



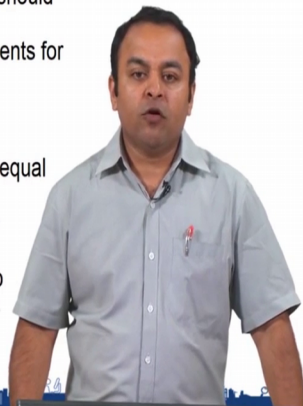
Glass Processing Technology
Prof. Somnath
Department of Civil Engineering
Indian Institute of Technology, Madras

Lecture - 36
Insulating Glass Unit

(Refer Slide Time: 00:22)

**3.2.18. REQUIREMENTS FOR LOW-E
/SOLAR CONTROL GLASS**


- In the case of coated Low-E or solar control glass, the glass must be double glazed within 24 hours of removal from the crate, and because the coating is soft, it should not be touched at any point in time.
- There are also certain washing machine requirements for Low-E or solar control glass.
- The brush used in the unit is cylindrical.
- The bristle should be 25 to 40 mm in length.
- The diameter of the bristle should be less than or equal to 0.15 mm.
- The preferred make of the brush is either nylon or polyamide.
- The water used should be a maximum of 20 micro siemens. And, the pH should be between 6 and 8.





Let us come to the requirement of Low-E and the solar control glass. In case of Low-E you know you have a multiple layers of silver as a coating layer ok. So, the edge relation becomes a very essential, and there are also special requirement of the washing machine for Low-E. A glass the brush used in the unit is always cylindrical, and the bristle should be 25 to 40 mm in length. And the diameter of the bristle should be less than or equal to 0.51 millimetre. You can either have very fine nylon or you can have polyamide. The most important thing is a water quality which has to be less than 20 micro siemens. And the pH always has to be between 6 to 8.

(Refer Slide Time: 01:09)

3.2.19. CHOICE OF DESICCANTS




- ▶ Now, let us study desiccants in detail.
- ▶ Desiccants are used to remove the moisture trapped within the IG unit.
- ▶ However not all desiccants work as required.
- ▶ Some absorb not only water, but also the inert gas between the panes, resulting in lower thermal performance of the insulating glass.





Now, let us come to the choice of desiccants. Normally, the desiccants which are use is 3 angstrom. Some absorb only the water, but also the inert gas between the panes resulting in lower thermal performance of the insulating glass.

(Refer Slide Time: 01:24)

3.2.19. CHOICE OF DESICCANTS



- ▶ To perform the required function, the desiccant should have the following characteristics:
 - ▶ It should be able to absorb water and hydrocarbons.
 - ▶ It should not absorb krypton, argon or other "thermal performance" gases.
 - ▶ And, it should not contain pre-absorbed nitrogen.



The desiccants should have a property to absorb water as well as hydrocarbons. It should not absorb the inert gas and other the thermal performance of gases. It should not contain any pre absorbed nitrogen.

(Refer Slide Time: 01:41)



Though the picture you can see that is of the zeolite.

(Refer Slide Time: 01:43)

3.2.20. TYPES OF DESICCANTS

- Desiccants are of three different types –
 - Molecular sieves,
 - Silica gel, and
 - Zeolites.
- Molecular sieve has a nominal pore diameter of 3\AA .
- Molecules with diameter greater than 3\AA such as ethane are excluded.
- It has alumina-silicate as the base, and potassium as the cat-ion.




That is the most commonly used. You also have something called silica gel which is not recommended ok. Desiccants are of 3 types. One is the molecular sieve silica gel and the zeolite.

Molecular sieve has a nominal pore diameter of 3 angstrom. The molecule with diameter greater than 3 angstrom such as ethane is excluded.

(Refer Slide Time: 02:07)

3.2.20. TYPES OF DESICCANTS

- Silica gel is similar to molecular sieve, but with a larger pore size.
- Zeolites are used to remove water molecules from organic solvents or to prevent condensation of water molecules on the glass surfaces (inside surfaces) in insulating glass windows.



Silica gel is similar to molecular sieve, but with a large pore. Zeolites are also used to remove water molecules from organic solvents, or to prevent condensation of water molecules on the glass surface in insulating glass windows.

(Refer Slide Time: 02:21)

1. MOLECULAR SIEVE







Figure 52



This is a typical molecular sieve something of silica gel and this is zeolite.

(Refer Slide Time: 02:24)

2. SILICA GEL



Figure 53



The slide features a title '2. SILICA GEL' in the top right corner. Below the title is a circular logo for 'GLASS ACADEMY'. On the left side, there is a microscopic image of silica gel particles, which appear as a dense, interconnected network of purple, irregular shapes. Below this image is the caption 'Figure 53'. On the right side, a man in a light blue short-sleeved shirt is speaking. At the bottom of the slide, there is a decorative blue bar with various white icons representing different scientific and educational fields.

(Refer Slide Time: 02:26)

3. ZEOLITES



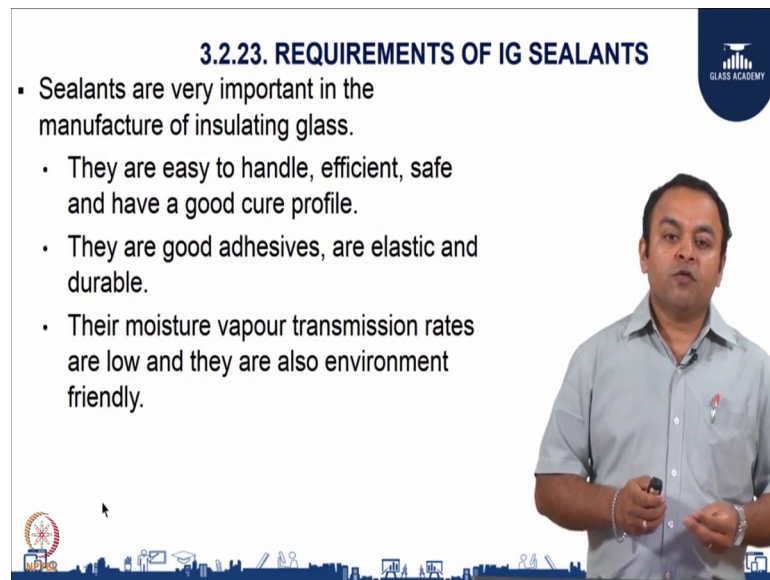


Figure 54



The slide features a title '3. ZEOLITES' in the top right corner. Below the title is a circular logo for 'GLASS ACADEMY'. On the left side, there is a photograph of a pile of brown, spherical zeolite particles. Below this image is the caption 'Figure 54'. On the right side, the same man in a light blue short-sleeved shirt is speaking. At the bottom of the slide, there is a decorative blue bar with various white icons representing different scientific and educational fields.

(Refer Slide Time: 02:29)

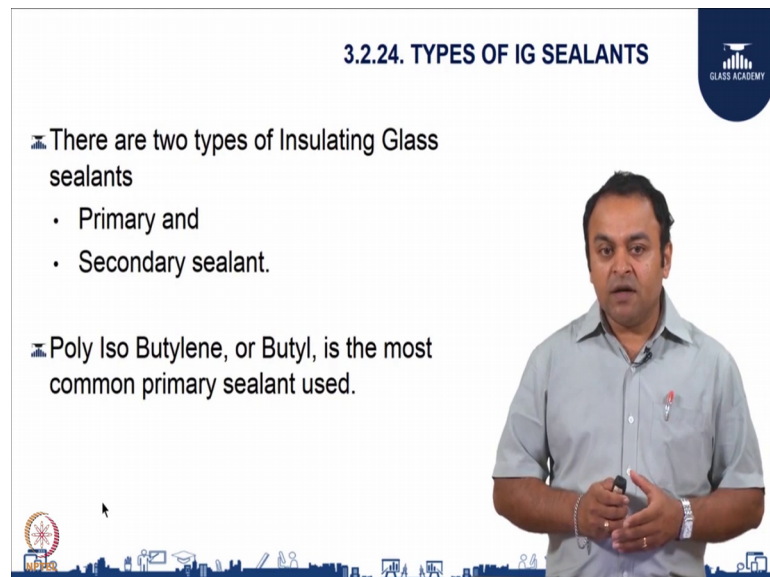


3.2.23. REQUIREMENTS OF IG SEALANTS

- Sealants are very important in the manufacture of insulating glass.
 - They are easy to handle, efficient, safe and have a good cure profile.
 - They are good adhesives, are elastic and durable.
 - Their moisture vapour transmission rates are low and they are also environment friendly.

Now comes the requirement of the IG sealants. Sealants are very important in the manufacturing of IG sealants. They are very easy to handle efficient, safe and have a good cure profile. They are good adhesives and are elastic and durable. The moisture vapour transmission rates are low and they are environmental friendly.

(Refer Slide Time: 02:52)



3.2.24. TYPES OF IG SEALANTS

- ☒ There are two types of Insulating Glass sealants
 - Primary and
 - Secondary sealant.
- ☒ Poly Iso Butylene, or Butyl, is the most common primary sealant used.

You have a primary sealant as well as the secondary sealant. Primary sealant is also called as Butyl or Poly Iso Butylene.

(Refer Slide Time: 03:01)




3.2.24. TYPES OF IG SEALANTS

The secondary sealant is of two types –

- One part and
- Two part.

▪ Silicone and Polysulfide are commonly used secondary sealants.

▪ Let us now look at each of them in detail.



And the secondary sealant you are having 2 types, one is a 1-part and you have a 2-part. You also have silicone and polysulfide as the 2-3 varieties which is used.

(Refer Slide Time: 03:14)

ONE PART SEALANT



Figure 59



This is a typical 1-part sealant.

(Refer Slide Time: 03:17)

TWO PART SEALANT



Figure 60




The slide features a blue header with the text 'TWO PART SEALANT' and the 'GLASS ACADEMY' logo. On the left, there is an image of two containers: a large blue drum labeled 'A' and a smaller white bucket labeled 'B', both with '9002' on the labels. Below the image is the caption 'Figure 60'. On the right, a man in a light blue shirt is speaking. The bottom of the slide has a decorative blue border with icons of various glass products and a mouse cursor.

And this is a 2-part sealant.

(Refer Slide Time: 03:19)

3.2.25. PRIMARY SEALANT

- ▣ Primary sealants are almost exclusively made of poly isobutylene (PIB) based formulations.
- ▣ PIB has thermoplastic properties and is heated and applied on the spacer bars by automatic lines.



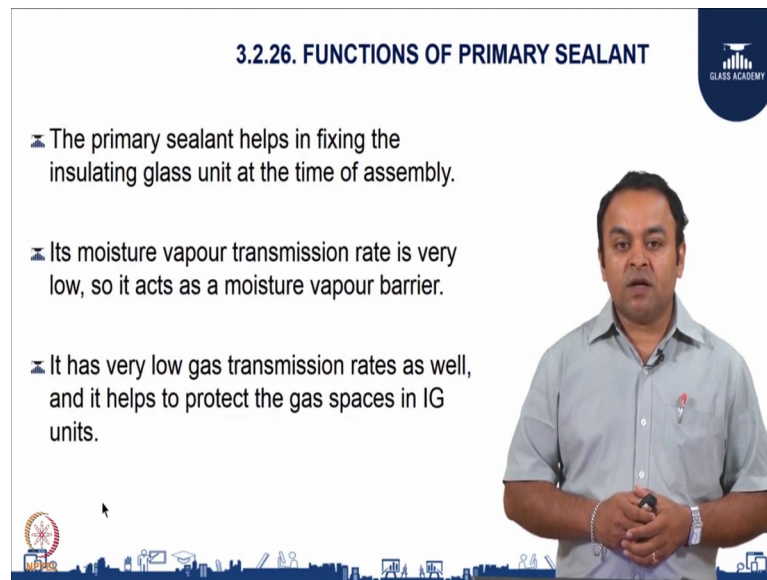
The slide has a blue header with the text '3.2.25. PRIMARY SEALANT' and the 'GLASS ACADEMY' logo. The main content consists of two bullet points describing primary sealants. On the right, the same man from the previous slide is speaking. The bottom of the slide has a decorative blue border with icons of various glass products and a mouse cursor.

Primary sealant are almost exclusively made of poly isobutylene. Thermoplastic properties and here heated and applied on the spacer bars by automatic lines.

(Refer Slide Time: 03:33)

3.2.26. FUNCTIONS OF PRIMARY SEALANT

- The primary sealant helps in fixing the insulating glass unit at the time of assembly.
- Its moisture vapour transmission rate is very low, so it acts as a moisture vapour barrier.
- It has very low gas transmission rates as well, and it helps to protect the gas spaces in IG units.

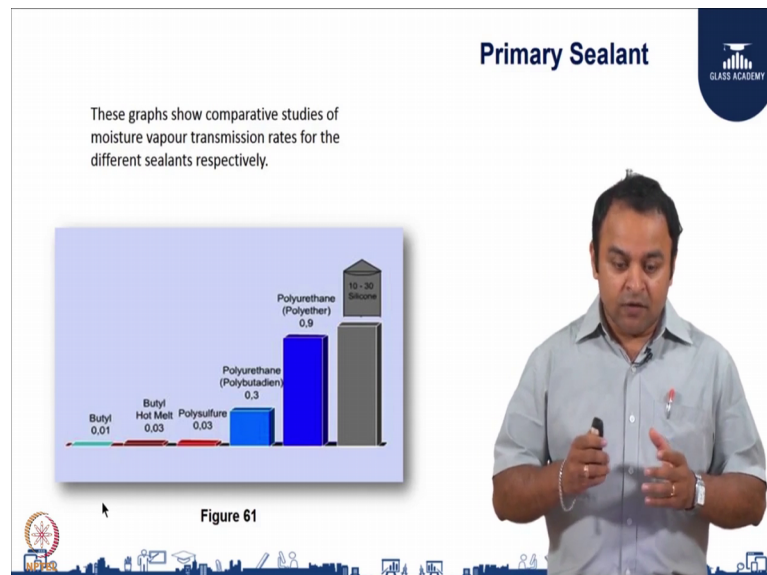


The primary sealant helps in fixing the insulated glass unit at the time of assembly. Its moisture vapour transmission rate is very low so, it acts as a moisture vapour barrier. It has very low gas transmission rates as well. And it helps to protect the gas spaces in IG unit.

(Refer Slide Time: 03:50)

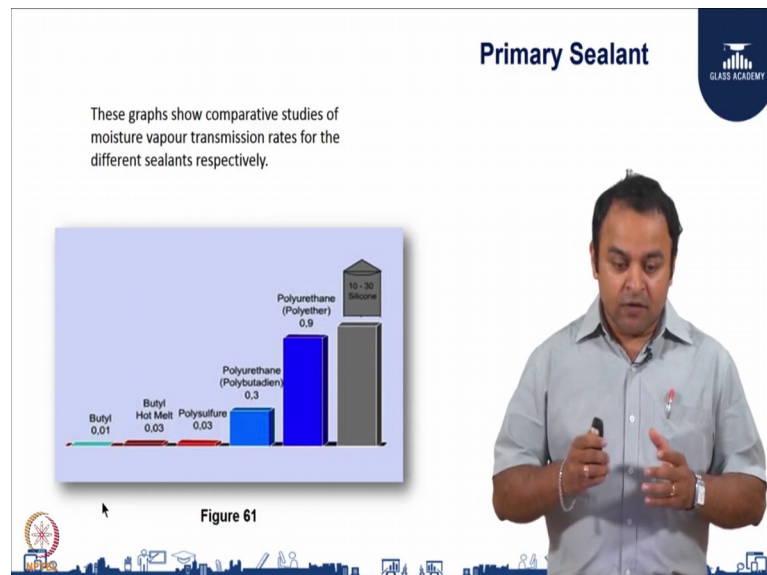
Primary Sealant

These graphs show comparative studies of moisture vapour transmission rates for the different sealants respectively.



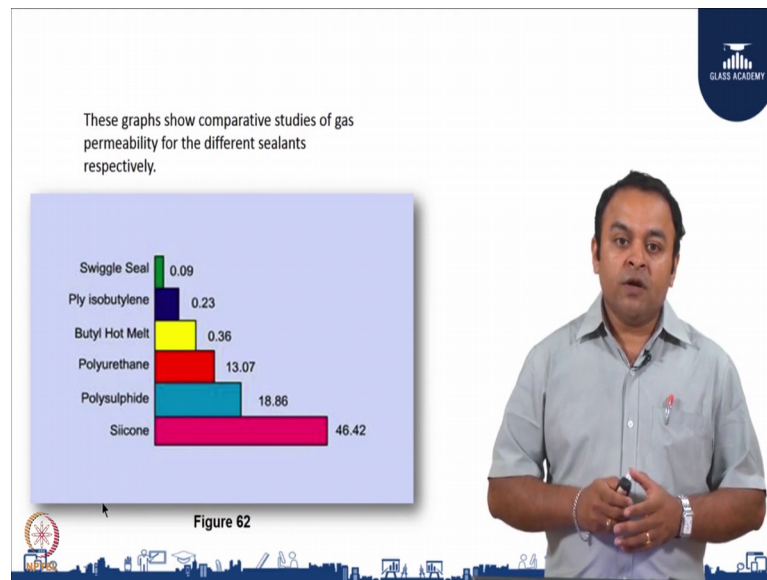
Sealant	Moisture Vapour Transmission Rate
Butyl	0.01
Butyl Hot Melt	0.03
Polysulfure	0.03
Polyurethane (Polybutadien)	0.3
Polyurethane (Polyether)	0.9
10-30 Silicone	10-30

Figure 61



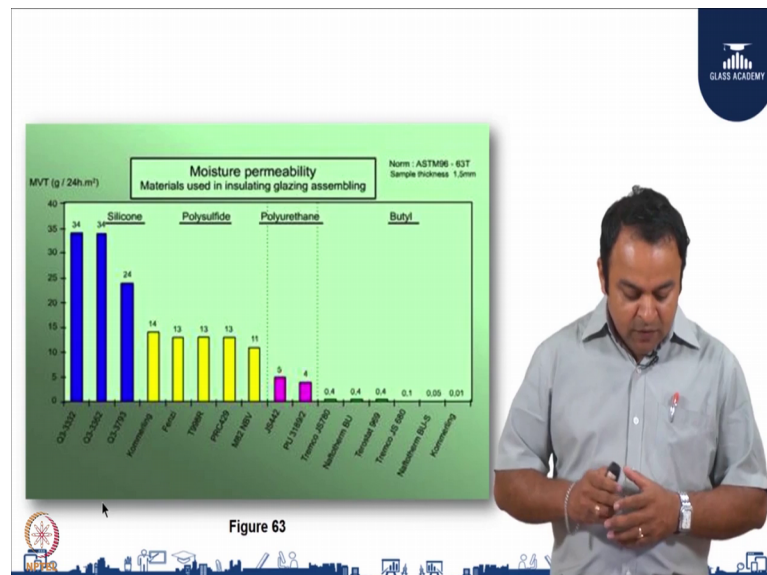
If you see the graph, silicon has got the maximum moisture vapour transmission rates while butyl as got the least from the list.

(Refer Slide Time: 04:01)



This compares the study made for gas permeability for different types of sealants. You have the butyls, you have the polysulphide, you have the silicones. Silicone is the most bad for using for gas this thing. And polysulphide is having much better property than a silicone. When you have the gas filled inside the DGU.

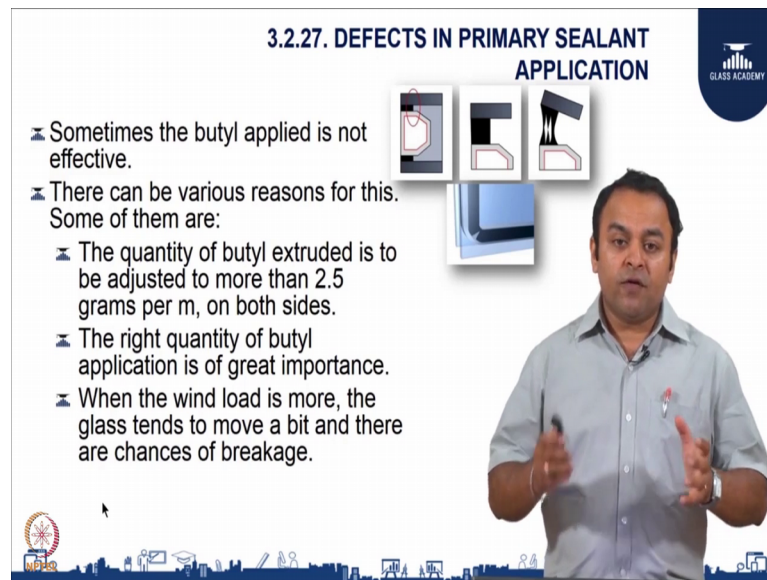
(Refer Slide Time: 04:23)



And this graph it shows different varieties of sealant as well as the polysulphides and polyurethanes. You can see the moisture permeability from this graph.

(Refer Slide Time: 04:36)

3.2.27. DEFECTS IN PRIMARY SEALANT APPLICATION

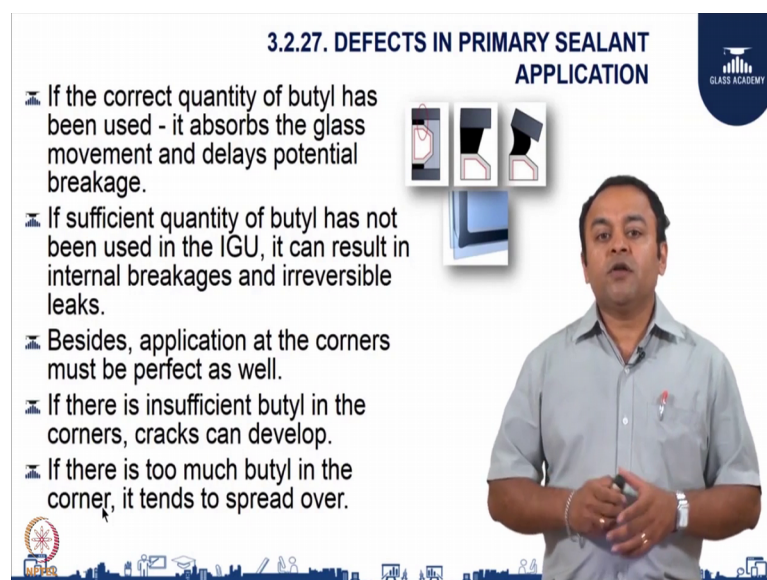


- ✘ Sometimes the butyl applied is not effective.
- ✘ There can be various reasons for this. Some of them are:
 - ✘ The quantity of butyl extruded is to be adjusted to more than 2.5 grams per m, on both sides.
 - ✘ The right quantity of butyl application is of great importance.
 - ✘ When the wind load is more, the glass tends to move a bit and there are chances of breakage.

Now, let us come to the defects of a IGU. The quantity of butyl extruded is to be adjusted to be more than 2.5 grams per meter on both the sides of the aluminium spacer. The right quantity of butyl application is of great importance; when the wind load is more, the glass tends to be moving a bit and there are chances of breakage. So, that is taken care by the primary sealant.

(Refer Slide Time: 05:02)

3.2.27. DEFECTS IN PRIMARY SEALANT APPLICATION

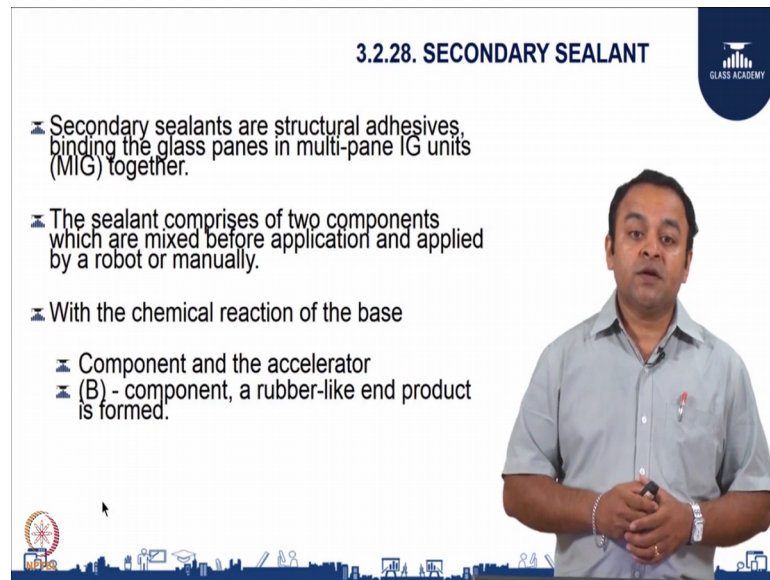


- ✘ If the correct quantity of butyl has been used - it absorbs the glass movement and delays potential breakage.
- ✘ If sufficient quantity of butyl has not been used in the IGU, it can result in internal breakages and irreversible leaks.
- ✘ Besides, application at the corners must be perfect as well.
- ✘ If there is insufficient butyl in the corners, cracks can develop.
- ✘ If there is too much butyl in the corner, it tends to spread over.

If the correct quantity of butyl has been used, it absorbs the glass movement and delays potential breakage. If sufficient quantity of butyl has not been used in the IGU it can

result in internal breakage and irreversible leaks. Besides application of the corners must be perfect as well. If there is insufficient butyl in the corners cracks can develop. And if there are too much butyl in the corner it tends to spread over.

(Refer Slide Time: 05:28)



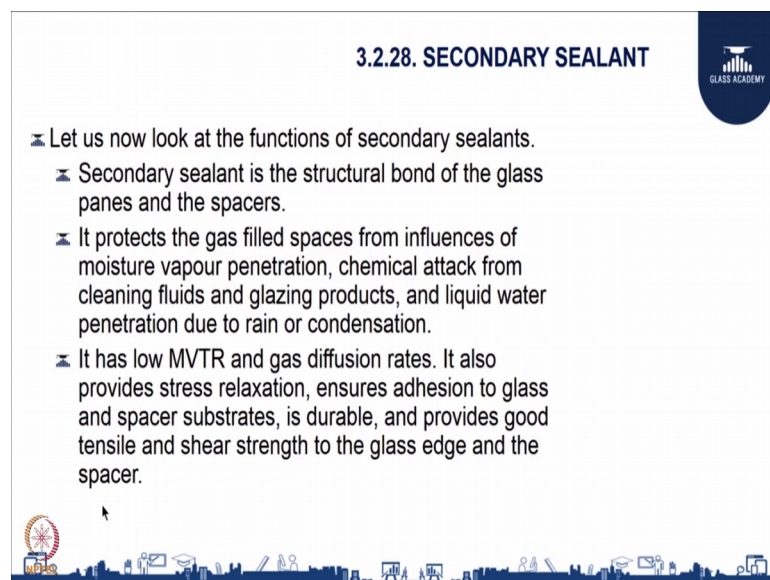
3.2.28. SECONDARY SEALANT

- Secondary sealants are structural adhesives, binding the glass panes in multi-pane IG units (MIG) together.
- The sealant comprises of two components which are mixed before application and applied by a robot or manually.
- With the chemical reaction of the base
 - Component and the accelerator
 - (B) - component, a rubber-like end product is formed.

The slide features a presenter on the right side and a decorative footer with various icons.

Now, let us see the secondary sealants defects.

(Refer Slide Time: 05:32)



3.2.28. SECONDARY SEALANT

- Let us now look at the functions of secondary sealants.
 - Secondary sealant is the structural bond of the glass panes and the spacers.
 - It protects the gas filled spaces from influences of moisture vapour penetration, chemical attack from cleaning fluids and glazing products, and liquid water penetration due to rain or condensation.
 - It has low MVTR and gas diffusion rates. It also provides stress relaxation, ensures adhesion to glass and spacer substrates, is durable, and provides good tensile and shear strength to the glass edge and the spacer.

The slide features a decorative footer with various icons.

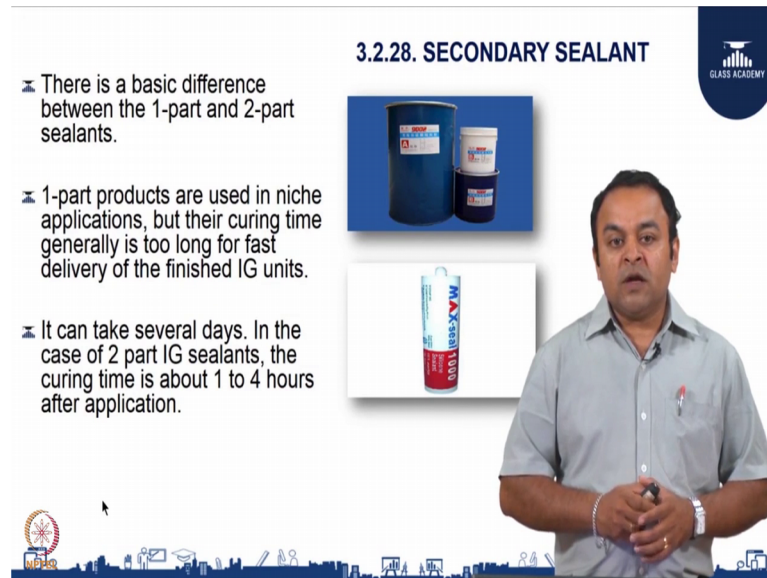
Let us now look at the functions of secondary sealant. Secondary sealant is the structural bond of the glass panes and the spacers. It protects the gas filled spaces from the influence of moisture vapour penetration, chemical attack cleaning fluids and glazing

products and the liquid penetration due to rain or condensation. It has low MVTR and gas diffusion rates.

(Refer Slide Time: 05:57)

3.2.28. SECONDARY SEALANT

- ✎ There is a basic difference between the 1-part and 2-part sealants.
- ✎ 1-part products are used in niche applications, but their curing time generally is too long for fast delivery of the finished IG units.
- ✎ It can take several days. In the case of 2 part IG sealants, the curing time is about 1 to 4 hours after application.



The slide features a man in a light blue shirt standing in front of a presentation slide. The slide has a white background with a blue header and footer. The header contains the text '3.2.28. SECONDARY SEALANT' and the 'GLASS ACADEMY' logo. The main content area has three bullet points. To the right of the text are two images: one showing two large blue and white containers, and another showing a single red and white container. The footer of the slide has a blue background with white icons representing various glass-related products and services.

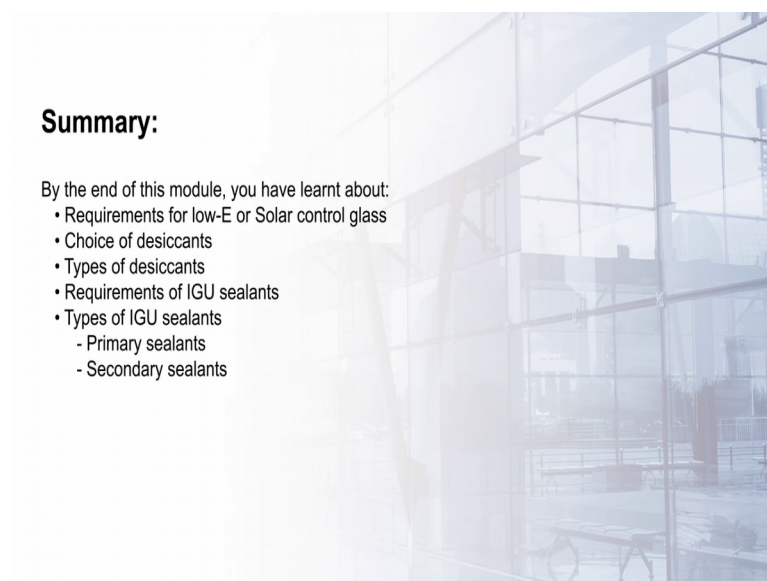
There are basic differences between the 1-part and the 2-part sealant. 1-part products are used in the niche applications, but the curing time is generally too long for fast delivery of the finished IG unit. It takes several days in case of 2-part IG sealants. The curing time is between 1 to 4 after application.

(Refer Slide Time: 06:16)

Summary:

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

- Requirements for low-E or Solar control glass
- Choice of desiccants
- Types of desiccants
- Requirements of IGU sealants
- Types of IGU sealants
 - Primary sealants
 - Secondary sealants



The background of the slide is a faded image of a modern glass building with a grid of windows. The text is overlaid on the left side of the image.