Glass Processing Technology
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Lecture - 62
Ceramic Printing on Glass-Part IV

Then we go on to digital printing which is the latest process of printing.

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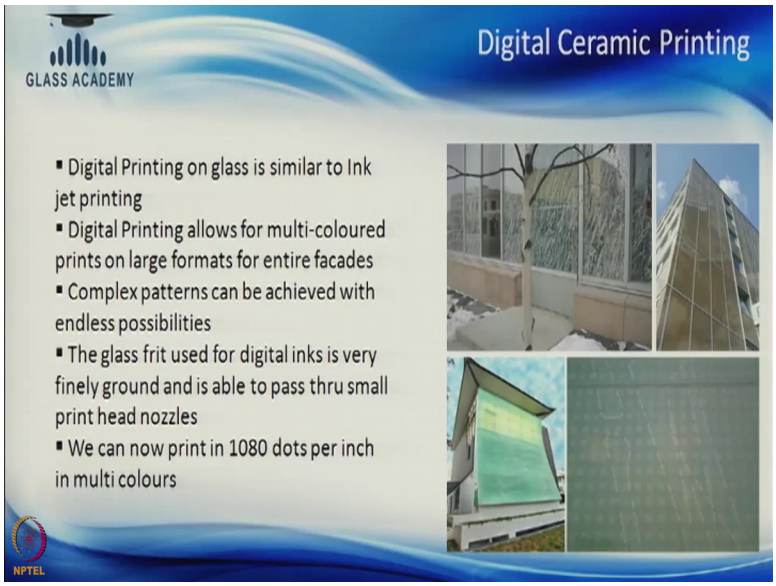

You can achieve very dramatic results with digital printing. It is similar to inkjet printing, but not entirely. Digital printing can give you multi coloured prints on large formats even on entire facades; which was very, very difficult to achieve with screen prints. As you can imagine large number of screens would be required to do a large facade. And as you have seen the screen printing process, it is not the easiest thing to make a screen.

So, making 100's and 1000s of screens is not easy or cost effective. So, in case you want to have a facade which is dynamic which has a lot of colour has a pattern flowing all across it, you need to go with a digital print. Complex patterns can be achieved even simple patterns can be achieved wherever you want to substitute an ink maybe there is one glass that you need to print. So, you do not need to make a single frame for that. And the glass frit as you understand is a glass particle. Now these digital printing machines can print to a resolution of 1080 dots per inch or 1080 p now that is very, very fine.

So, the glass frit that is used for these inks is very, very special, it is very finely ground and is very expensive. So, the inks that are used for this kind of printing are very special, and that is what drives up the cost and they have to be very, very fine. The nozzles through which the ink comes through is susceptible to dust, and the areas need to be very clean, and you need to wash the heads well. So, it is not as simple as your normal inkjet printer because the inks are far more complex.

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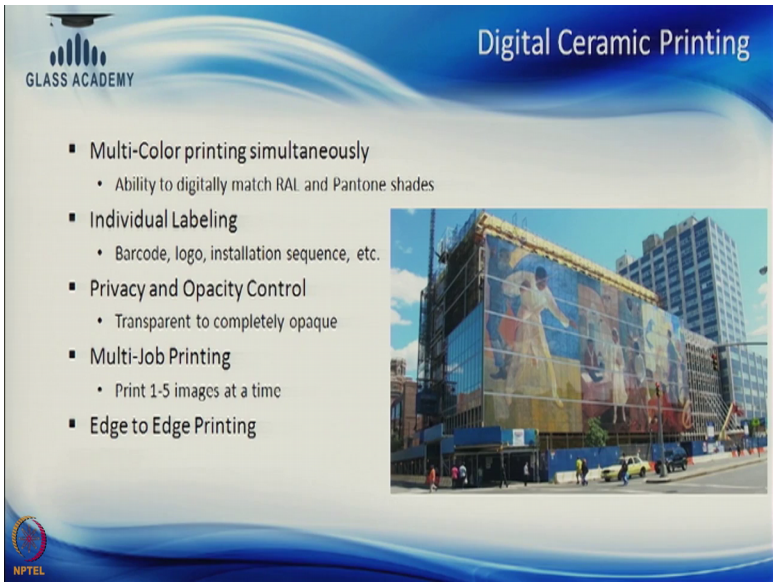

So, you can do multi colours simultaneously. It is not a CMYK print. A CMYK print means that you have 4 basic colours and you can then perhaps go on to make 256 colours or more.

With ceramic inks I have explained before that it is not that easy to mix. So, you have a large variety of spectrum inks, or various kinds of inks which are available in many many colours. So, you can mix and match various colours and you can incorporate that into a design, but essentially you do not get the CMYK print that you get in other inkjet printers.

So, there is a limitation on what you can print. If it is a 6 colour design; that means, only 6 colours are going through and whatever you can achieve through mixing those 6 colours can be achieved. Although, as you can see the examples are quite brilliant, but they cannot be compared to an inkjet or a UV inkjet printer which will have very vivid designs, but they will not be robust.

So, you can have individual labelling on the facade glass, you can you can have numbers and panel numbers on each glass when you print it. So, they all come together as a jigsaw puzzle. You can do multiple jobs at the same time you can do edge to edge printing, you can do dot on dot printing;so, several possibilities with digital printing.

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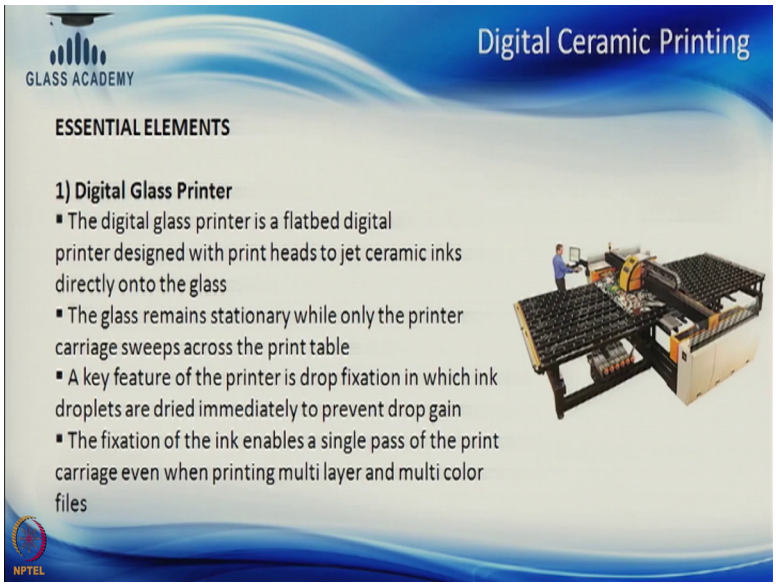

But you know we need to understand the process, before we know what are the limitations as well. It is essentially a flatbed printer which will throw the ink onto the glass surface directly. The glass normally is stationary, although there are certain models where the glass will not be stationary. And the inkjet will print on the glass. Now the drops which are going onto the glass surface can also be dried at the same time with a dryer attached to the print head itself, which is called drop fixation, which will allow the ink not to spread.

So, you can have a dot which is very precise, because it is a liquid when it goes onto the glass surface it will try to spread, but if it is dried up immediately, it will not spread. So, this allows you to do very accurate prints, where you can put one dot on top of the other which is called dot and dot. So, you can have white print from one side and black print from the other. So, you can have the building look white from the outside and have the black colour from inside. So, this is possible with digital printing technology.

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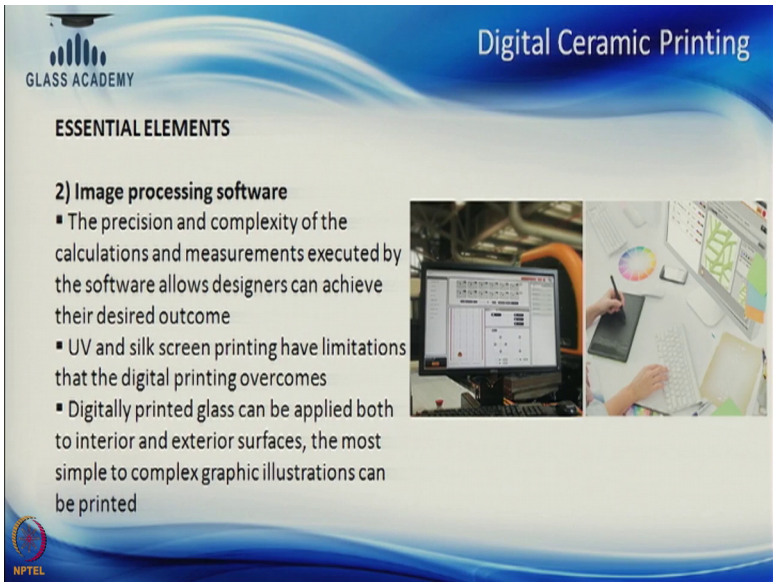

So, this is quite interesting. The heart of the digital printing technology comes from image processing. So, we have to understand that normally even a high resolution image is really small.

So, we are talking about size of an A4 and when we have to print across the size of the building the formats need to be bigger, we need to tile it, we need to expand it. As soon as we expand the image the image gets blurred. So, the image processing has to be considered before we can print. If we want to print something in a very large format, it needs the image processing to support that, now whichever digital printers are there in the market they have image processing which supports this kind of prints. And we can calculate the amount of ink that is going through we can simulate how it is going to look on the facade.

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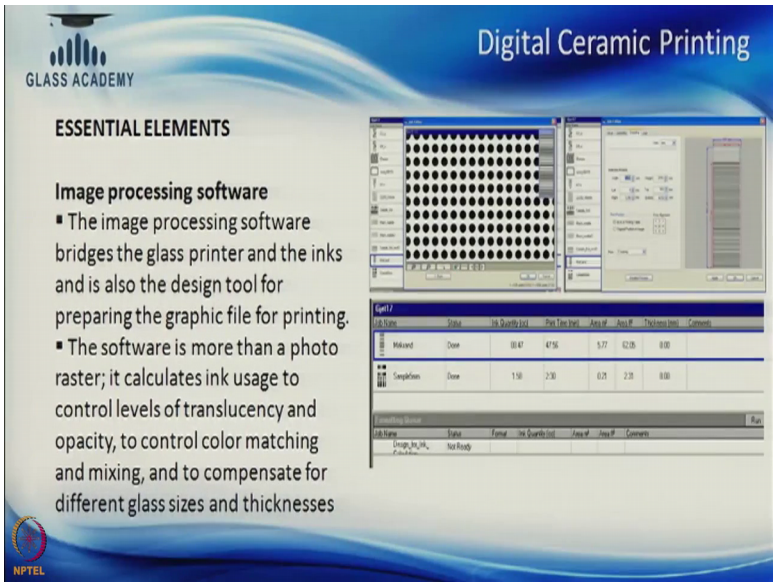

So, the image processing software will calculate that for you, as it is shown over here what is the dot coverage, what is the amount of ink that is going to be used. Since you are able to calculate the ink that you are going to use, you can calculate the cost per print. As I explained earlier, the inks are really expensive for the digital prints, but they cover a lot more area, why? Because the inks are really thin.

So, the inks are really thin; so, they can print on a lot many square meters so, it is a balance. Some designs will be in fact, cheaper and the digital print where the ink deposition has to be very low as compared to any other process. So, the same process can be cheap or expensive depending on what you are trying to print. So, if it is done intelligently it can be quite cost effective.

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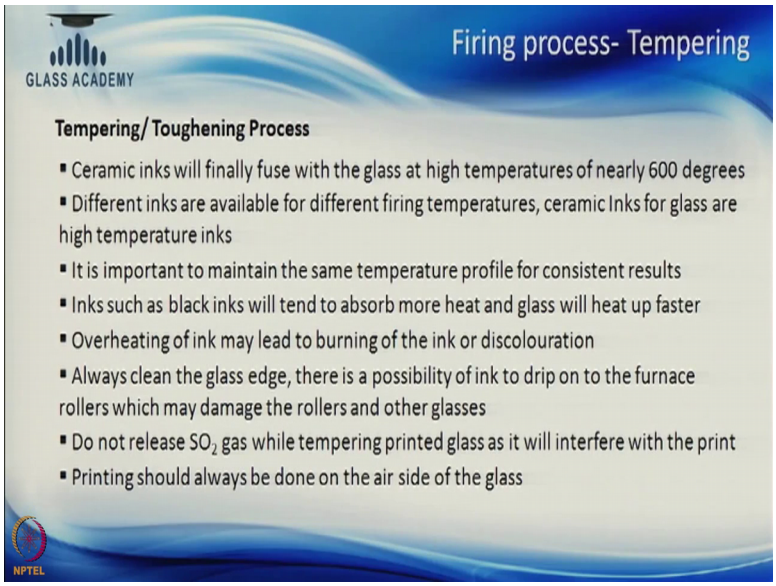

So, we have not talked about the firing process I will briefly mention it. So, once we have printed through any of the 3 processes whether it is roller screen or digital, then we need to fire the ink.

So, in order to fire the ink, we need to put it through a tempering furnace. Most of the ceramic inks are high temperature inks, although for certain applications such as bottling, they are available for lower temperatures. You have to keep in mind that processes like windscreen bending where the glass goes in the bending section for a longer period. A different grade of ink will be required which is also high temperature, but can stay on a high temperature for along the period of time.

So, normally certain inks will go up to 600 degrees before they fire some would go lower. So, that depends on the ink that you are using, but they will fire at a high temperature on the tempering furnace, but what you need to maintain is that the firing temperature has to be consistent you need to note down at what temperature the ink is going to be fired, and what is your setup process. The setup process needs to be replicated; if you have multiple furnaces different furnaces will give different results.

So, the same pattern and the same design and the same job has to be done on the same furnace. If you do it on this on different furnaces, there will be a colour variation on certain inks if it is fired differently. Radiation furnaces will react differently than

convection furnaces, and you have to be careful not to release. So, 2 gas while you are doing the firing because that will interfere with the ink.

So, essentially the parameters have to be consistent, you have to note them down. And you have to understand that the medium which is carrying the ink will be burnt in the firing process and will escape during this process. So, the final result of the printing can only be checked after the firing. So, after the firing you will notice a number of defects pinholes issues, which were not visible earlier; because now the medium which has escaped has left some gaping holes in the design.

So, which needs to be checked on the other problems, which a lot of people are faced is the ink dripping onto the surface of the rollers. So, you need to clean the edges well, you do not want that if there is some ink right on the edge of the glass, when it goes inside the furnace, it goes into a liquid stage first, dips on to the ceramic rollers and those ceramic rollers are quite expensive, and it will damage them permanently.

So, this is not something that you want to do. So, you need to clean the glass edge before it goes on to the tempering. So, these are some of the things that you need to take care of, and always ensure at the tempering process as well. If the printing is on the air side, if it is on the tin side, you may have problems during the firing.

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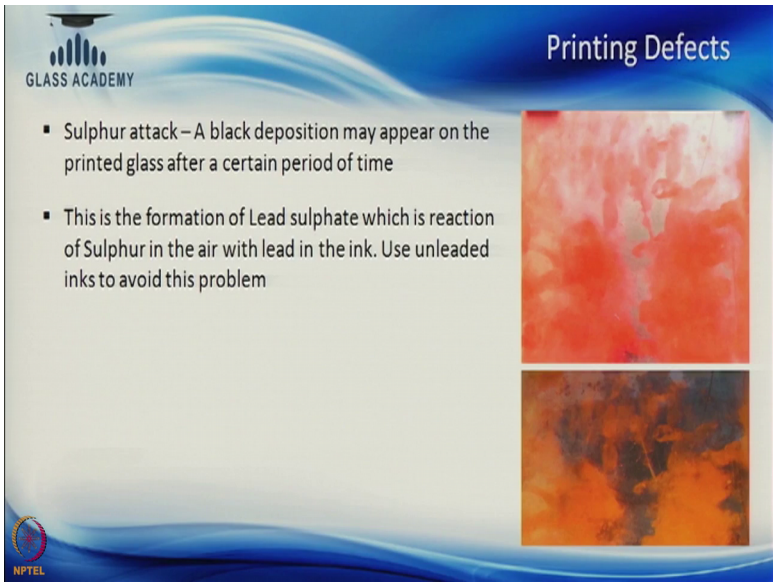

So now we will go to certain printing defects. Once you have printed everything and fired the glass there are certain issues, that are known I am just going through a couple of issues; which you may face and these are the reasons for it. There is something called a sulphur attack. Sulphur attack is a black deposition essentially on the glass printed surface.

Now, this happens after a few months of you know the glass has been supplied. Essentially, you will not see it in the factory quite often. This is a lead from the glass ink reacting with sulphur in the air. So, it makes something called red sulphate. So, it is essentially a chemical reaction which goes off which is not pretty. And sometimes it is visible from the other side as well. So, if you have got certain areas where you know you may see some patchiness after some time essentially, what is happening is that the sulphur attack is happening at the back.

So, we need to be careful do not use leaded inks, I know they are cheaper. But they have these kinds of problems, and in India the pollution levels are so high that there is practically no place without sulphur. So, you this is one of the major problems. So, I highly recommend to use unleaded inks and heavy metal free inks. And make sure that there is a certification to go along with it. Certain lead free inks are not very lead free. So, look at the certification look at what the supplier is giving you.

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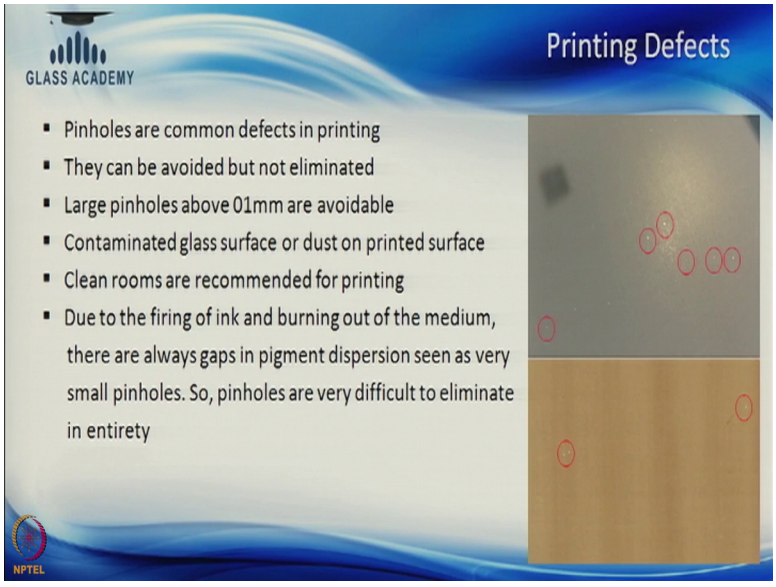

The other common printing defect is pinholes. And now pinholes on glass, roller quoted, screen printed any process of printing of ceramic ink, when it is a solid print you do not want it in the vision areas. If there is light coming through the fret patterns, you will see many defects; which are essentially unavoidable. So, you can control them, but you cannot eliminate them. So, pinholes are issues where which will throw up, because when the medium burns out, there are certain gaps left between various pigments. And if you put a very harsh light even on the best printed glasses, you will see very small pinholes.

Now, these are not something which the customer objects to. What the customer objects to are the are the large pinholes that are there in this you know image. These are essentially 1 or 2 mm. Now these may happen due to 2 or 3 reasons. Some of these reasons are not well understood. The first reason is the glass itself is not clean. So, there was dust on the glass surface when you printed it and the, that has not allowed the ink to worn through the glass surface. The other thing is that you printed the glass, and dust has settled on the ink. And it has burned out during the firing process; which will also leave a small mark around that particular pinhole.

There is a third possibility as well although not so common; is if the ink itself has dust in it so, you need to filter it well. So, dust free environment for printing is always better, but it does not ensure that there are no pinholes. So, the ink if it is separated; that means, the ink if it is you know kept in conditions which it is not supposed to be kept high temperatures, the pigment may settle down and the medium may separate which may also leave gaps in the dispersion. So, when you print the glass and you fire it some of the pigments do not actually go and fuse with the glass. So, pigmentation issues can also lead to pinholes.

So, this is one of the essential problems, you need to have the right ink you have to need to have the right process and the environment has to be dust free. So, this is a common issue. I do not recommend using solid planes on vision areas use it for spandrel areas use it for wall claddings. But if the pinholes are too big, it will even appear on you know (Refer Time: 13:51) lightings. So, just maintain the process right.

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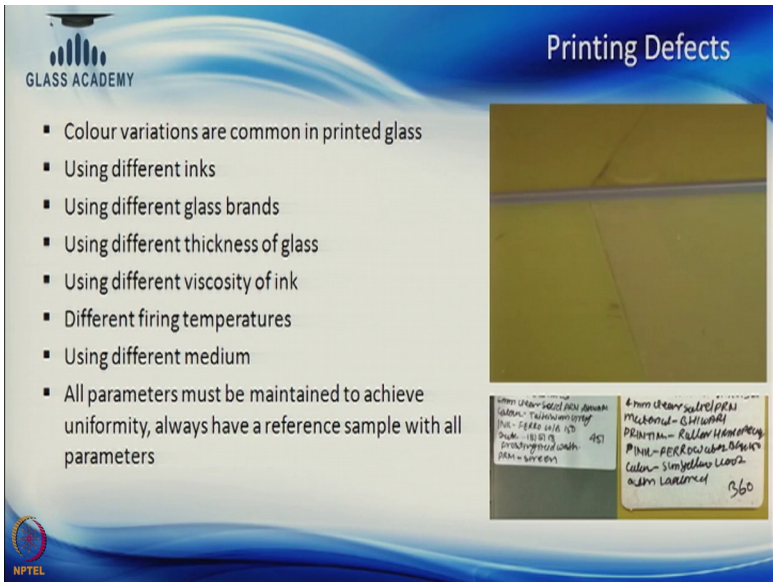

Colour variation is the most common printing defect. It is essentially because you have not controlled a variety of things. Ceramic printing is not easy, you need to control the substrate which is the glass the glass colour if it changes, you have a colour variation if the ink it changes you have a colour variation if the ambient temperature in the room, or the viscosity changes while you are printing it. Or the deposition of ink is different in different lots or the firing temperatures are different in different large. These will all be contributing factors to colour variation.

I have just shown a couple of images with the parameters of a reference sample. So, once you set on to print anything you must have reference samples. The reference samples should have the exact specification of what you are printing under what conditions. So, those conditions can be repeated, and if those conditions are repeated and if the processes are repeated more often that not, you will have a uniform print, which is which is not you know visible to be to be to be having any kind of variation.

So, this is not the easiest thing to print on glass, but you know you have to follow the processes and keep improving.

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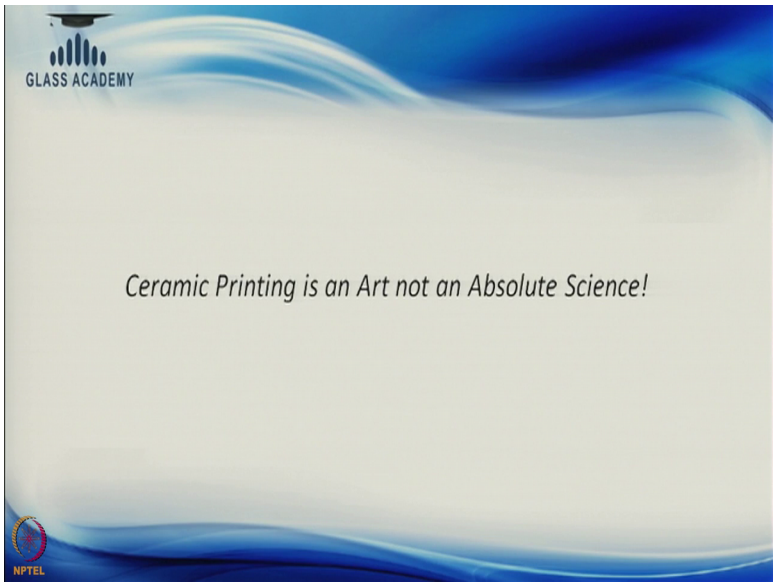

To finish off, I will say that ceramic printing is an art, it is not an absolute science, so many parameters that need to be looked at. And because of that you need to keep moving with the process you keep doing and checking. So, have reference samples, see what works for you use the same brands of inks use a consistent process.

No ink manufacturer will tell you what is the exact viscosity, no machine manufacturer will tell you what is the exact speed at which you should be running. No furnace manufacturer will tell you what is the exact firing temperature. So, all of these things have to be done through a process, you have to keep recording and keep having a uniform base and then you will achieve uniform results.

In architectural applications; where the processes may change and the requirements may change on a daily basis. This is much harder than industrial applications, automotive appliances, where you are essentially doing the same thing and it can be repeated in a much tighter sequence. So, it is something that you need to learn. And there will be differences in inks, there will be differences in mediums, there will be differences in various parameters; that need to be tracked well. You need to understand the problem, you need to understand the process before you can have a good print and it is always a work in progress. So, I wish you the best luck, and I hope you learn something.

Thank you.