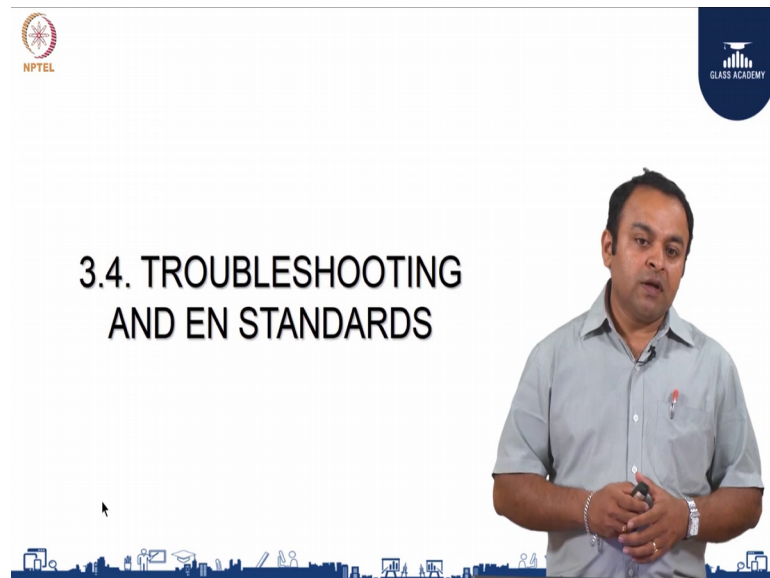


Glass Processing Technology
Prof. Somnath
Department of Civil Engineering
Indian Institute of Technology Madras

Lecture - 34
Insulating Glass Unit

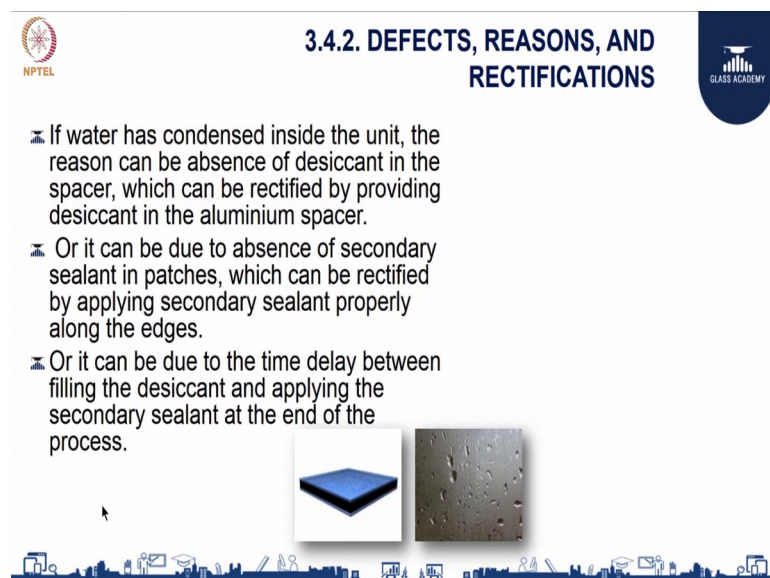
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The slide features the NPTEL logo in the top left and the Glass Academy logo in the top right. The main title is "3.4. TROUBLESHOOTING AND EN STANDARDS". A photograph of Prof. Somnath is positioned on the right side of the slide. The bottom of the slide has a decorative blue border with icons representing various engineering and educational fields.

Now, let us see the troubleshooting and the EN standard for IG unit standards.

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The slide features the NPTEL logo in the top left and the Glass Academy logo in the top right. The main title is "3.4.2. DEFECTS, REASONS, AND RECTIFICATIONS". The content includes three bullet points with icons:

- ☒ If water has condensed inside the unit, the reason can be absence of desiccant in the spacer, which can be rectified by providing desiccant in the aluminium spacer.
- ☒ Or it can be due to absence of secondary sealant in patches, which can be rectified by applying secondary sealant properly along the edges.
- ☒ Or it can be due to the time delay between filling the desiccant and applying the secondary sealant at the end of the process.

At the bottom of the slide, there are two images: a blue spacer on the left and a close-up of a glass unit with condensation on the right. The bottom of the slide has a decorative blue border with icons representing various engineering and educational fields.

The major defects which is observed is condensation. If water has condensed inside the unit the reason can be absence of desiccant in the spacer, which can be rectified by providing desiccant in the aluminium spacer. It can be also due to the absence of secondary sealant in patches, or you have some bubbles which forms in between the secondary sealant which can be rectified by application of secondary sealant properly along the edges. And also it can be due the time delay between the filling the desiccant and the applying the secondary sealant at the edge, at the end of the process.

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The slide features a presenter on the right side, wearing a light blue shirt, gesturing with his hands. To his left is a white box containing text. Above the text is the NPTEL logo and the title '3.4.2. DEFECTS, REASONS, AND RECTIFICATIONS'. Below the text is a small image of a blue insulating glass unit. The bottom of the slide has a decorative blue border with icons representing various educational and technical fields.

NPTEL

3.4.2. DEFECTS, REASONS, AND RECTIFICATIONS

GLASS ACADEMY

- If the defect is dirt marks between the insulating unit, the reason can be due to dirt in atmosphere, which can be rectified by maintaining an enclosed and dust free room.
- It can also be due to dirt in the water used for washing, which can be rectified by cleaning the water filter periodically and using dirt free water for washing the glass.

If the defect is a dirt marks between the insulated glass and the reason can be due to the dirt in atmosphere, which can be rectified by maintaining an enclosed and dust free room. It can be also due to the dirt in the water used for washing, which can be rectified by cleaning the water filter periodically and using the dirt free water for washing the glass.

(Refer Slide Time: 01:25)

NPTEL

3.4.2. DEFECTS, REASONS, AND RECTIFICATIONS

GLASS ACADEMY

- ✎ Glass can obtain scratch marks on its surface during washing, when the brushes touch the glass without water.
- ✎ This can be rectified by taking care to avoid brush touching the glass without water.

Glass can obtain glass scratches on the glass surface during washing when the brushes touch the glass without water. Please ensure proper water inside the washing, and do not use without having any water inside. This can be rectified by taking care to avoid brush touching the glass without water.

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NPTEL

3.4.3. AREAS OF CONCERN - IG

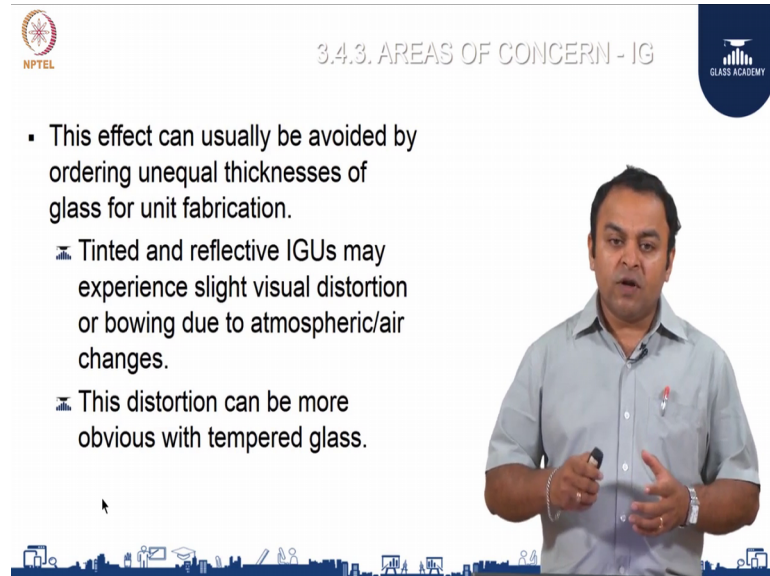
GLASS ACADEMY

- ✎ There are a few areas of concern which need to be highlighted.
- ✎ They do not specifically fall under the category of defects, but are effects that have been observed on insulating glass due to various factors.
- ✎ Brewster fringes refer to the rainbow effect occasionally seen in double glazing.
- ✎ This is not a deterioration or stain on the glass, but is simply caused by light refraction between four glass surfaces of similar thickness and substrate.

There are few areas of concern which needs to be highlighted. We have the Brewster fringes refer to the rainbow effect occasionally seen in the double glazed unit. This is not

a deterioration or the strain of the glass, but it is simple cross by the light reflection between 4 glasses surface or similar thickness and substrate.

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NPTEL

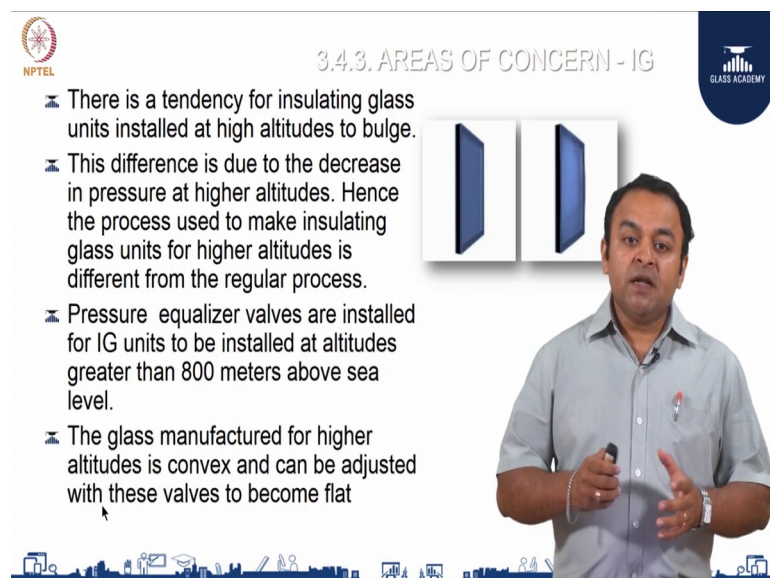
3.4.3. AREAS OF CONCERN - IG

GLASS ACADEMY

- This effect can usually be avoided by ordering unequal thicknesses of glass for unit fabrication.
- Tinted and reflective IGUs may experience slight visual distortion or bowing due to atmospheric/air changes.
- This distortion can be more obvious with tempered glass.

Tinted and reflective IGUs may experience slight visual distortion of bowing due to the atmospheric or air changes. This distortion can be more obvious with tempered glass.

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NPTEL

3.4.3. AREAS OF CONCERN - IG

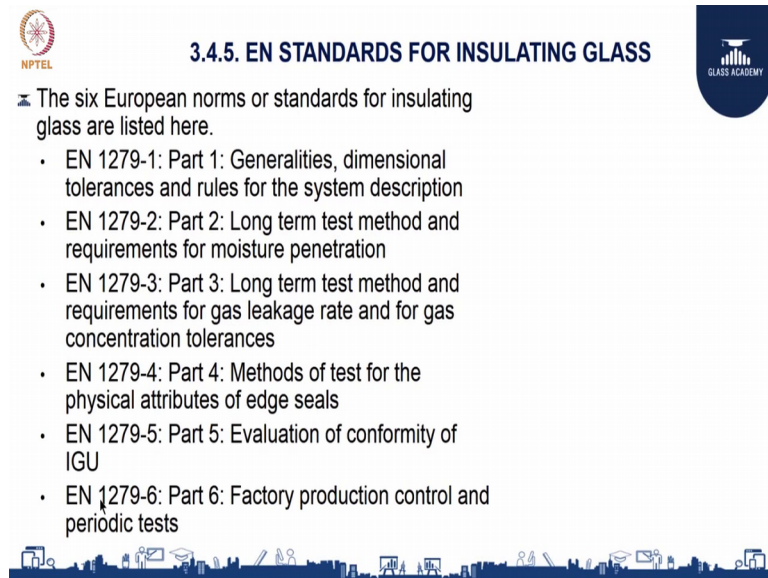
GLASS ACADEMY

- There is a tendency for insulating glass units installed at high altitudes to bulge.
- This difference is due to the decrease in pressure at higher altitudes. Hence the process used to make insulating glass units for higher altitudes is different from the regular process.
- Pressure equalizer valves are installed for IG units to be installed at altitudes greater than 800 meters above sea level.
- The glass manufactured for higher altitudes is convex and can be adjusted with these valves to become flat

There is a tendency for insulated glass unit at high altitudes to bulge, the difference is due to the decrease in pressure at higher altitudes. Hence the process used to make the insulated glass unit at higher altitude is slightly different.

You have something called the pressure equalization walls which is fixed to the IGU. These are installed for the IGU unit to be sent which is more than 800 meters from the sea level. The glass manufactured for high altitudes is always convex and can be adjusted with these valves to become flat at the installation site.

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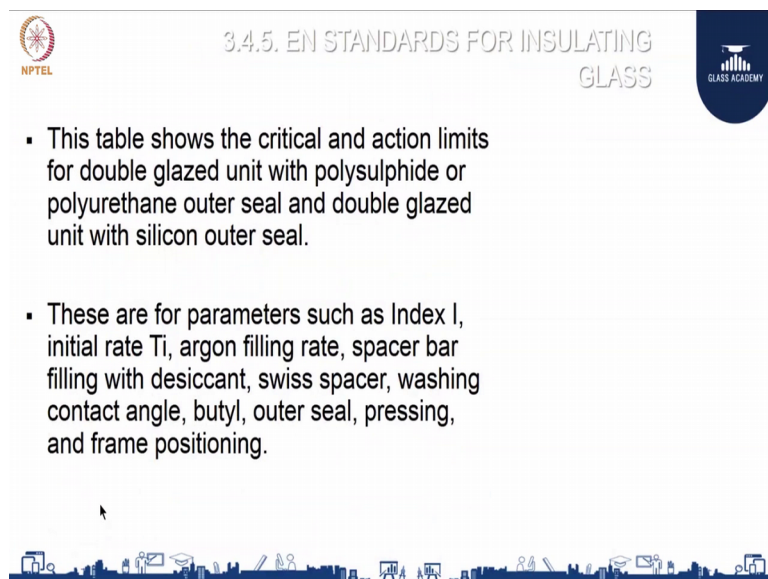
The slide features a white background with a blue header and footer. The header contains the NPTEL logo on the left, the title '3.4.5. EN STANDARDS FOR INSULATING GLASS' in the center, and the Glass Academy logo on the right. The main content is a bulleted list of six European standards for insulating glass. The footer is a blue silhouette of a city skyline.

3.4.5. EN STANDARDS FOR INSULATING GLASS

- The six European norms or standards for insulating glass are listed here.
 - EN 1279-1: Part 1: Generalities, dimensional tolerances and rules for the system description
 - EN 1279-2: Part 2: Long term test method and requirements for moisture penetration
 - EN 1279-3: Part 3: Long term test method and requirements for gas leakage rate and for gas concentration tolerances
 - EN 1279-4: Part 4: Methods of test for the physical attributes of edge seals
 - EN 1279-5: Part 5: Evaluation of conformity of IGU
 - EN 1279-6: Part 6: Factory production control and periodic tests

The European standard for insulated glass is EN 1 2 7 9 it has got 6 parts and the table shows the different parts of EN standards.

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The slide features a white background with a blue header and footer. The header contains the NPTEL logo on the left, the title '3.4.5. EN STANDARDS FOR INSULATING GLASS' in the center, and the Glass Academy logo on the right. The main content is a bulleted list of two points. The footer is a blue silhouette of a city skyline.

3.4.5. EN STANDARDS FOR INSULATING GLASS


- This table shows the critical and action limits for double glazed unit with polysulphide or polyurethane outer seal and double glazed unit with silicon outer seal.
- These are for parameters such as Index I, initial rate Ti, argon filling rate, spacer bar filling with desiccant, swiss spacer, washing contact angle, butyl, outer seal, pressing, and frame positioning.

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Air Width (mm)	Desiccant weight (gr/ml) For Swisspacer	Desiccant weight (gr/ml) for other Space bars
6	12	16
8	18	24
10	25	33
12	30	40
14	37	49
15	40	53
16	43	57
18	49	65
20	55	74
24	68	91

Table 19



Now comes the how much desiccant to be filled in a alumina spacer based on the air gap, you have for the Swiss spacer as well as for the normal annual spacer. There is a table which shows how much minimum of desiccant to be filled.

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■ Bite is calculated as

- Minimum Structural Bite (m) = Glass Short Span Dim. (m) x Wind load (Pa) x 0.5/ 140,000 Pa

Where,

- Glass Short Span Dimension (SSD) is the shorter of the two dimensions of the rectangular glass panel
For example, on a 1.5 m by 2.5 m glass panel, the SSD is 1.5 m
- Wind load is the maximum wind pressure in Pascal for a return period of 10 years based on EUROCODES and local regulations
This value is 1 Pa = 1 N/m²
- 140,000 Pa (0.14 MPa) is the Maximum Allowable Design Stress







Figure 113




Bite is calculated by that there is a formula for the bite which is like the glass short span dimension always in meters, multiplied by the wind load in Pascal multiplied by 0.5. That divided by the maximum allowable design stress which is like 140000 Pascal's of 0.14 mega Pascal's.

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	Butyl width		Outer seal height		Outer seal width	
	DGU with PS or PU	DGU with silicone	DGU with PS or PU	DGU with silicone	DGU with PS or PU	DGU with silicone
Critical limit	2mm	4mm	1 mm	2 mm	3mm	4mm
Action limit	4mm	5 mm	2 mm	3 mm	4mm	5mm


Table 20




And you always have a butyl width the outer seal height and outer seal width, which is there for the edge of the sealant as well as for polyurethane and poly sulphide.

There is a small table which gives the action and the critical limit.



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TEST UNITS AGEING: CONSTANT SOAK

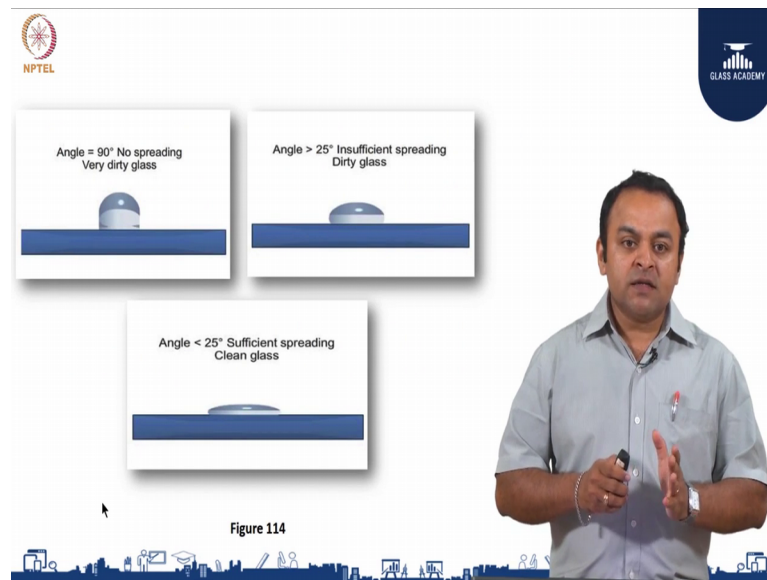


- Washing quality: Contact angle method. Place a drop of demineralised water on the inner surface of the 2 glasses for each reference double glazed unit.
- Measure the angle made by the drop, and assess the cleanliness of the glass surface.



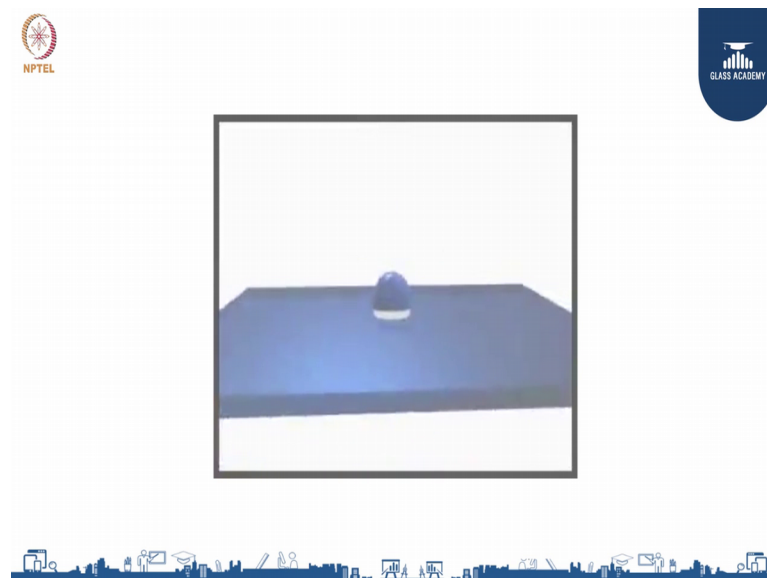
Now, the washing quality which was highlighted earlier, we have a contact angle method place of place a drop of demineralised water on the inner surface of the 2 glass for each of this reference double glazed unit. Measure the angle made by the drop and assess the clean enough of the glass surface.

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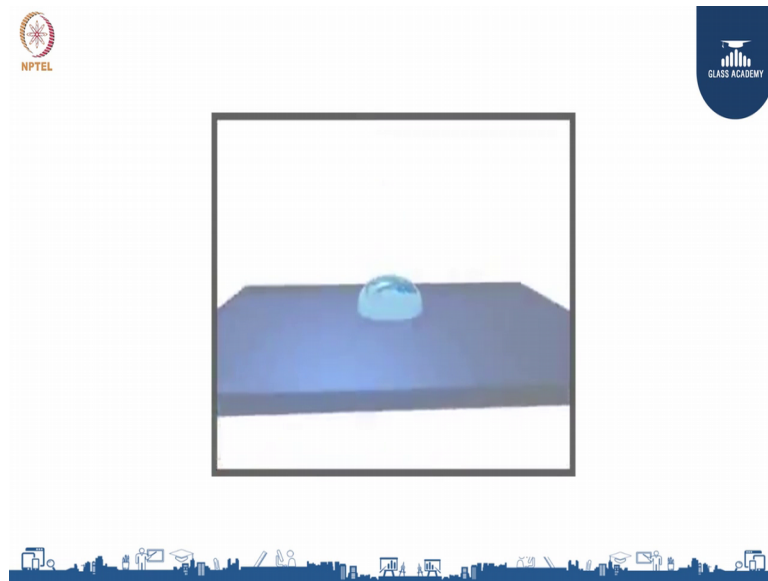


If the angle is more than 90 degree the glass is said to be very, very dirty. If it is up to 925 degrees even it is dirty, if it is less than 25 degree the glass is said to be clean.

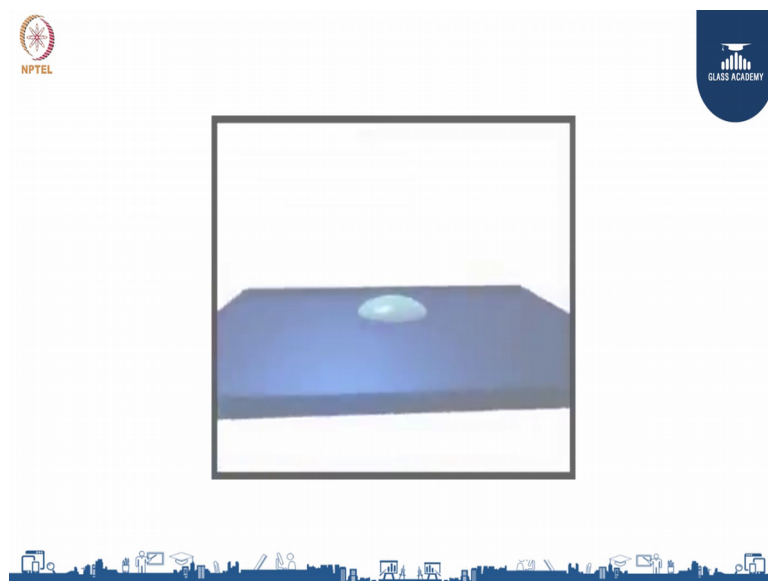
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Thank you.