Glass Processing Technology
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Lecture - 27
Tempering_Part IV

Let us move on application of tempering. Basically, the tempering is widely used for in glass industry and this thus glass has been used widely for all part of country.

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So, where is application of tempering is its architectural glass either in the form of you can use the monolithic glass or you can use the double glazed or will be laminated. But, the tempered glasses is widely used because the safety nature and impact resistance and blow resistance like outside wind resistance and distortion has to be tempering glasses would be there. But you can that can be eliminated will be reduced with help of a good tempering process, if you have a continuous process continuous chambers are there.

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So, these are the applications of architectural glass of tempered glass and you see the complete clear glass building this these are the tempered glasses.

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And, lobbies inside the lobbies not only the exterior facade there is no restriction at all, it can be used for the interior application partitions as well interior. So, which are the what are the glasses you saw that inside the building which is completely tempered the glass simple.

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And most important next is automotive sector yes, widely used for windshield and side windows, back side windows. Those car, those automotive sectors have been used laminated glasses which tempered glasses safety aspect of this. This is one of kind in tempering process and annealed process it widely used in glass in automotive sector.

So, let us move on heat strengthening. So, what is mean by heat strengthening? Heat strengthening is a process it is nothing, but the rate of cooling is differs. The similar as good as a tempering, the heating is similar. The only the rate of changes in the process count a cooling and quenching process. How slow you are cooling the glasses, you will be getting the heat strengthening glasses.

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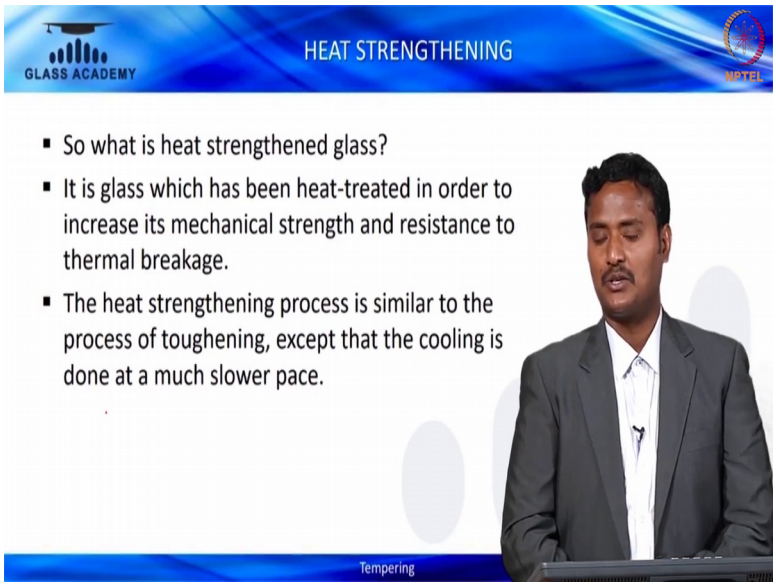

So, what is heat strengthening glasses we discuss about right now. So, it is the glass which has been heat treated in order to increase the mechanical strength and resist into the thermal breakages. Again, the as good as similar tempered glass definition, but the heat strengthening process is similar to the process of toughening process except that cooling is done at the much slower pace. So, that is having said that. So, how fast you are cooling the glass will be getting the tempered glass. How slow you are cooling the glasses you will be getting the tempered glass. So, of reason follow me that we will be getting a heat strengthening glasses.

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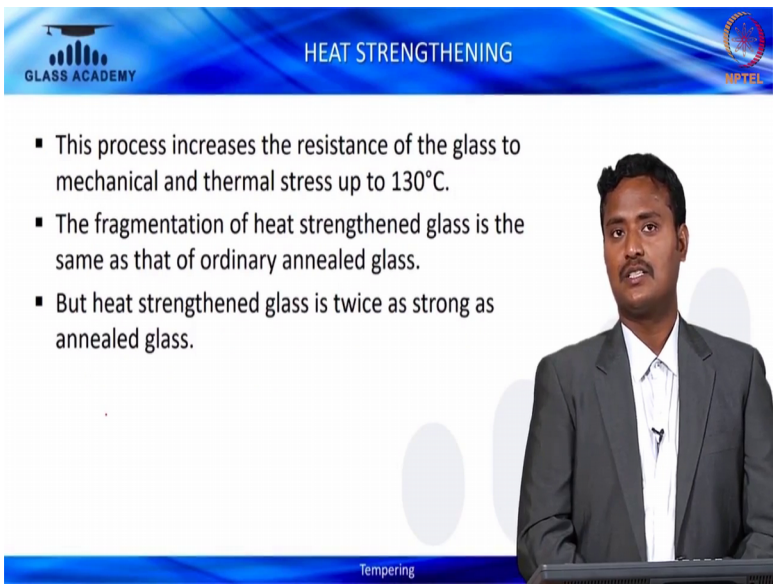

This is the process increase the resistance of the glass to mechanical and thermal stress up to 130 degree centigrade whereas, tempered glasses it can resist up to 200 degree centigrade. The fragmentation of the heats in the glasses are similar to that of a ordinary annealed glass fragmentation. But heat strengthened glasses is twice as stronger than the annealed glass ok.

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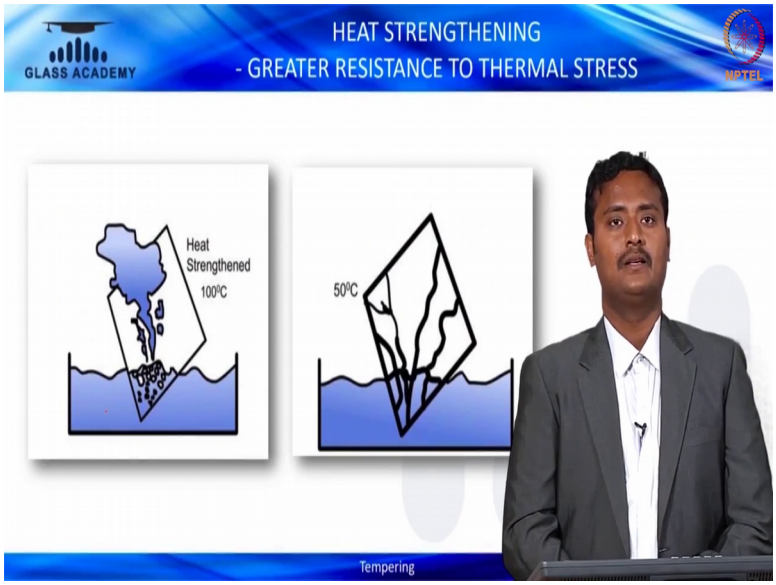

So, heats in the glasses you can see that up to 100 and 120 and 130 degree centigrade that heat can the thermal shock proof can be resist up to 130 degree centigrade. Whereas, annealed glass you can see that the rightmost which is 50 degree centigrade; the fragmentation is completely differs.

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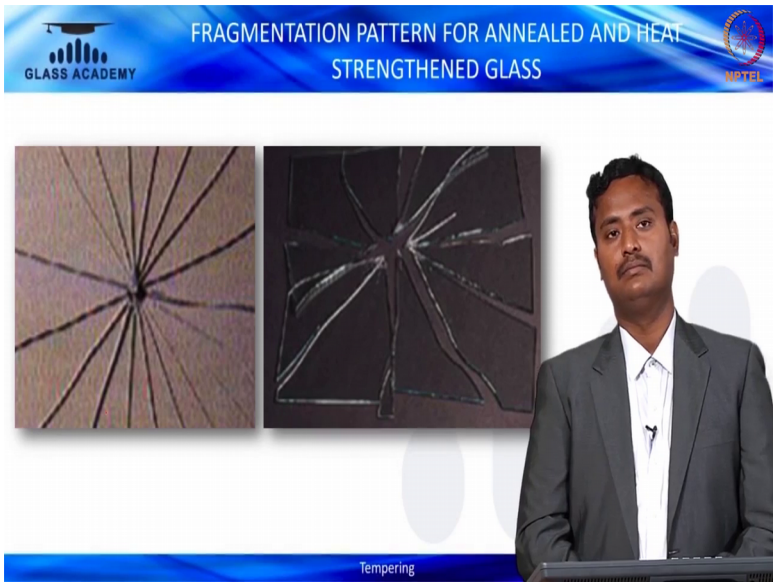

So, this is the fragmentation pattern. If the glass brokes kind of breakage pattern you can understand either it is annealed glass or its tempered glass or its heat strengthened glasses.

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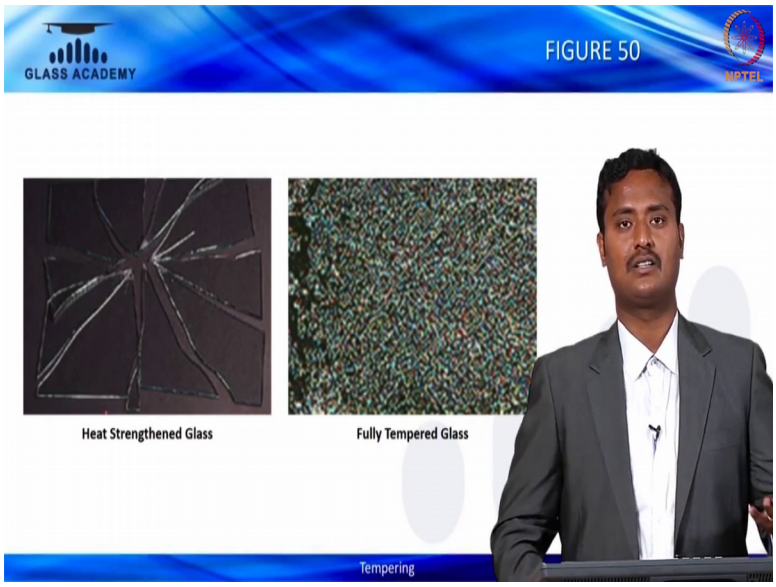

So, this is the difference between heat strengthened glasses fragmentation and tempered glass fragmentation.

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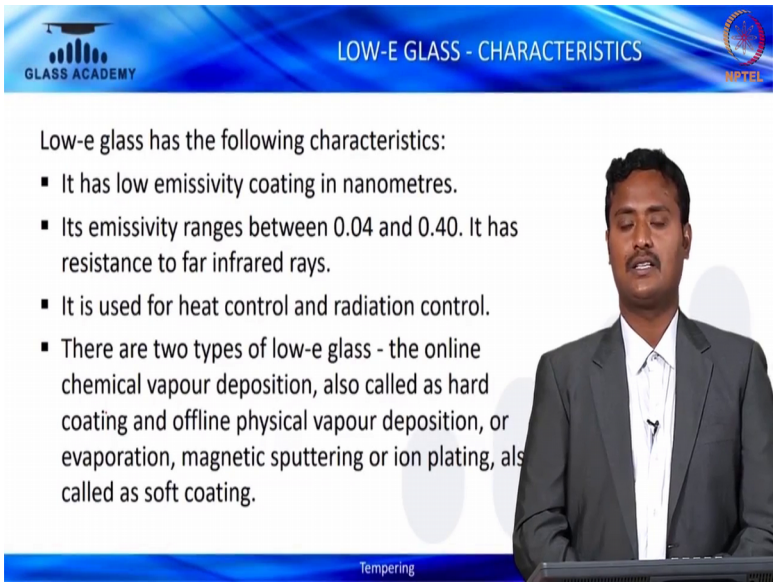

Let us move on low-e glass tempering. So, low-e glass has following characteristics. It has a low emissivity coating in nanometres, low emissivity and it has a range of between 0.04 to 0.40, it has a resistance for far infrared radiations. It is used for heat control and radiation control and thermal insulation glass. There are two types of low-e on online that is called CVD: Chemical Vapour Deposition and one is called offline which is called physical vapour deposition.

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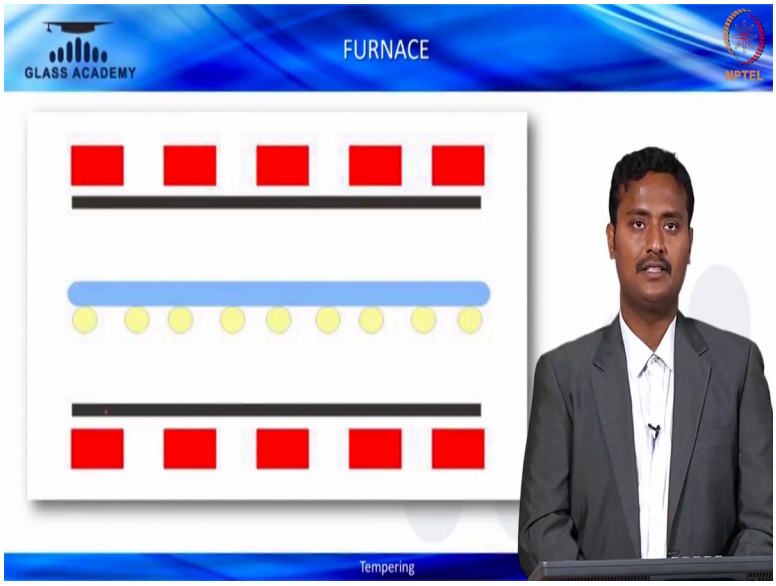

So, this is the furnace you are fed as low-e glass inside. Basically, the low-e which is

coating is on the on the airside which is which is not touching on the roller side that is called airside. So, low-e glass fed as a on the airside.

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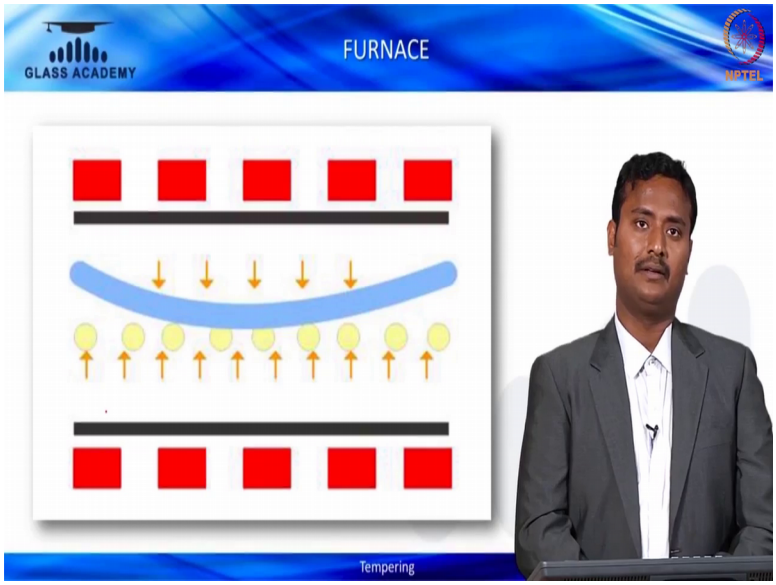

So, what has happening? So, when it is as soon as the glass gets inside within 60 second the glass would tends to bent like convex. So, because why this is because the low-e coating it reflect a heat more because, it is low-e its emissivity low emissivity coating it reflect more heat on the top. To due to that so, the glass after 60 second immediately glass will go like a concave like its dish, like boat kind of this.

In order to avoid such a defect or if you want to make it as a flat so, what we have to do? We have to increase the top temperature a bit and you can play the air pressure on the top. So, thereby you can make it a flat in terms of by glass processing.

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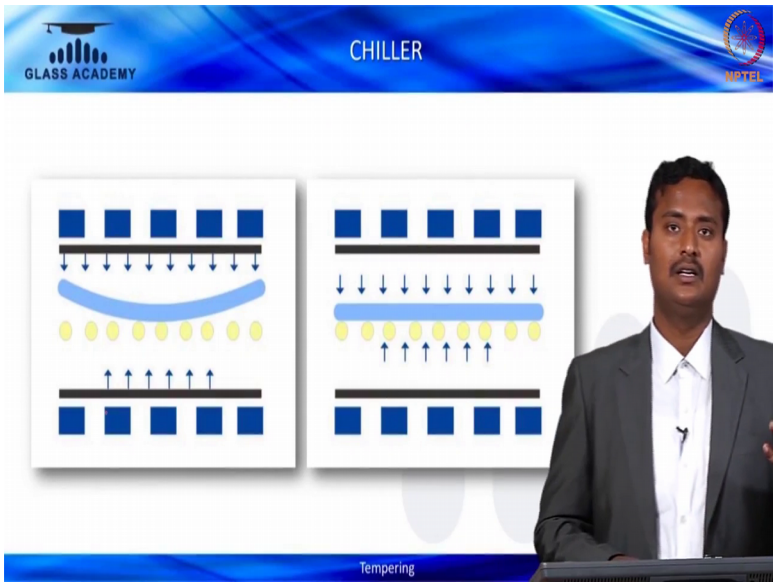

You see that the more heat comes in the top and more air comes in top. So, thereby will be attaining the flatness of the glass in as compared to the low-e glass process.

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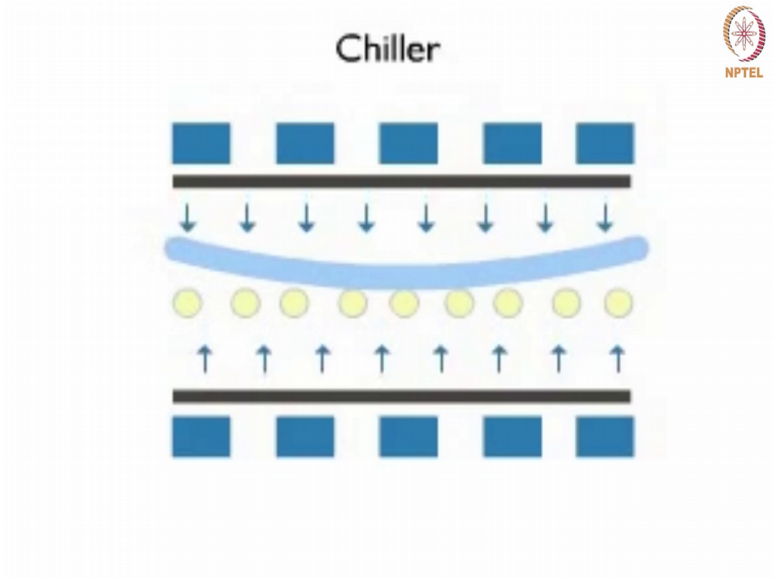

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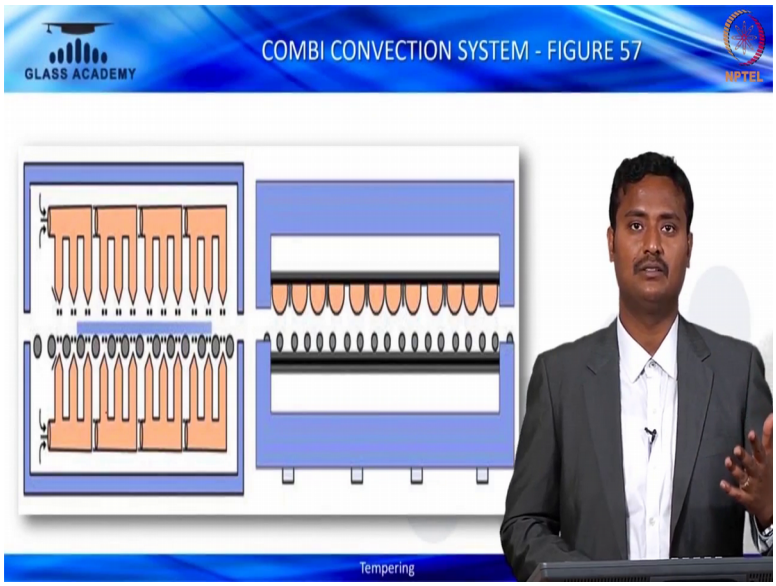

And, combination of convection system which is it is a preheated like which is low-e glass has been heated up in the ones one chamber. After that you immediately pass on to the another chamber which is combination of convection, which is basically two types of batch process will be taken place. Thereby, you will have a more optical quality because low-e tempered glass as a as a more distortion at the when you glaze it outside.

In order to avoid that if you used as a continuous like process like combination of convection system where is it is not on the single chamber alone or if you have a continuous chamber, you will have a greater optical quality you can get it out of this without changing that characteristic of a light transmission, sharing coefficients everything.

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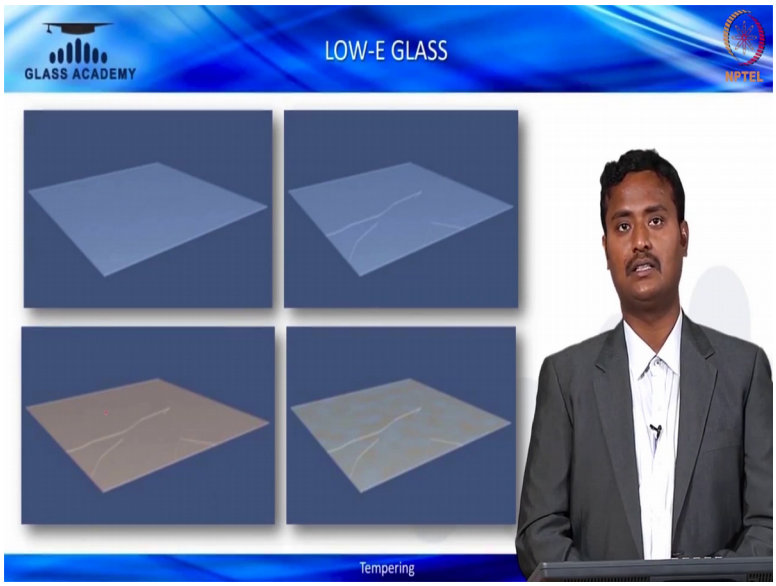

And low-e glass if you see that the glass breaks, not only the low-e glass or any glass if it is in the furnace, if it is not as a good recipe the glass would break like this start like this. Let us discuss about an defects in tempered glass and common defects or what are the common defects or there in this defects in tempered glass.

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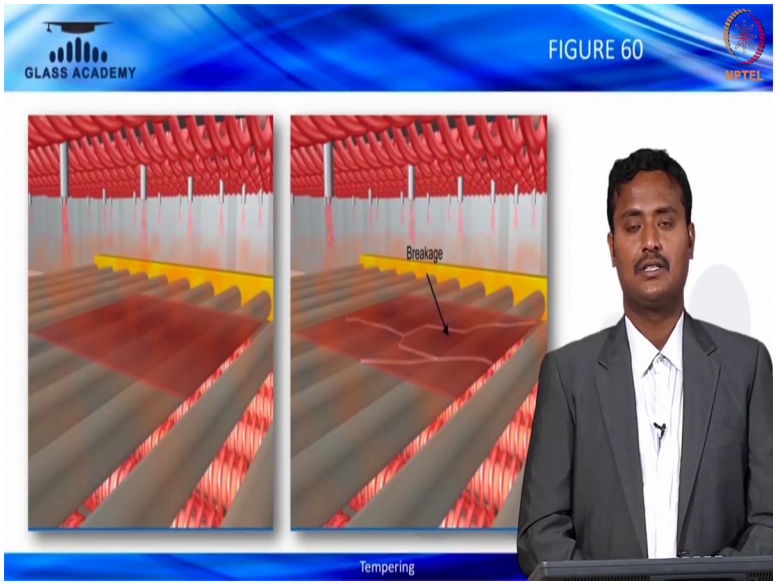

Breakages, this is happening in the chiller or this is happening in the furnaces. There are two types can be done also.

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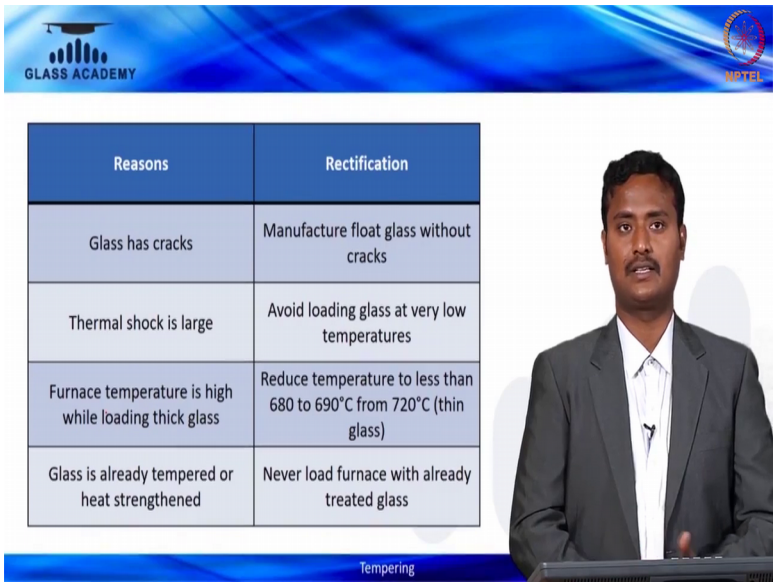

Let us see what is the issues, what is the solution. Reason for the crack glass has a crack, manufacture the float glass without crack. So, which means what is the reason if you fed in the glass recipe with the fed the glass inside the furnace, you should not have any crack as a annealed glass form.

So, in thermal shock is large for example, thermal shock people are when you glaze outside the glasses started breaking it would not like self suicide kind of a risk. So, avoid loading the glass at very low temperature. So, should be as good as 680 for 6 mm 680, 700 within the range you have to fed. If it is less then the limit was specified the glass would break in the furnace and furnace temperature is high while loading the thick glasses. So, imagine we have discussed this main parameters for the heat tempering. So, thickness as goes the temperatures as less whereas, heating time will be increases.

So, furnace temperature is when is high, one at the time of loading the thicker glasses. So, reduce the temperature 680, 690 from 720 thin glass like this. So, glass is already tempered or already heat strengthened glasses. So, once it is processed please ensure the all the process should not be fed. Again, we should not retreated, again we should not retemperate again or we should not reheat it reheated process you should not do that. Once it is done its done because, that is characters of stress has been attained already from the surface of composite free zone, you there is no longer to rearrange themself.

So, you cannot do any mechanical or strength cannot be increased. So, it is not advisable

to use already tempered glasses should not fed as I mean once again we should not use for tempering. So, which means we should avoid. So, never load furnace with already treated glasses that is solution.

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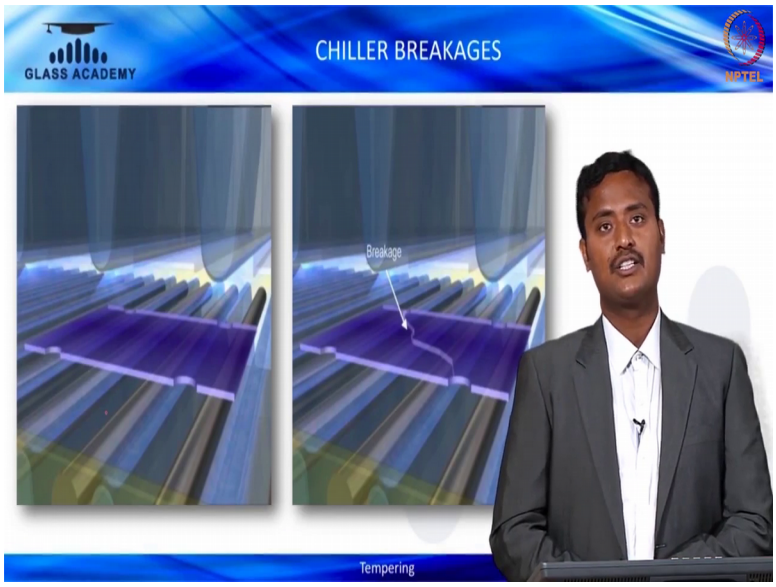

Next the glass breakage inside the chiller. So, why it is breaking? Let us see the reasons.

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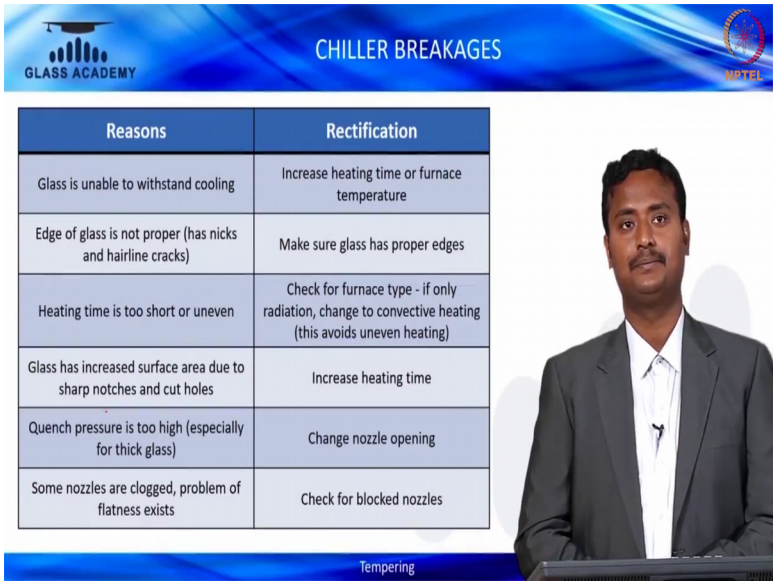

Glass is unable to withstand the cooling. Increase the heating time or furnace temperature basically, it has a low cooling. So, you have to increase the heating time or furnace this thing. The main aim is to increase the heat because the glass is not withstand

the heat or withstand the cold. So, better increase the heat a little bit than the proposed one so, that way you will get it.

An edge of the glass is not proper as a nicks and hairline cracks which is not able to understand hairline cracks or if any already nicks. For example, during the grinding process there may be some particle would have been left, the grinding portions or that have a shelf form there. If they not flatten enough the polish is not flat or arising is not flat, if fed as inside the furnaces it will start breaking edge. So, make sure the glass has a proper properly levelled, properly edged finished.

Heating time is too short or uneven; having said that heating time which is temperature is very less. So, either we have to increase the temperature or heating time that we have to increase. Check for the furnace type - if only radiation type change the convictive heating, avoid uneven heating which means in the radiation type you will have a you have to increase more heat. I mean hating time has to be increased 10 to 20 percent than the convection type because, the radiation type where you are feeling the heat because of the electromagnetic waves there will be a considerable loss of heat loss.

So, the significant temperature changes I mean heating uniform take place at the convection type whereas, radiation type you have a greater loss in terms of radiation types. So, thereby you need to have a more heating time up to at least 10 to 20 percentage than the convection system. Quench pressure is a too high. Change the nozzle opening because, the rate of opening is much more higher so, that we have to change it. Some nozzle are clogged, a problem of flatness exists. If you are not done properly maintenance or schedule or breakdown maintenance or preventive maintenance are not done so, far. What happen after couple of months all the dust has been accumulated on the orifice of nozzle.

So, when the glass comes into the quenching portion those dust it will not allow further air flowing to quenching section cooling section, it is a blockage which is it is completely useless if you use those kind of nozzle. So, better we have to clean the surfaces thereby, the uniform air flow will be blown through the surface of the nozzles. To check this block nozzles, if this block it can be clean and further blocked kindly replace it that is the best solution for this.

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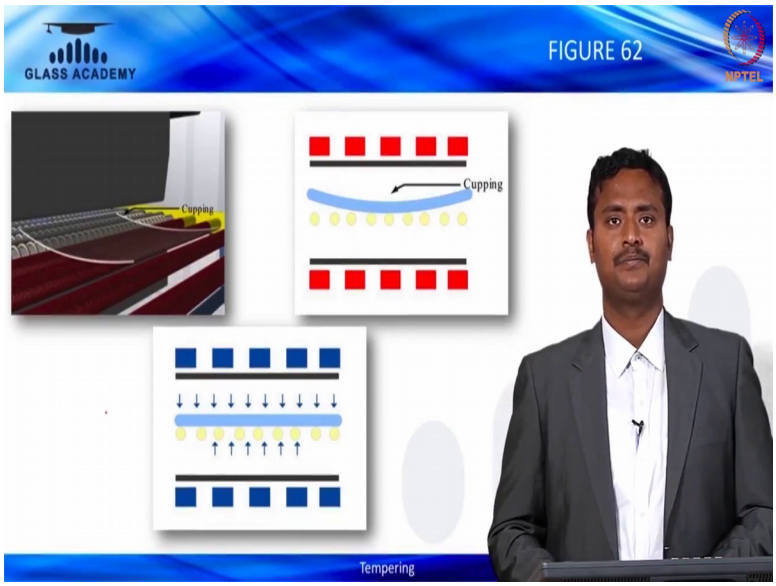

Figure 62 what is being to understand this is the cupping this is the concave, this is the convex types of defects which you would of seen that. So, what we can do in this either increase the top temperature, we have reduced the temperature. Let us see the bottom.

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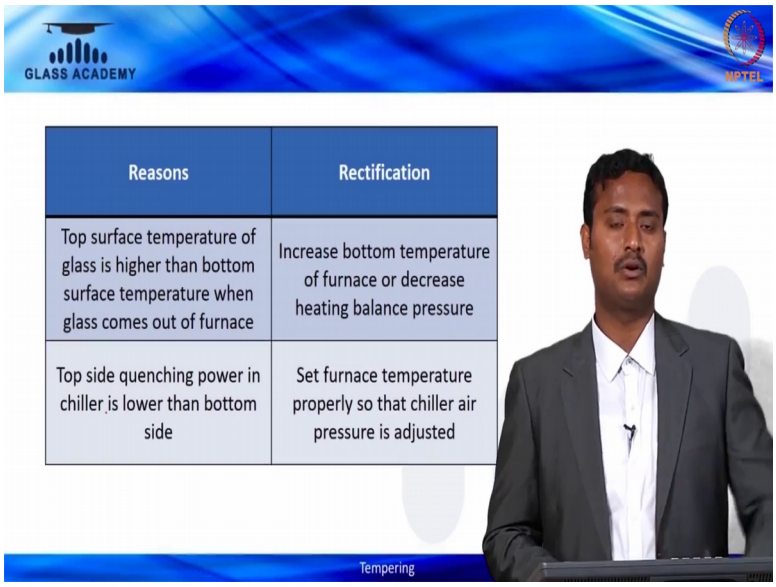

Let us see the reasons and rectification. Top surfaces of temperature is higher than the bottom surfaces temperature when the glass come to the top furnaces. Increase the bottom temperature of furnace or decrease the heating balance pressure. Top side quenching power is in chiller is lower than the bottom side. Set the furnace temperature

properly so, that chiller air pressure is adjusted. So, that is rectification we can do.

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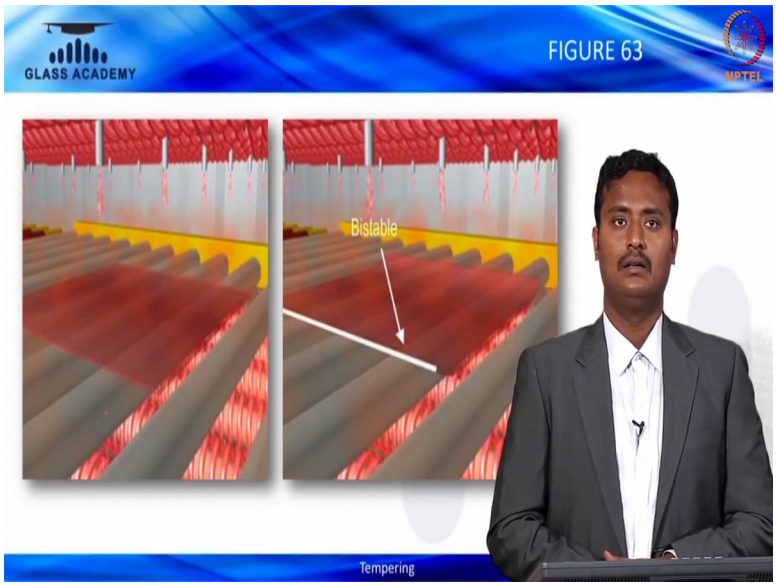

And this is the bistable problem when the glass is heated up ugly any one side will be heated up further than the other side.

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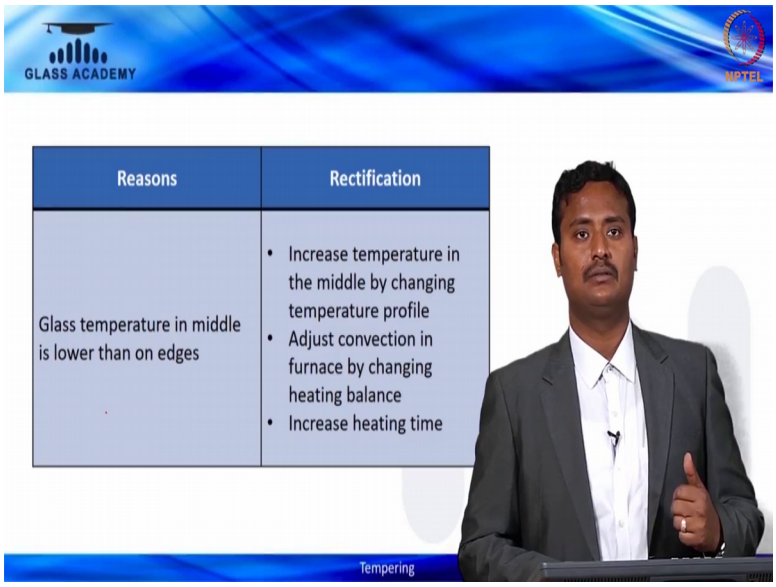

So, glass temperature in the middle is lower than the edges. That is the which means, the centre have a mode the middle is the mode the edges are very less or edges is more high or middle is low. Rectification: increase the temperature in the middle changing the temperature profile, adjust the convection furnace by changing the heating balance,

increase the heating time. So, waviness this is the most common defect for all the tempered glasses, inert it cannot be avoid it can be slightly modified or you can say slightly eliminated with help of convection system with the heating time changes.

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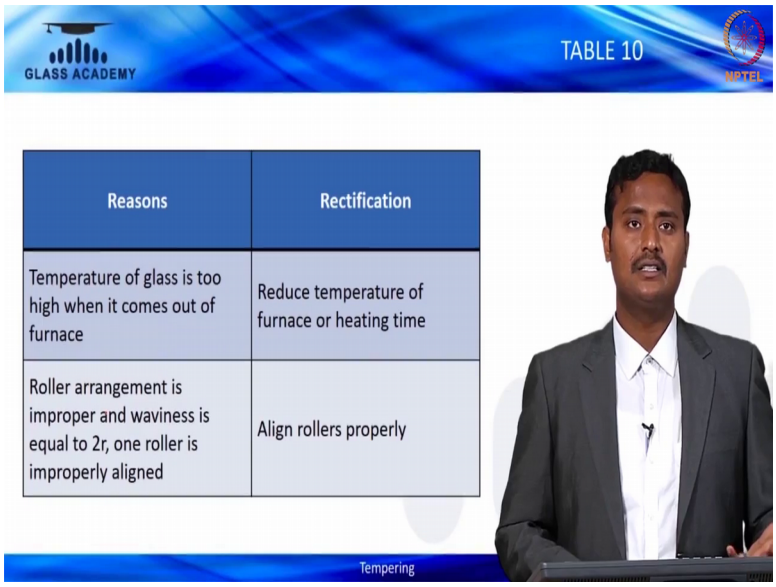

So, reason is the temperature of the glass is too high when it comes out of furnaces. Reduce the temperature and furnace or heating time. Mostly if you reduce the heating time gradually, we will be able to attain a proper distortion less tempered glass. Roller arrangement is improved, I mean improper is not if it is not proper rollers distance and waviness will be obvious. So, thereby the equal distance has to be measured, if anything is any problem with the align we have to be carefully has be settled out. So, basically the rectification align the rollers properly.

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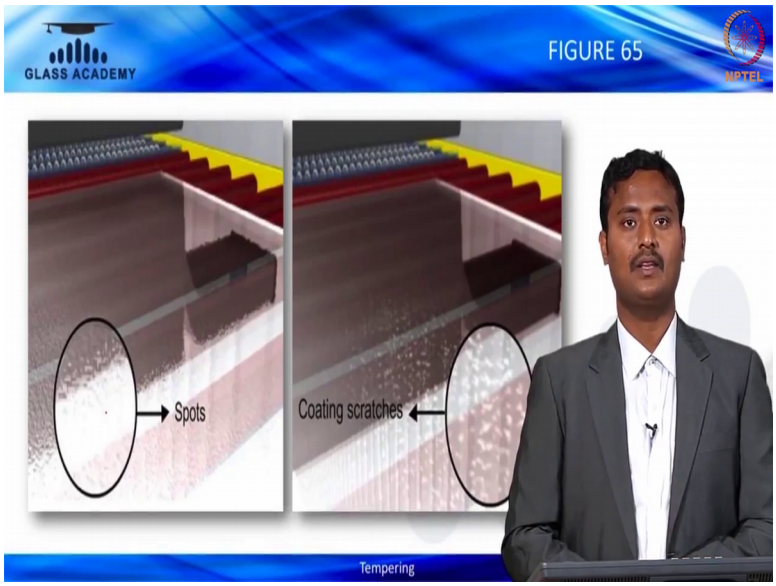

Spots and coating scratches basically, this can happen pre-processing time like coating scratches either in the form of grinding, in the form of washing brushes and everything. So, these are the common defect at the time of pre-processing.

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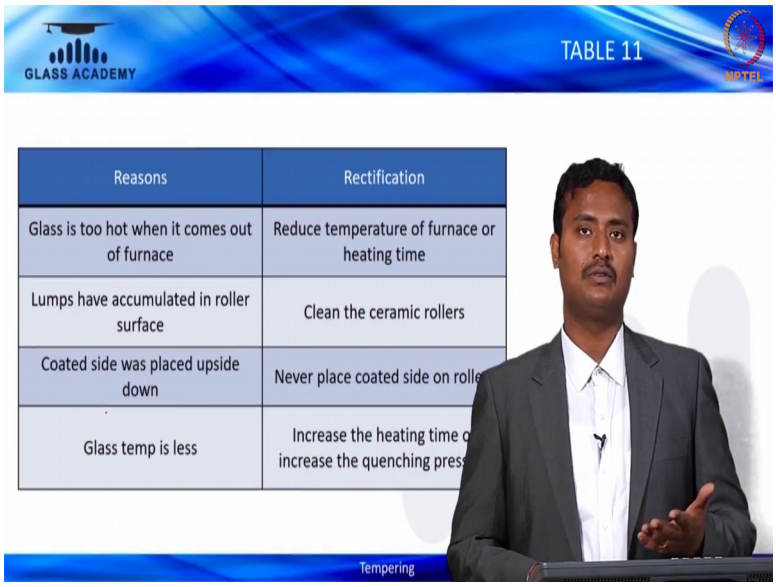

So, glass is too hot when it comes to furnaces. Reduce the furnaces which is with respect to spots these are the solution which we are talking about. Lumps have accumulated in roller surfaces, which means in this rollers you can see that is there is a white spots, which is you see that which means already the broken pieces of glass particle which is

stick on the rollers; which will causes the white mark spots on the tint on backside of the glass. Clean the ceramic rollers basically, you have to clean the ceramic rollers.

Coated side was placed upside down. Never place coated side on the roller paces. So, coated keep it on this again you will have a prop limits. Glass temperature is less. Increase the heating time or increase the quenching pressure. So, that way we will not have any spot like what you saw.

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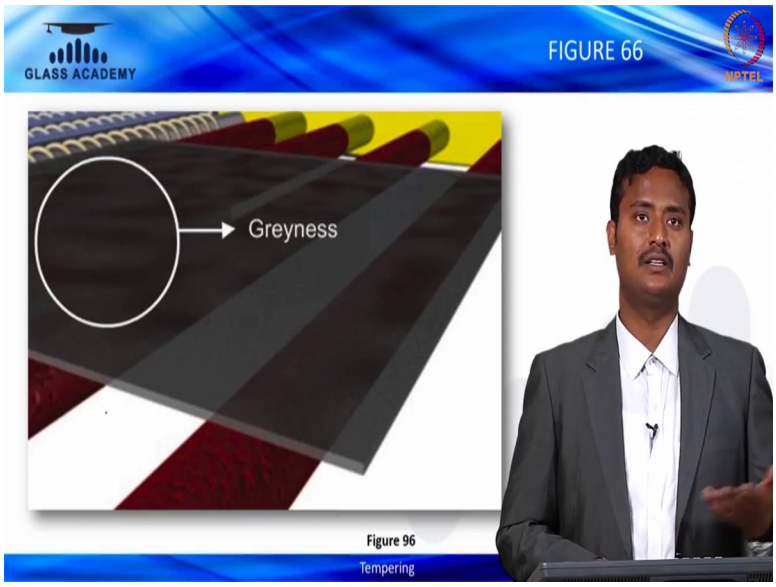

This is the greyness of the coating low-e glasses basically, it will be commonly seen through.

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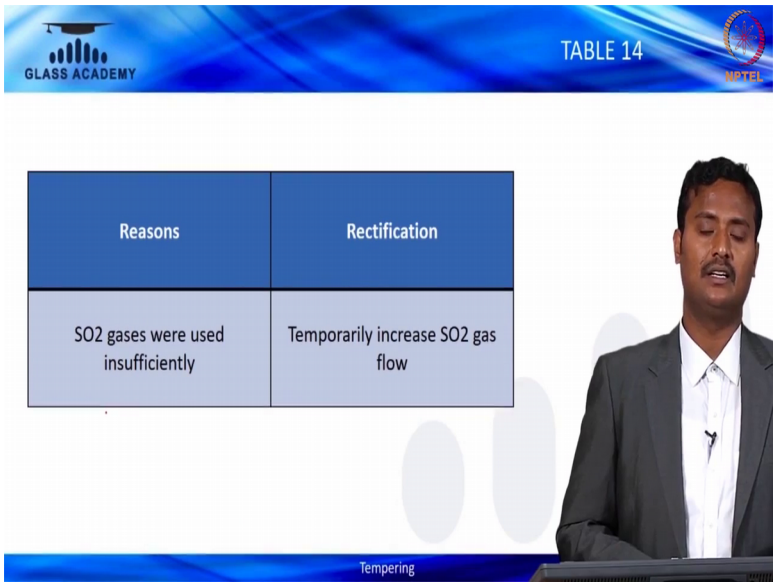

So, basically the less insufficient amount of sulphur oxide SO 2 been used. So, temporarily increase SO 2 or better not to use SO 2 for the low-e glass processing. We should not be used for low-e glass processing for at least 24 hours. So, prior to annealed glass processing you have to ensure the SO 2 should not be used for a low-e glass processing, if you are using it is such a kind of defect may comes.

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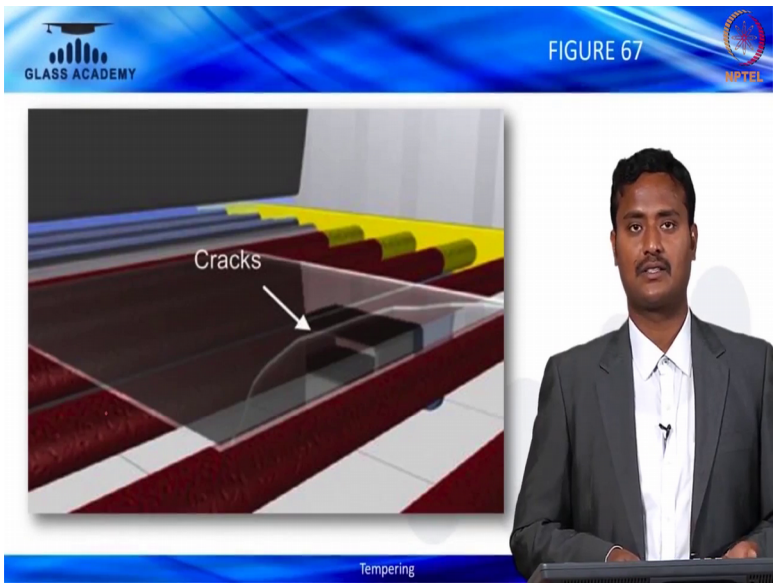

Again, cracks which you having said that earlier. So, it is a many reason let us look at it.

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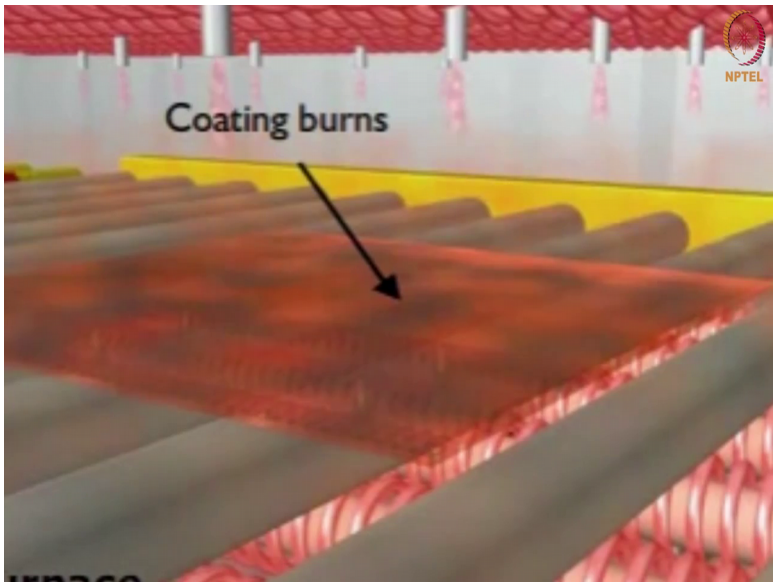

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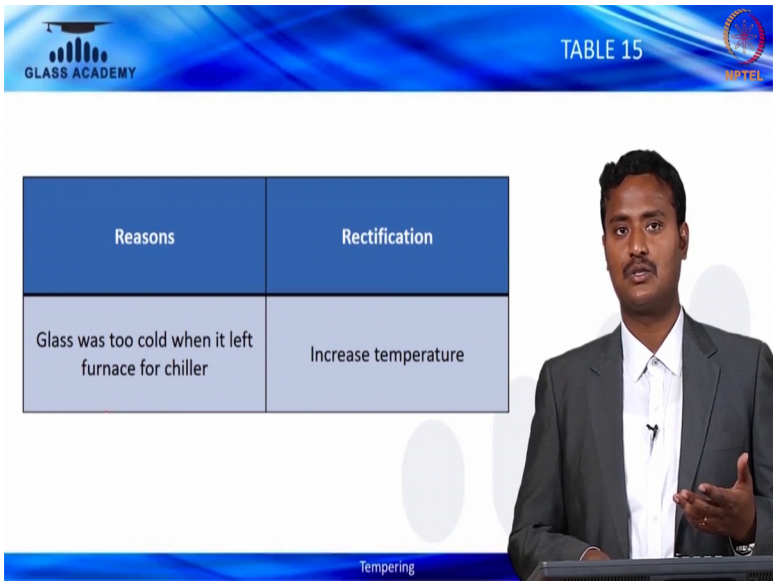

The one reason is glass was too cold when it left in the furnaces which is which is not sufficiently heated up. So, increase the heating time or in case any shall adjust like pre-processing time, it is not properly grind enough that you know during the chiller it will breaks.

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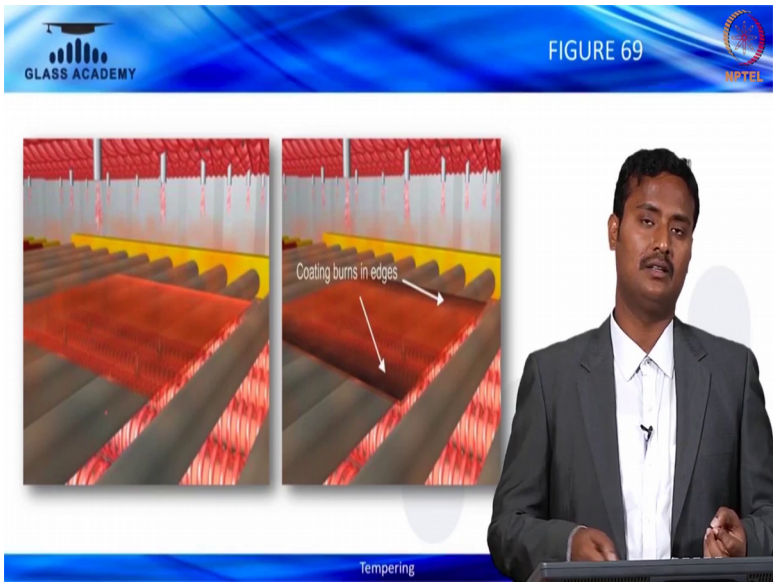

And coating burns, is most important for low-e glass processing, coating unable to withstand the heat.

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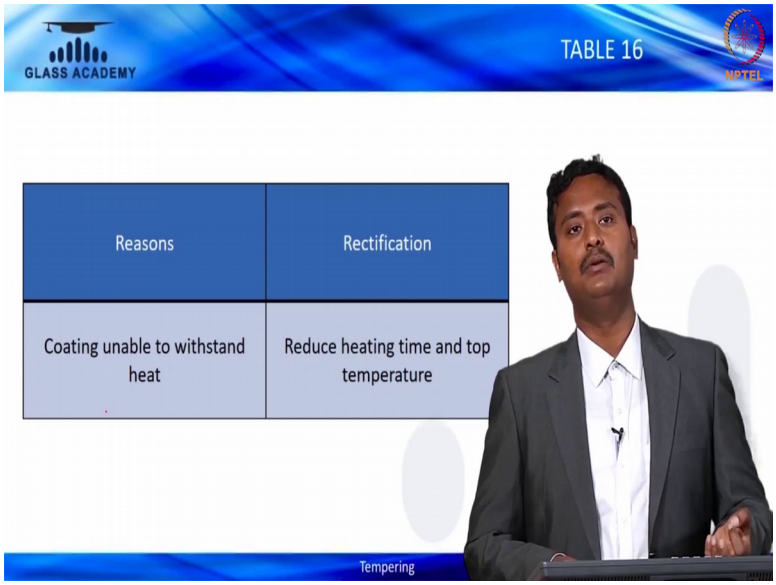

So, basically you have to reduce the heating time or reduce the top temperature. And, coating burns in the edges, these also commonly used for, this also commonly widely has been seen so, far in this low-e glass processing.

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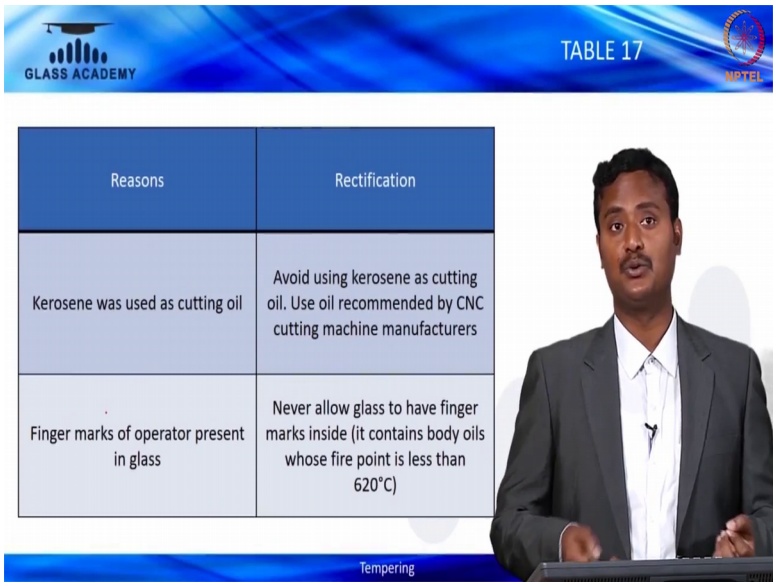

If they are using kerosene like sometimes people on the cutting while there will mix with the kerosene in order to liquidate you know dilute one. So, please not to use any kerosene. So, if you use kerosene this during the cutting machines so, that will seepage it will be seepage on the coating phase that will be captured during if it is not completely washed away during the washing machine, during tempering it will create as a defect.

And, finger marks of the operator present in glass. If a people is not using the proper gloves that body oils, sweating's those marks will be imprint on the coated phase. So, prior tempering which you are not able to notice, after tempering obviously, what all the finger prints would be you know imprinted on this coated face; basically it is a coating one kind of this.

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