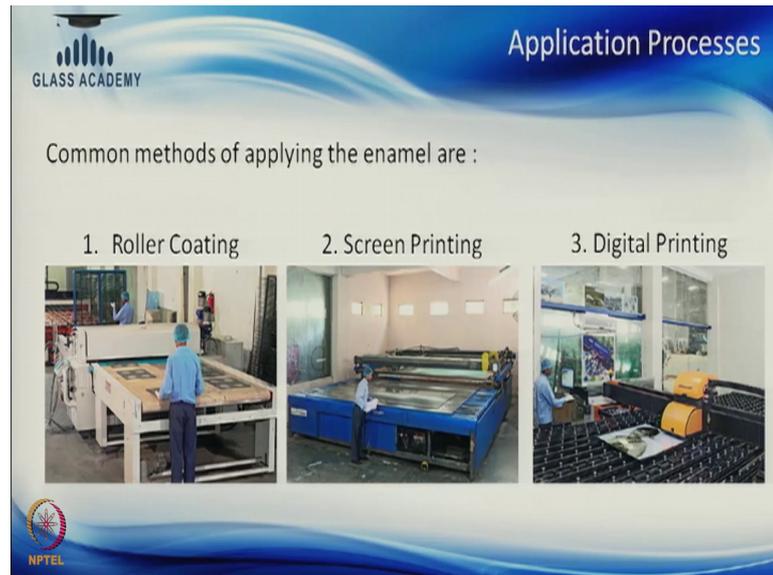


Glass Processing Technology
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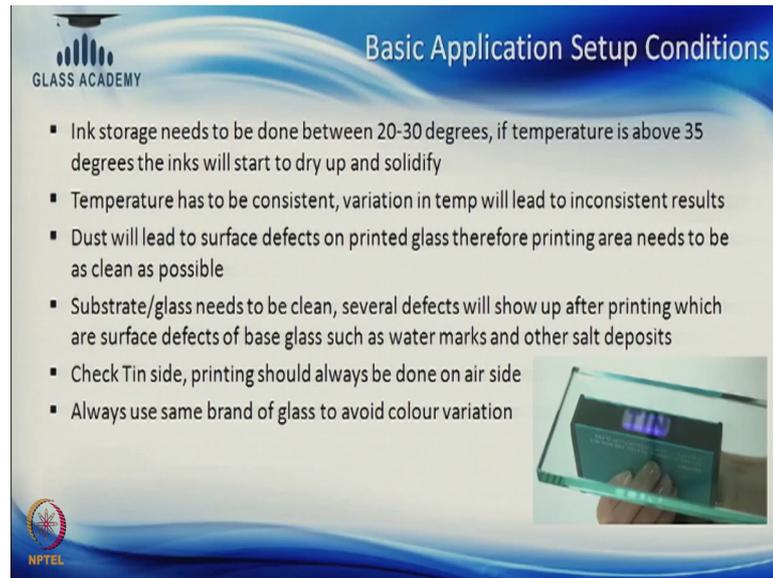
Lecture – 60
Ceramic Printing on Glass

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So, now we come to the application process. The application process we have covered three one is the roller coating or the roller printing, the other is the screen printing and the third is a digital print.

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Basic Application Setup Conditions

- Ink storage needs to be done between 20-30 degrees, if temperature is above 35 degrees the inks will start to dry up and solidify
- Temperature has to be consistent, variation in temp will lead to inconsistent results
- Dust will lead to surface defects on printed glass therefore printing area needs to be as clean as possible
- Substrate/glass needs to be clean, several defects will show up after printing which are surface defects of base glass such as water marks and other salt deposits
- Check Tin side, printing should always be done on air side
- Always use same brand of glass to avoid colour variation

NPTEL

Now, before we go on to how we apply these inks onto the glass there are certain things that need to be taken care of. The ink storage needs to be between 20 to 30 degrees which in India which is a warm climate the temperatures may go up to 45 is a problem. So, temperature above 35 will start to deteriorate the ink, the pigment will start to settle down in the ink basket and you will see a medium deposit on top of the ink layer. And this will result in consistent printing.

So, we need to store inks in cool and dry place, that means even refrigeration or maintaining a temperature between if not 20 to 30, a little bit more than 30 maybe a couple of degrees no more, it is essential otherwise will not get consistent results.

So, the printing areas where the print has to be done has to be as dust free as possible. I have seen certain print areas which are completely dust free, because the deposition of this dust on the glass surface or on top of the ink will later lead to pinholes and defects when the glass you know is tempered or fired. The substrate the glass has to be very clean. Now, a lot of the times there are solid deposits which are not visible by the naked eye if the glass is not cleaned well. And when we print it and when the firing of the glass happens, these watermarks or these salt deposits are visible at that time you may have lost a lot of glass and you will have no way to repair. So, it is best to clean the glass well before we start to print.

The other essential is checking the tin side. Now, when you are using float glass there are two sides of the glass one side is the air side, and one is the side which is floating on the tin bath. Now, tin is a metal. Some of the inks do not react to with tin. So, it is essential to print on the air side and all the glasses have to be printed on the air side, otherwise you will get a color variation or you might get something called a loom or a color difference in the. Other than that always use the same glass I know there are many brands of glass available, so it does not matter which one you use just use the same glass because there will be a color variation because of the tint of the glass. And also ensure that it is from the same furnace. So, if a glass manufacturer has three furnaces make sure it is coming from the same one you do not want a color variation due to this. So, these are certain preconditions before we start to print the glass.

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Roller Printing line

GLASS ACADEMY

- Washing section to clean the glass
- Roller coater for printing on the glass
- Dryer section for drying the ink
- Unloading
- Drying section can be as long as 30m
- It will depend on line speed and deposition thickness

NPTEL

So, the next process is roller printing. A roller printing line is essentially a washing section which will wash the glass to clean it properly, and then there will be something known as a roller printer which will apply a solid coat of a single color on the glass. And then there would be a drying section which will dry the ink. And you will get a uniform coat of any color that you are printing on the glass, where the even deposition of ink. This deposition of ink can be controlled the drying section it is quite long at times it will depend on the speed of the line. So, if the speed of the line is 7 meters per minute which is quite fast. You will need the glass to be dried off before we take it off the line, so that would mean that the line would be designed according to the speed of the roller printer.

So, it does take a little bit of space. So, the line speed and the deposition of ink the thickness of the deposition of ink will determine the size of the drying section.

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GLASS ACADEMY

Roller Coating Process

- When solid single colour printing is required it is preferred to use Roller coating process
- A roller coater has rubber rollers, normally with grooves, which carry the ink and transfer it to the glass
- A steel roller works in combination with the rubber roller to constantly clean the roller and maintain the ink flow.

NPTEL

So, what is a roller coater? So, roller coater is essentially a rubber roller which will it may be steel as well, but in case of glass normally we use a rubber roller to transfer the ink onto the glass surface. Now, in this kind of a roller normally a single color is deposited. The rubber rollers as I explained have grooves and the grooves will carry the ink which on contact with the glass will deposit the ink onto the glass surface. There is also steel roller which sort of you know attaches itself to the rubber roller, and controls the amount of ink that is going through and a scraper will clean the roller as the ink goes through.

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GLASS ACADEMY

Roller Coating Process

- Roller can also be patterned and mass production of patterned printed glass can be done by this process
- A thick deposition of up to 100 micron ink deposition can be achieved
- The lines of the rubber roller are often visible from the ink side



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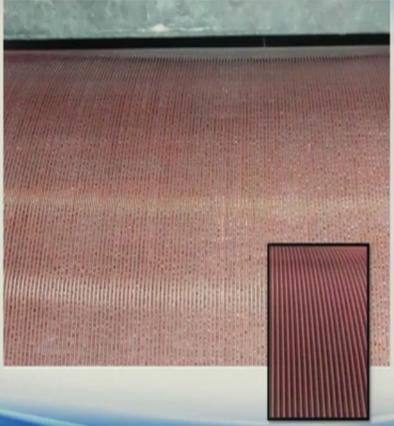
There can be certain rollers which I have certain patterns as well. So, there are you know like in the image, you can see certain patterns on the roller. So, you can also have patterned glass through this roller coating process. And you can transfer this pattern onto the glass. The same roller coating process can also be used for organic inks such as lacquers and is commonly used for that application as well.

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GLASS ACADEMY

Roller Coating Process

- Rollers are available with different grooves, defined in lines per inch
- 20 lines per inch would mean higher deposition of ink, 55 lines per inch would mean a lower deposition of ink. We may call it high and low opacity rollers



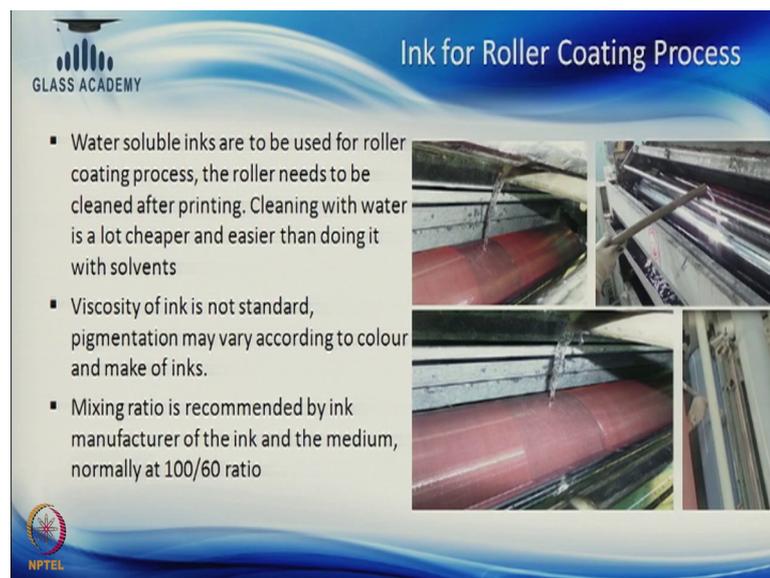
NPTEL

The rollers are you know grooves can be customized, so there can be more grooves or there can be less grooves as is shown in the image. A 20 lines per inch groove would give

a higher opacity of print and a 55 lines per inch will give a lower opacity of ink. So, the maximum that you normally print is 100 microns which is what we call a high opacity print, anymore and you will start having problems during the firing process and 40 to 50 microns would be the lower end on the low pass it into deposition.

So, it depends on the application in which the glass is going. For example, if it is going on a wall cladding you need a high opacity print, you need a 100 micron deposition. And with certain lighter colors even that 100 micron deposition may not be sufficient. So, you have to choose the right ink with the right pigmentation. And in certain applications organic inks are better, where they are more opaque. The use of the ceramic ink for wall cladding is where it can resist UV, where light is coming onto the glass or when it needs to be tempered. Certain applications, the glass will break and you need the glass to be tempered and there you need to use a ceramic frit.

(Refer Slide Time: 07:13)



GLASS ACADEMY

Ink for Roller Coating Process

- Water soluble inks are to be used for roller coating process, the roller needs to be cleaned after printing. Cleaning with water is a lot cheaper and easier than doing it with solvents
- Viscosity of ink is not standard, pigmentation may vary according to colour and make of inks.
- Mixing ratio is recommended by ink manufacturer of the ink and the medium, normally at 100/60 ratio

NPTEL

So, rollers are used water soluble inks if you use solvent based inks it is far too expensive to clean the rollers. Every time you are finished with a color you need to clean the rollers with water. So, water soluble ink is easy to clean. It will come off the grooves with a simple jet of water, and it is environmentally friendly. So, it is it is a much easier way of processing. Viscosity of ink will depend on the pigmentation of the ink it will depend on the color which you are printing. The darker colors may require less viscosity the others may require more. The mixing ratio normally is a 100 and 100 to 60 that

means, when you get the ink you have to add a certain amount of medium to the ink, and then you measure it what is the viscosity. How do you measure the viscosity?

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GLASS ACADEMY

Ink for Roller Coating Process

- Viscosity can be checked by Brookefield's viscometer or Ford cup
- Ford cup is normally sufficient and easy to use, where we measure the time taken for a measured quantity of ink to flow thru the cup. It is measured in seconds
- Normally 80-100 seconds viscosity is sufficient for a good print



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You can use a viscometer, popular brand is the Brookefield's viscometer which will give you how thick the ink is or you can use a very simple method which is known as Ford cup. Where you put a amount of ink in the Ford cup and you let it drain and you see how much time it takes for the ink to drain. So, based on that you can measure whether it is 80 seconds or 100 seconds. So, normally 80 to 100 second ink is sufficient for roller coating. In certain application lighter colors if the pigmentation is lesser, you may need to go for higher you know viscosity which means that if you go 200 seconds that means, the ink is thicker and the deposition will be will be the same, but the in viscosity will be. So, this is essential for determining the opacity of the print which is essential in roller coating. And it will also determine how the role of how the ink is rolled onto the cola coater. And this will determine how it is then passed onto the glass substrate.

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GLASS ACADEMY

Roller Coating Process

- Certain applications where glass has to be pasted on another surface, normally high opacity rollers are to be used for a deposition of up to 100 micron.
- Ink preparation is key to achieve the opacity that is desired
- Actual machine parameters vary and need to be set based on machine supplier recommendations



NPTEL

So, applications such as these where it is going on a wall, we recommend that you use a high opacity roller go for a 100 micron deposition; and the viscosity of around 80 to 100 although parameters vary according to the inks that you use. And you can have a nice and even print where you cannot see the silicon while it is being pasted which is the essential requirement for this process.

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GLASS ACADEMY

Dryer for Roller Printing

- As the deposition of ink is quite thick in Roller coating, it needs to be dried well
- Contamination will occur if ink takes long time to dry
- Adhesion between ink and glass also improves during this process
- With high line speeds of up to 7m/min, dryer lines can be 30m long
- Infra red heaters are used to dry the ink and cooling sections then cool the glass for further handling



NPTEL

So, as soon as you print the ink it has to be dried, because you are doing a thick deposition of ink dust will come and settle on the glass. And dust when it settles on the

glass or on the ink it will show up when you fire the glass in the furnace. So, you need to dry it off as quickly as possible. The other reason is that it takes a long time for the ink to dry. So, when you unload the glass of the machine, there is a chance that the frit gets damaged. So, the sooner it gets dried off, the better adhesion it will have on the glass and the lesser chances it has to deteriorate while handling. So, normally the dryers that are used use infrared heating and you also heat the glass and then you cool it.

So, it is essential to cool it to be able to handle it. And if you just heat it and let it be that then there can be other problems as well. So, the line speed can be controlled and essentially the fastest you can go is 7 to 8 meters. So, the drying length would be determined accordingly, you can have more heating sections or more cooling sections depending on the time type of glass that you print. There are certain applications glass shells spandrel panels which may require low opacity prints. And there you may not require a very long dryer if the interposition is lesser.

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Summary:

By the end of this video, you have learnt about the:

- Application processes
 - Roller coating
 - Screen printing
 - Digital printing
- Basic application setup conditions
 - Roller coating

