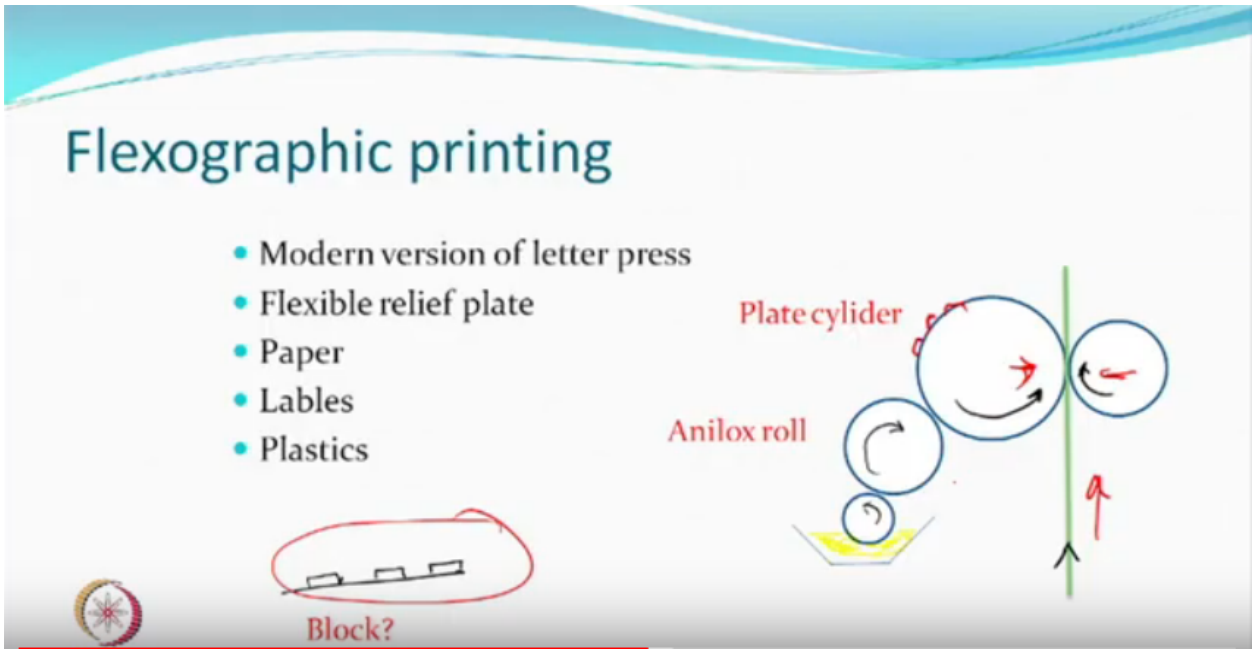

One of the interesting printing processes is, in the paper, is called the, ‘Flexographic Printing.’ Now flexography is something like a, Block Printing. The way we have block printing, where the design is like a relief, it is coming out of the surface. Alright? Block has a design, outside the whole block, so it’s like a, relief. So similarly, or if you have seen, if anyone of you have seen, earlier printing, operations of papers, they used have a letter press; that means, the letters are lying everywhere, you pick up A, B, C, makeup spellings and keep adjusting the thing and start printing. So there, it is also, the letter is in relief, it is relief. So, like a block, you take the block, put it in, on a, on a pad, ink pad and then, ink or the color, is picked up only the relief portion and then you transfer. So this is exactly similar, for example; you can have some type of a design, which is raised, but instead of a wooden block, they can have a plate, metal plate, for that matter. Which is flexible enough and then you can put it on, on a machine, which is, let’s say, print, plate cylinder, as they’re calling it, plate cylinder. So everywhere you may have some plate, which has a design and the design is in a relief mode. Right? So, and then you wrap it around and it can be used as a, say for, paper printing or labels or plastics also. This technology is therefore available, for doing this type of job. So this is, in some sense, a continuous method of printing, so this is how the paper can move and here you compress. Alright? You compress here and this pressure and transfer will take place. So you have a ink, which is, in some trough, then you have some, transfer roller, then there is, Anilox roller, they call it, which have got small grooves, which picks up the ink and then, it gets transferred. So only thing which is interesting here is, the ink, obviously touches only the design portion, it should not go beyond the design that is the only thing is there. So that control, one has to make and then you transfer and dry. So it’s an extension of a block kind of a printing, but in a continuous manner. Alright? Wooden blocks are too rigid, to be made flexible, so you have plates.

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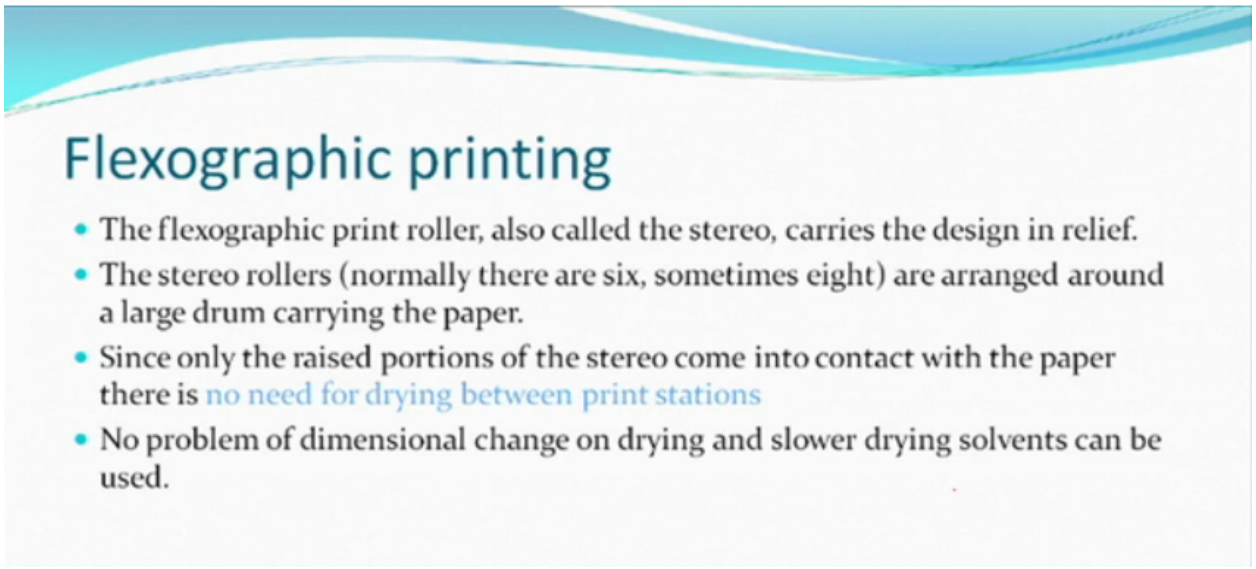

Sometimes, they were also called, 'Stereo Rollers', they carry the design, in relief. Okay? Flexographic, Print roller. So main thing is, there is a plate and the plate can do it. So you, instead of everything being on a design which is permanently fixed on a roller, this technology say's, plate can be made somewhere else, you can come and fix it here. So the design has to be made, to be transferred only onto the plate and the plate can be put on the roller. So there can be also, more than one printing rollers. So 6 or 8, like the way we have, already know could be there and they can be arranged, around a large drum or which, which is carrying the paper and you have, like in a roller printing machine also, you have a large drum and you have, one roller, the other roller, the other roller, all along. Similarly, here also the same arrangement can be done. So one colour, versus the other colour and the third colour and then you finally print. So in a continuous manner, so instead of textile, it is paper which is going. So this interesting remains, that as the raised portions, come into contact with the paper. There is no need for drying between print stations. So you have one print, coloured, then you don't really have to dry, because it is obviously, the other design is not going to be coming onto the print, if everything is nicely, you know, stabilized. So there is no need of a drying, between the print. Otherwise, if you believe that your next roller is actually going to roll over the other design, in a manner that, it actually touches the coloured portion also, you know, then either the ink formulation or the heating etc, will have to be done, so that, as it moves to the next, get dried, so this has one advantage. So you can think that this could be, a Batch Process also, if you're, just have a letter press kind of thing, it goes one way, then the next page and the next page and the next page or it could be continuous roll machine.

So this is one, which, let's say, in very early days, was a popular printing process, of paper. So, what is interesting is, there if suppose, the paper gets wet, during printing, the stability comes to play, there. Suppose it slightly shrinks, you know, slightly curved, it gets curved and then, there

can be a problem. So then you relieve that, so the, so this is a, thing which does not require any of those over and over printing, so dimensional change during drying, because, whenever you absorb something and dry again, you can expect something, you can think of any paper, put little bit of a moisture and then try to dry, you will see, stability in that area, slightly different, compared to the rest of the paper. You know? Mainly mean the flexibility. Those kinds of changes can be there. So, what it means is that instead of a fast drying thing, you can use slow drying solvents also. Which also means, if the fast drying solvent means that it vapour will also come to the environment? It's obviously not water. Right?

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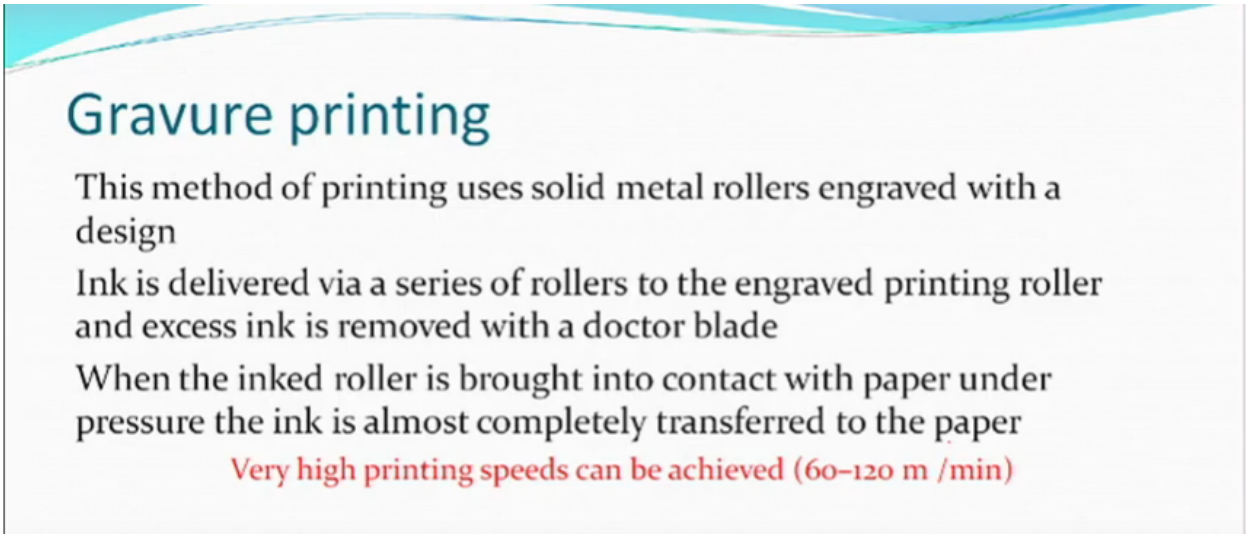

So the next technology which is used for paper printing is called, also, 'Gravure Printing'. Now, this is exactly, like a roller printing machine. Because, here the design is engraved. In a roller printing machine, the design is engraved on to the roller. Right? So, in the previous case, it was a relief, the design is outside the main surface, here it is engraved. And this is what we have in the, textile roller printing machines also, we have designs, engraved. And excess ink is removed by a doctor blade, like you had a doctor blade? So it is more or less similar machine. So ink roller is brought in contact with the paper and the pressure, ink is a mostly completely transferred to the paper, that's what the principle is. Here, because everything is smooth, the most of the roller surface is plane and design is inside, so you can actually think of, increasing the speed. If suppose, you have rough surfaces, which are edges, pointing out and you want to do, that fast, then you may have some impressions of the design, which is not just the colour, but the edges can also, press the paper and so you may get the different impressions and made on, so you say, 'Go slow'. Right? Here you say, because, most, most surfaces, the transfers, surface of the,

Engraved roller as well as the cylinder, on which the paper may be moving or a blanket on which it may be there, they are all full. So pressure is in some sense, distributed all over and so you can run it at a higher speed as well.

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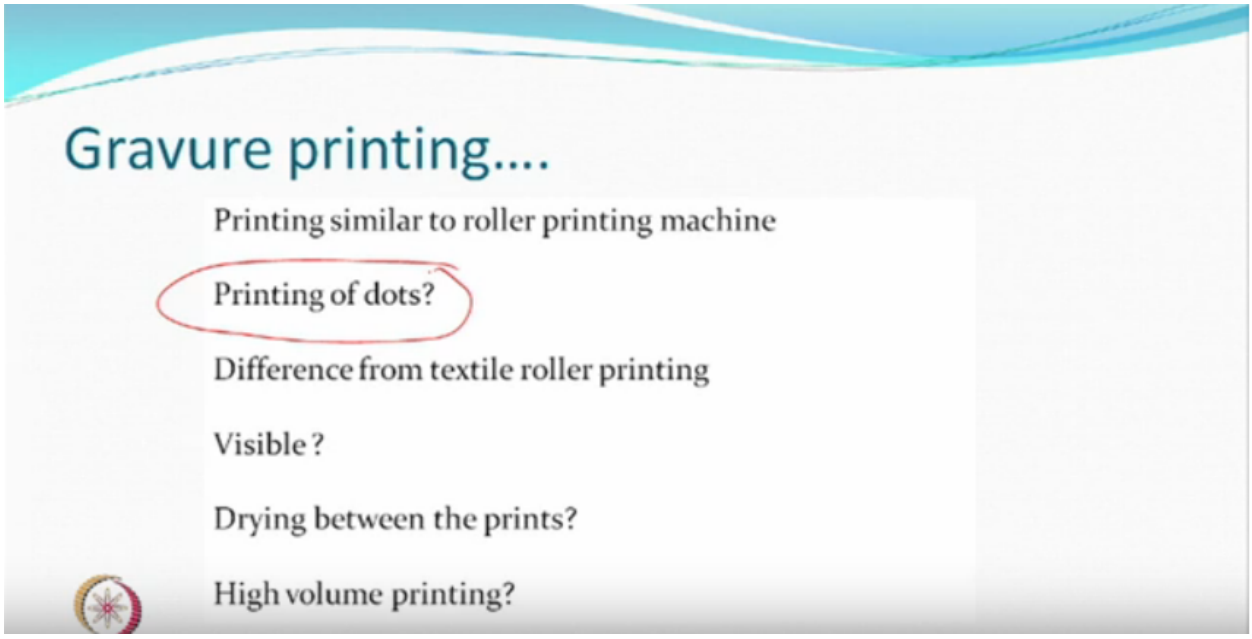

So it is similar to roller printing machine. The difference is here. So it prints dots; so when you talk about, the design, the design engraved, as a dot.

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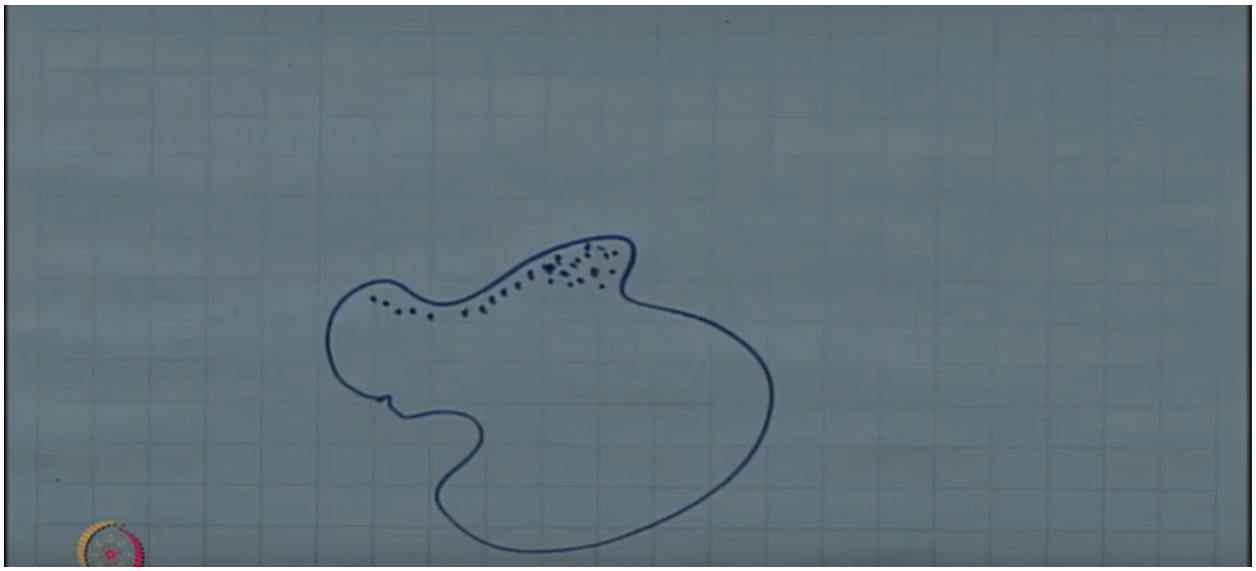

For example; if you have this type of a design, so here, you actually have dots. So you do indenting or it could be done by, any other method, but, it is like dots are inside. So you have all the area, design area is covered with dots and so colour will go inside the dots and then it will get transferred. So the whole design is, when you say engrave, it is not that you have etched out everything from that area. So only that there are fine dots or less fine dots, but there are dots. Okay? And this principle itself is led to great advancement in the printing technology, that you, just have dots. So if you take any printed paper and look in microscope, we will see that there are dots, coloured dots all over the place. So they engrave the dots, around the design, which ever the design is. So that, the boundary is also clear and the colour gets transferred. And so, as I said, they are visible means, they you can actually go and see under the microscope, these dots will be visible.

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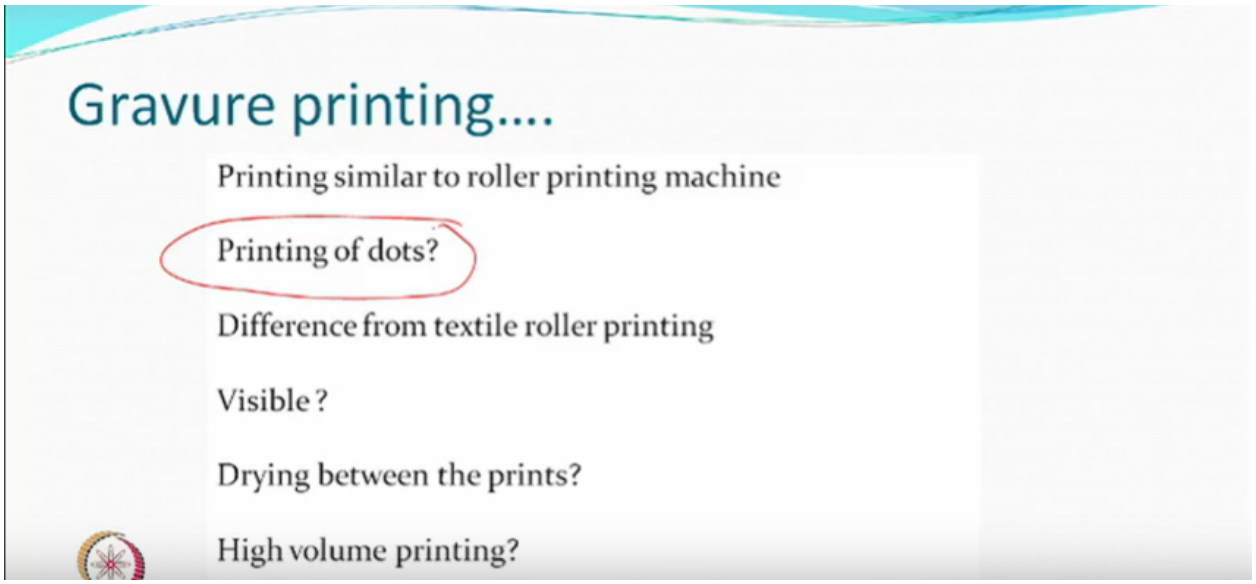

The drying between the prints, you may have to. Right? Because, the portion which comes, over the in contact, is also the portion, which has no design, on it. So you print, the next roller will come. So here may be fast drying inks, you may have to do and or keep the distance between the two stations, larger, but or heat them up or do whatever. So that there is no smudging of one roller to the other roller. Right,

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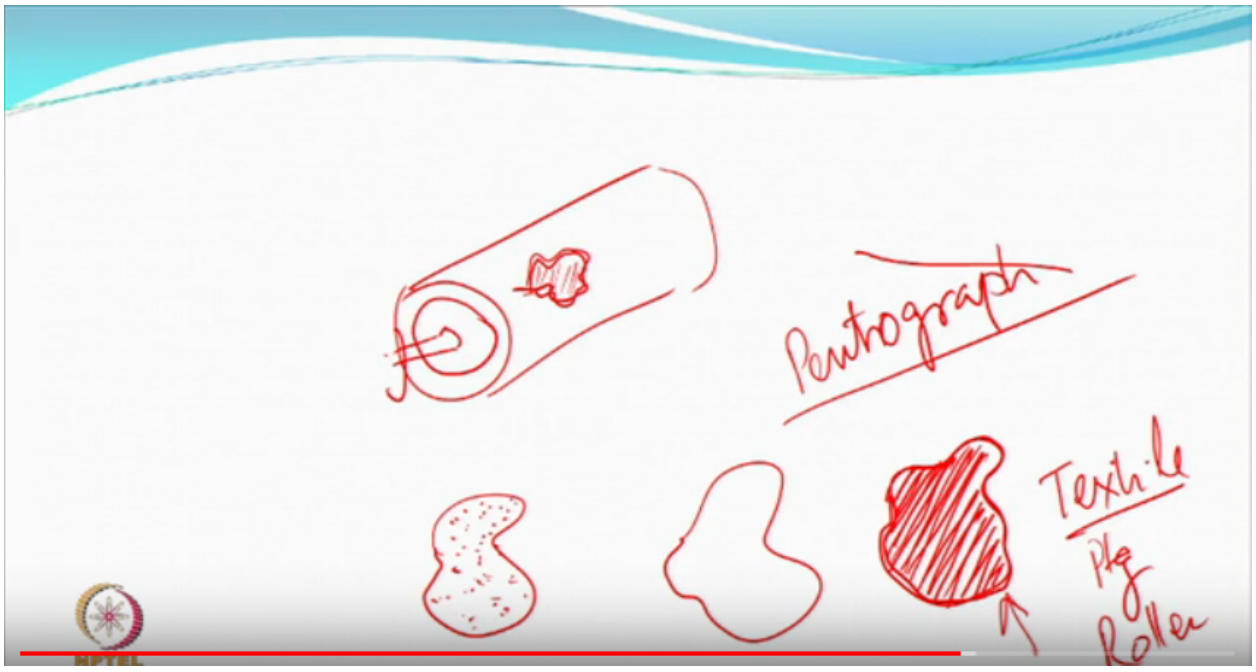

So this just shows the difference in the textile this is done. Textile printing roller, they don't have dots, they have lines, parallel lines, being etched. So you probably be aware, that you will have a Polymeric layer coating on the roll and then there is a machine, which maybe you know, called, 'Pentograph'. Have you heard of this, machine? So when you have a roller, over which, there is a polymer coating, so how do you etch the design? So design is on paper, somebody has made the design, let's say and this machine is that you, one end of the machine is moved over the design, the other arm gets moved automatically over the roller, so there is a magnification or contraction. Maybe if a design is very large, it is easy to do certain things, then you keep doing it and this can make smaller etches or the reverse of it. If you have a small design with your hand and you're making your effort, on the small design and on the design, let's say, if you keep running the needle of the Pentograph over the design and then you keep etching, marking on the polymer film and this becomes your design and later of course you can do etching by asets or something and finally the polymer remove, the polymer layer is removed and what you get is a, etched design, where the fine lines are there. Now somebody asks, 'Why do you want a fine line'? Why not just remove the material from there, just etch, because acid can eat it up, the whole thing, rather than only, the portion where, the polymer has been removed? Okay? Can you tell me, why? Is a roller. This etching has been done on a chrome plated, roller.

So even if, it's a thick paste and if there is just a groove, a big groove, roller has to move, one will find that just by gravity itself, the print, when it is vertical, may, the whole paste may, like have a tendency or ink may have a tendency to come down, by gravity. And if you have this etching, so ink is only in the etched portion. And so there is a, like a barrier or a dam at every point, so it doesn't come down. If the whole design is just plain and there is some depth, half a mm or less than half an mm or whatever, you will find, colour cannot be held, in the design and therefore, this is done. But, when you transfer, because of capillary action, these line are never seen. Okay? In the case of paper, instead of lines, you are putting the dots and so the ink goes in the dots only and then gets transferred as a dot. And if they're very close, you don't see the dots. But if you go very close, by a microscope, then you can see the dots also. So this is how, they do, what we call as the, 'Greuvera', so there is engravings.

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This is one of latest ways of printing paper, which is called, 'Lithographic Printing', also, known as, 'Offset'. So a large number of people who go, for getting anything printed, they say, 'Well, I want an Offset Printing machine', high quality and high volume prints. If suppose somebody is doing printing of a book, so, so many pages have to be printed or so many copies of the page, have to be printed, like even newspapers today, so you will go for Lithographic printing. So you make plates, the way you make plates and the plates are put in the roller and then the print, keeps on taking place. But it's really an advanced level of printing.

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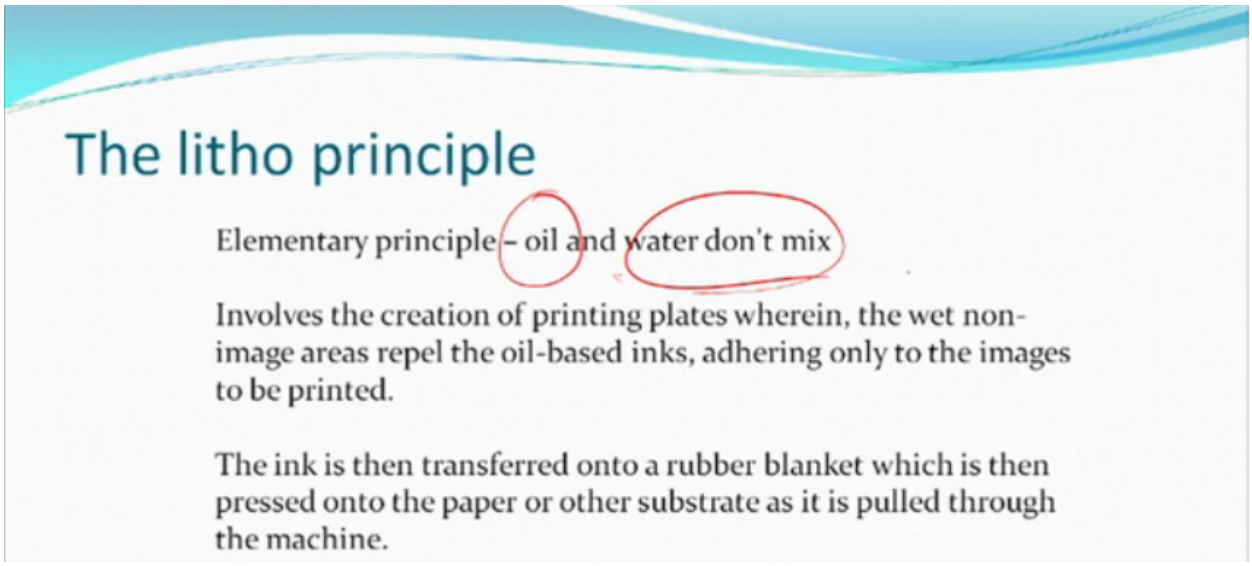

So the principle is simple, but interesting principle. So although there is a design to be made, but the important thing is, the ink is oil based and rest of the roller is, let us say, treated, with water.

And because ink and water do not mix, so when a transfer roller comes in contact with the roller, where the design is there, oil based ink goes to the portions, where there is hydrophobic film. And, it does not go to the area, where there is water. And so you do not do need any engraving, you do not need, any other thing. Just, that this ink, if it is oil based ink, will go to the hydrophobic portion of the design. So where ever there is design, it is hydrophobic film. The ink goes to the, hydrophobic site, stays there, rest of the roller is wet, rest of the roller is wet. So even if, all the ink, so the transfer roller, when it transfers the ink, fortunately ink goes only towards the, Oleophilic portion, which is the design. Then it is transferred on to another work one, where the ink gets transferred. So ink is only on the hydrophobic part and so from they had to foot part goes to, another transfer roller. And from the transfer roller, it is then transferred to, so 2, 3, steps. One, obviously you are going to be making a plate, which will be on the printing plate roller. But the plate is first made a design, with polymer systems, which are from the hydrophobic material and oil based inks will go only to this thing, although the transfer roller has ink everywhere. But, ink does go to the water, but it just, doesn't get transferred. And then, from the hydrophobic portion of design which has the ink, you transfer it another roller or a blanket and then, this blanket or a blanket containing, roller will transfer the design to the paper. Right? So the principle is simple; oil and water do not mix.

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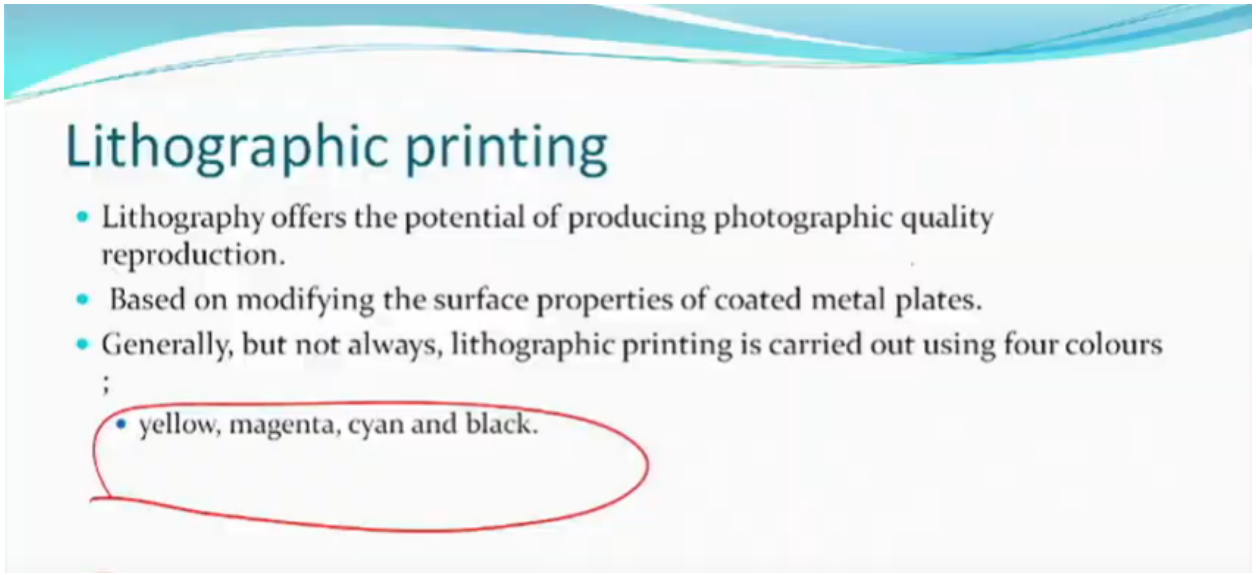

So the more interesting part is, they can produce, photographic, quality printing. Your letter printing could not do it and very difficult from others, to do it, 4 rollers, 5 rollers, printing machines will not be able to do it. But, they could do it, photographic. So, what you're doing is, they use only 4 colours, you can use only 4 colours, Yellow, Magenta, Cyan and Black. And

that's for, these days' in a paper printing, you can say, is a 4 Colour Printing. 4 colour means, you're using 4 colour, but getting every shade. Right? That's Lithographic Printing. And therefore it is more popular today. So here also, you may still have dots. Right? So, one of the roller is printing, yellow dots, other roller is print, picking up, Magenta dots and they're being placed over each other. So you can just think, if you mix yellow with magenta, what colour will obtain. Now how much yellow and how much magenta? Would also depend on, how many dots, what is the density of the dots, of the magenta and yellow? So main thing is, you have to, first, be able to separate, any kind of a colour, a photograph or print design, into four different varieties. That is the most import, important part. If you can do that, then it is adding again, first separate them, so that you make 4 different rollers or 4 different plates and then once you have done that, then you just, print it in the same manner. If you do right, you actually reproduce exactly what you saw. So, this is one the most popular printing technologies, which sometimes called, 'Lithographic printing' and also sometimes, '4 Colour Printing' and also with just 4 colours, you can make. But it doesn't mean that you can, cannot use only simple printing, you can just use 2 colour, which is not photograph. So there is no problem, you can just make designs, black and white. So you just take one black plate and just keep doing it or any other designs. So every design can be printed, but a photography can also be printed. Right? That's one interesting part of it.

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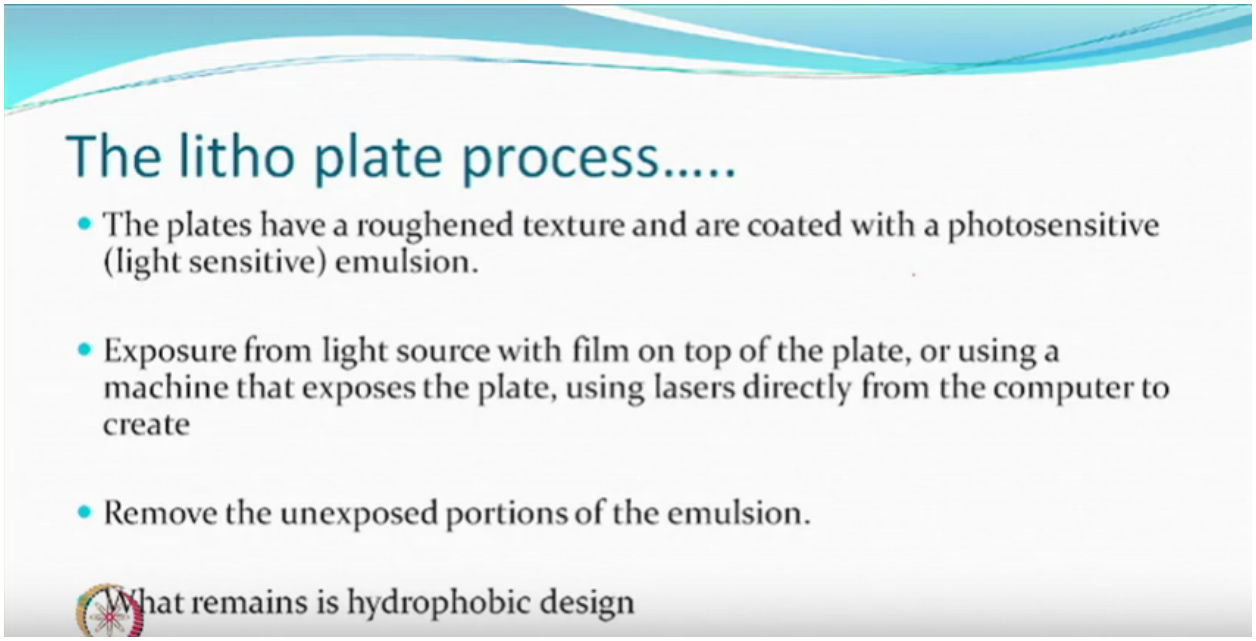

So the plates have roughed texture, were first coated with forces the photosensitive, you know, like, like a roller printing machine or a rotary printing machine or a screen printing machine. You also have photosensitive lacquer, which is sensitive light. So you have, your designs, then you expose them to the light, then remove those portions, which you do not want, they are washable, because, they've not been exposed to light, so they are water soluble. And what remains is, a hydrophobic design, at the end of the day. So this is exactly the process, which we use for generating any screen. Right? So you have design, which is fixed by exposure and half of that, you remove and then what remains? And then the same principle, oil and water, don't like, each other. Okay? So 4 steps; obviously before also you have to have a design first. The design, let's say, on a transparent material, the film is coated all over, lacquer is quoted all over the plate, dried and then expose the design. That means, the light goes, wherever the light goes, it becomes hard, so your design has to be negative, so that, so you have to negative, positive combinations, you have to make. Which, which is what you're going to make. Right? So one is going to be, wherever you had the design, it will not be there, then you will have the material, so you have to make sure that, whatever you want, is actually hardened. Alright? And then, obviously the design also must be having, what we call, as the dots. Okay? So texture is rough texture, in that sense. And then finally, the hydrophobic design, which can be used for transfer.

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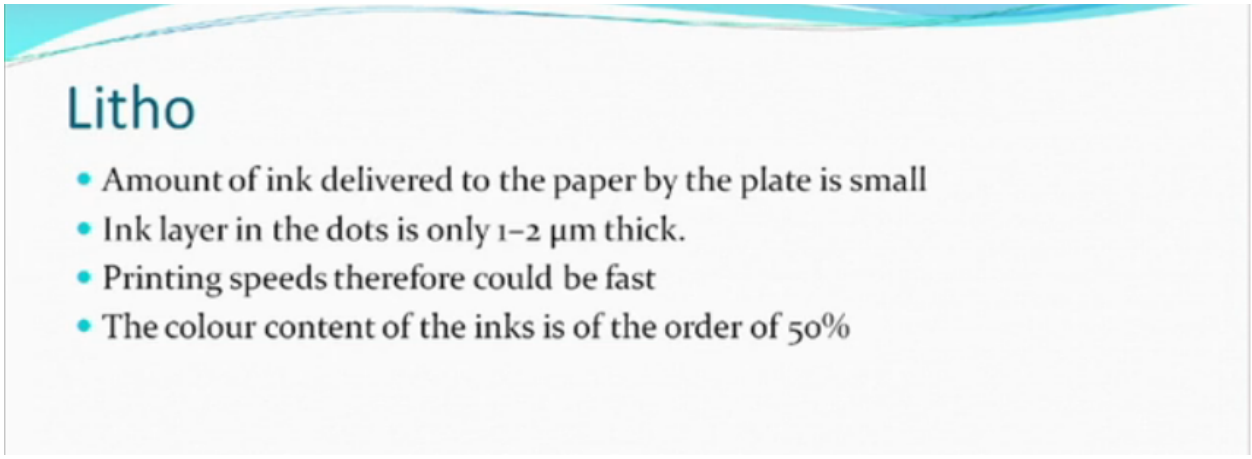

Amount of ink deliver to the paper, by this plate, is very small. There are no engraves, nothing is going inside. Just a layer. So you're looking at1 to 2 micron, thick layer, which is very thin. And therefore, transfer from one to another is not too much of a mass transfer. And so you just, can be quick. But, the concentration of the colour could be very high, where high as 50%. So this is how, this technology is used now, what we have to do is, how to use the same technology and use our dye. Our dyes are going to be different than the paper dye, paper ink. There, paper is not to be washed, but textile has to do. And therefore, you're talking about a different thing, so. When

people started talking about transfer printing, the paper printing were used in, different kind of inks, which was good for them. And whatever they're using today also, is not everything is not been transfer printing. You just call, 'Paper printing', and that remains, as it is. But the moment you want, this should get transferred, then the nature of the dye will have to be checked.

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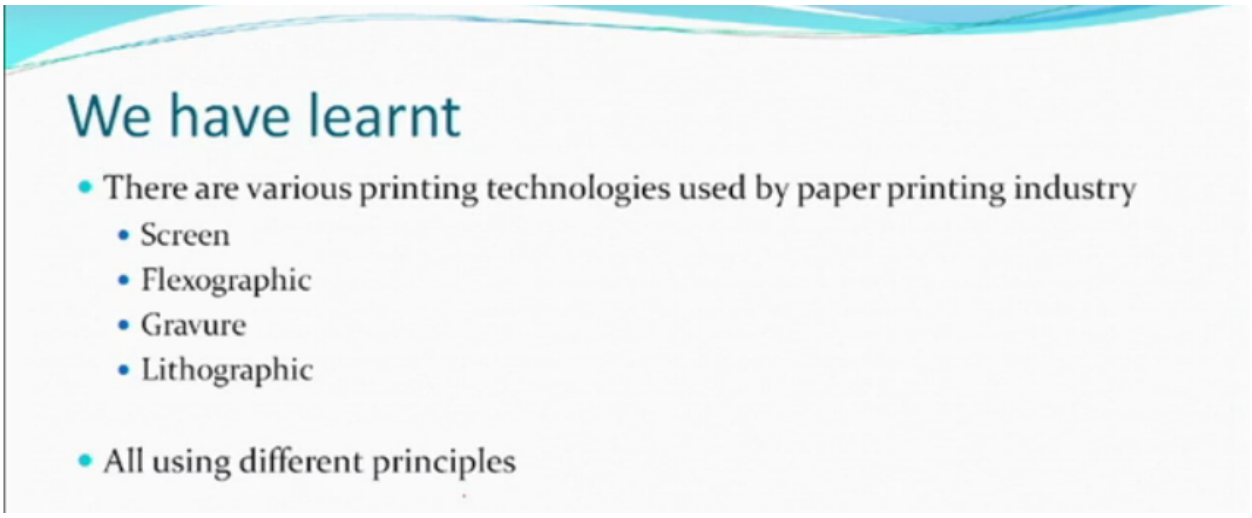

So, for today, we think, these are the four technologies, that can be used for printing, paper, having different principles. Some of them are similar to the textile printing and lithograph is very different. So there we stop today.