

~ Davison



# **THE ROLE OF DESICCANT IN INSULATING GLASS**

**IGMA**

**Educational Seminar**

**Las Vegas, NV**

**September 18 & 19, 2006**

**Presented by Steve Meisel   Prepared by Dr Fritz Kilthau**

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# Agenda

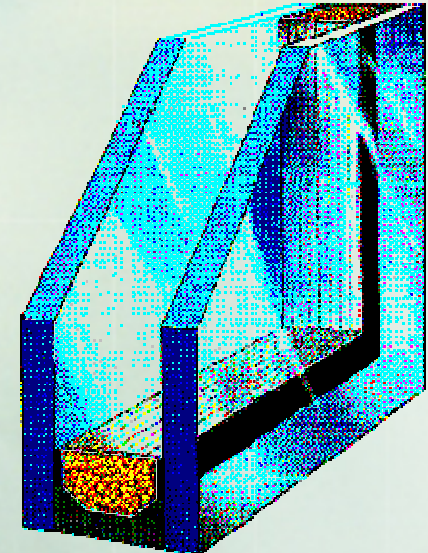


- The functions of desiccants in insulating glass
- Types of desiccants (MS, SG)
- Selection of suitable desiccants
- Correct handling of the desiccant during insulating glass manufacture
- Quality Control/questions to ask
- DESICCANT in insulating glass - a review
- DESICCANT MATRIX

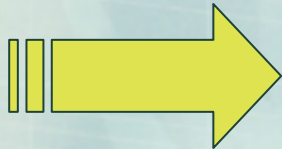
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# Functions of the Desiccant in Insulating Glass

- Wet air trapped in IG
- Condensation at low temperatures



## Function #1:



Drying of the moisture trapped during manufacture of the IG unit

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# PACKAGING “WEATHER”

Sealing an IG unit alone does NOT  
eliminate moisture, but rather

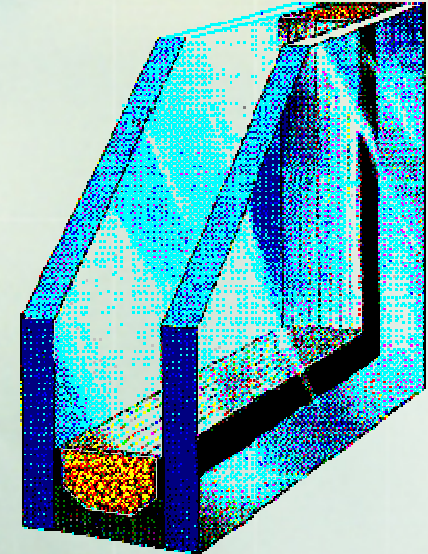
**SEALS MOISTURE**

**Into the IG**

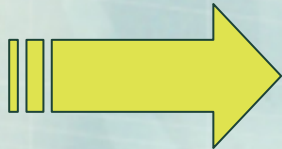
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# Functions of the Desiccant in Insulating Glass

- All sealants allow moisture to permeate through the barrier at some MVTR
- CBA Testing



## Function #2:

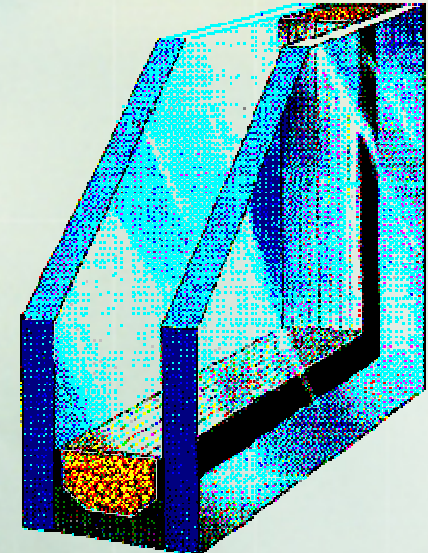


- Uptake of the water vapor diffusing through the edge seal of the IG unit during its period of use
- Keep the trapped-in air / gas dry

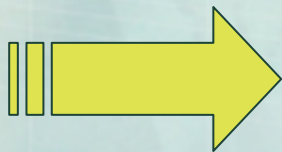
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# Functions of the Desiccant in Insulating Glass

- Sealants / Muntin bars / Glass cleaners / Corner pieces / Polymeric Spacers
- “Fogging”: Condensation of the off-gassed organics in the IG unit - Coated Glass
- Canadian Fog Test



## Function #3:

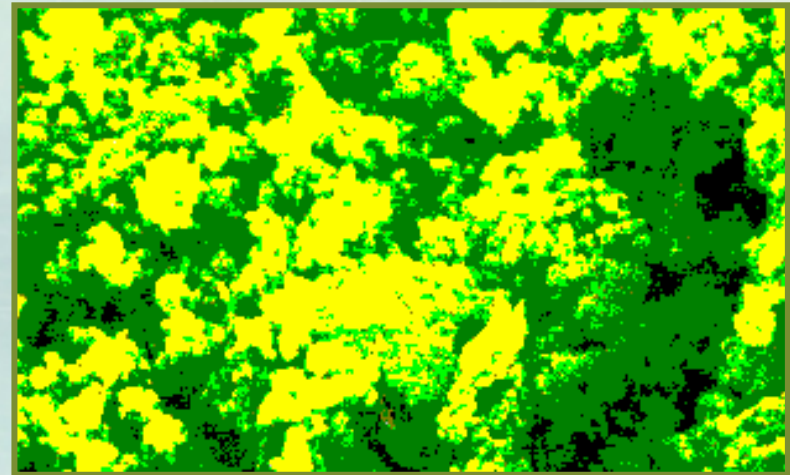


- Uptake of organic vapors

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# Types of Desiccants: Silica Gel

- SiO<sub>2</sub> structure
- Highly porous
- Non-uniform pore sizes:  
Ranging from  
20 to 200 Ångstroms



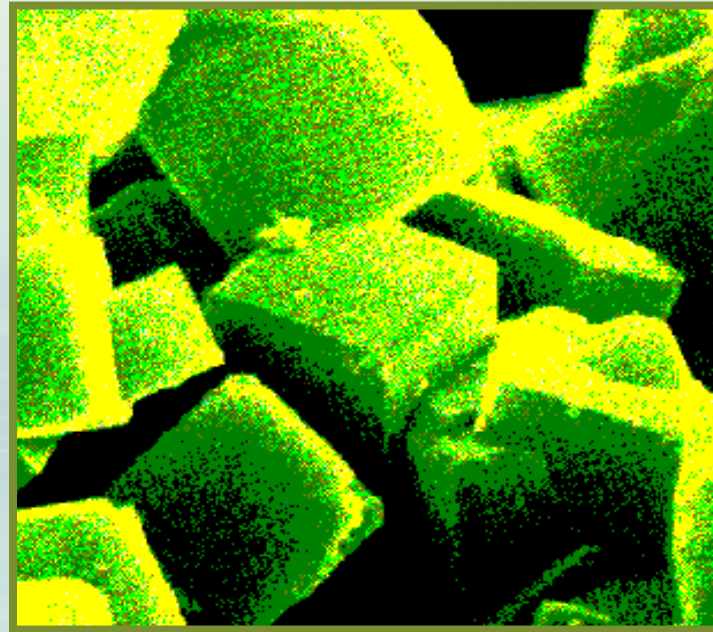
*REM photograph of a Silica Gel  
in 15000X magnification*

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# Types of Desiccants: Zeolites (Molecular Sieves)

- Crystalline
- Highly porous crystals
- Uniform pore sizes:  
3 Ångström  
( $3 \times 10^{-10}$  m)

10 Ångström  
( $10 \times 10^{-10}$  m)



*REM photograph of a 3Å-MS in  
15000X magnification*

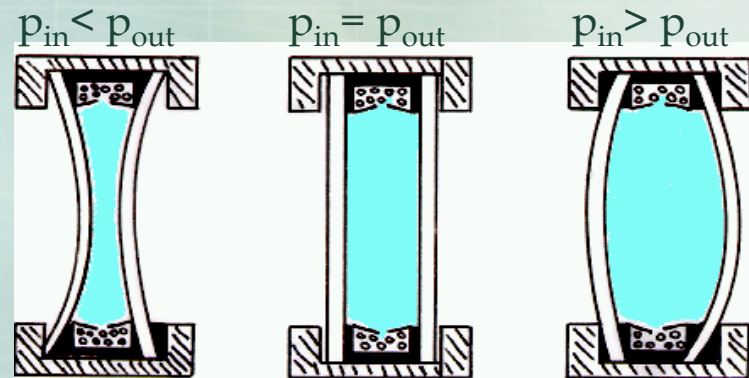
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# Selection of Suitable Desiccants

- Dependent on the gases/vapors in the insulating glass:
  - Water vapor → *should be adsorbed*
  - Air (nitrogen/oxygen) → *should NOT adsorbed*
  - Argon/Xenon → *should NOT be adsorbed*
  - Solvents/Plasticizers → *should be adsorbed*

# Selection of Suitable Desiccants: Cause of IG Unit Deflection

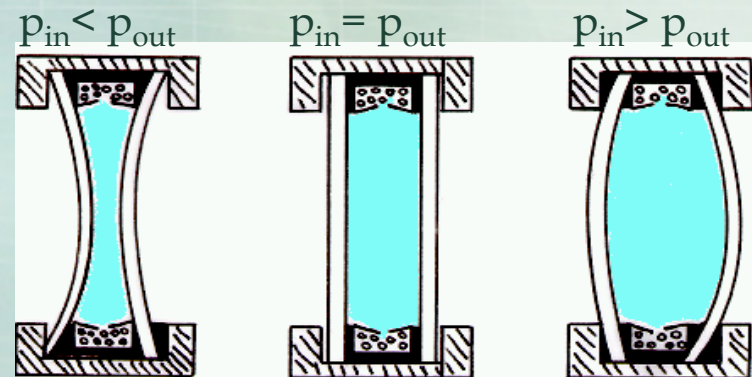
- Temperature variation
- Atmospheric pressure variation
- Difference in height between manufacture and installation
- Adsorption of the trapped moisture
- Adsorption of air (nitrogen/oxygen) or Argon/Xenon



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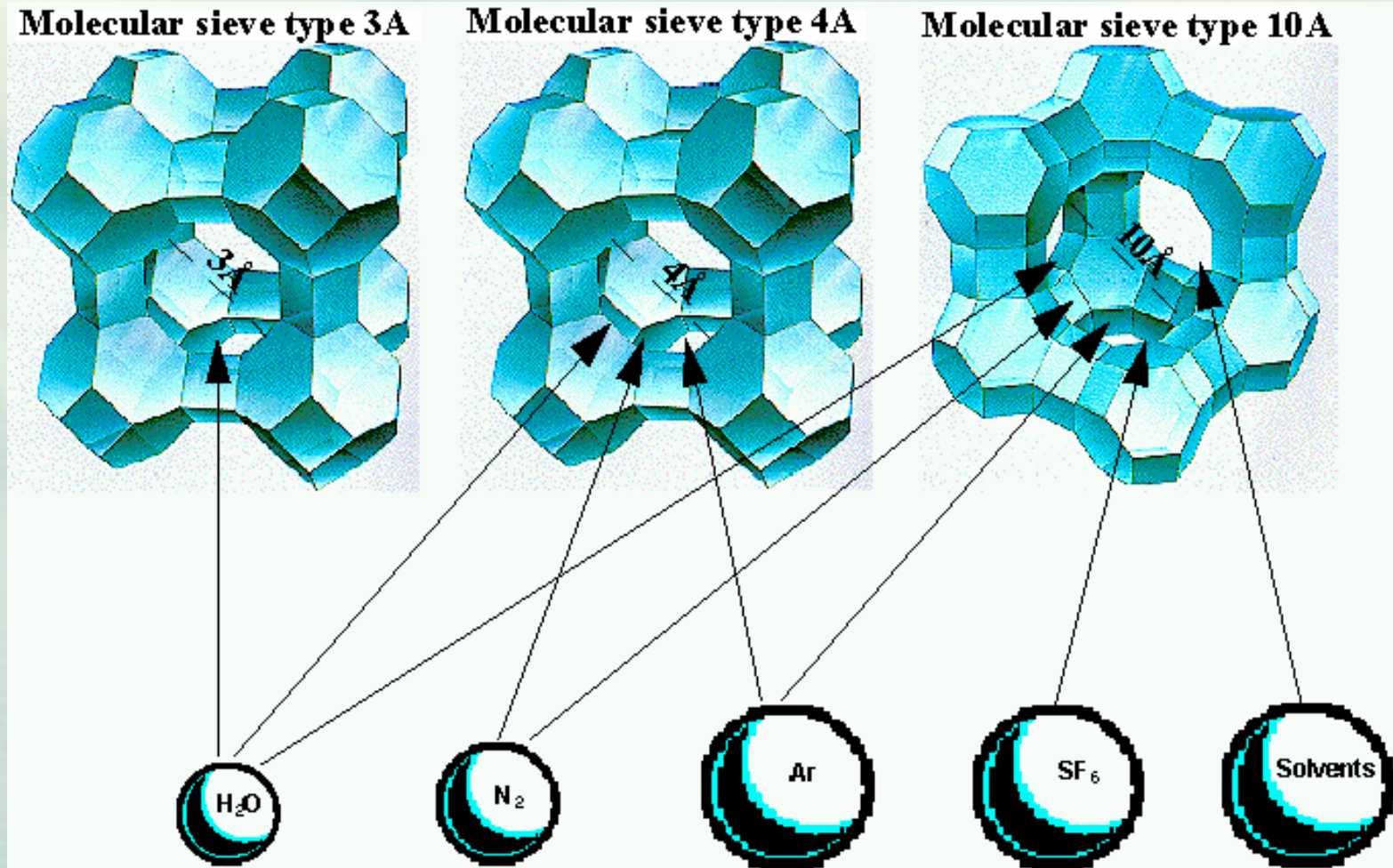
# Selection of Suitable Desiccants: Impact of IG Unit Deflection

- Distortion of reflection image
- Reduced thermal conductivity - comfort and energy
- Increased stress of the edge seal, faster aging, higher water vapor transmission rate, reduced IGU life-times
- Danger of glass breakage - particularly smaller units



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# Selection of Suitable Desiccants



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# Selection of Suitable Desiccants

## Adsorption Properties In IGU Conditions

	H <sub>2</sub> O	N <sub>2</sub>	O <sub>2</sub>	Solvents
3A	<i>yes</i>	<i>no</i>	<i>no</i>	<i>no</i>
4A	<i>yes</i>	<i>yes</i>	<i>yes</i>	<i>no</i>
10A	<i>yes</i>	<i>yes</i>	<i>yes</i>	<i>yes</i>
Silica Gel	<i>no</i>	<i>no</i>	<i>no</i>	<i>yes</i>

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# Correct Handling of the Desiccant



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# Correct Handling of the Desiccant During IG Manufacture

## Storage

- Under roof
- Dry
- Bag/Super Sack: no exposure to UV radiation
- Storage time (on packaging: date of manufacture)

Drum: max. 4 years

Bag: max. 1 year

Bag-in-Box: max. 1 year

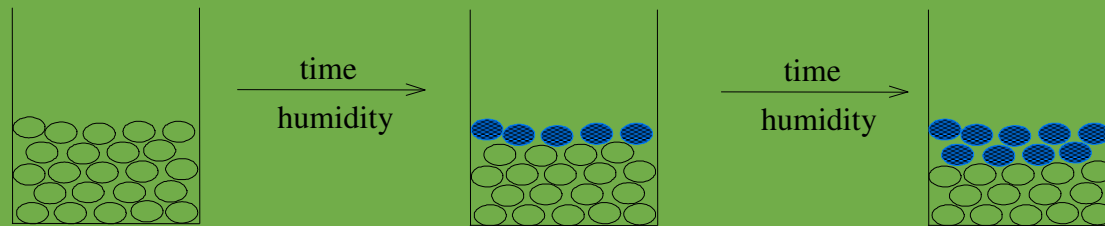
Super Sack: max. 0.5 years

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# Correct Handling of the Desiccant Water Absorption Capacity

## Square Wave Diffusion Model

Driver: High affinity of zeolite for water



- active zeolite particle
- water saturated zeolite particle

Open Drum/Bag time

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# Control of the Activity of the Desiccant Before Use

## Delta-T Test

### Principle:

- Active MS in water:
- Heat released  $\rightarrow$  leads to a temperature rise (Delta-T)
- Delta-T test is an easy, but rough test to check on the activity of the desiccant

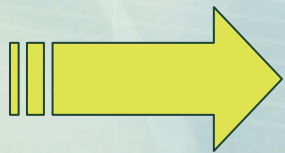


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# Correct Handling of the Desiccant During IG Manufacture

Supply drum at LISEC filling machine

In the case where the supply drum is filled from bags, the drum should be cleaned from time to time!



Prevention of  
dust!



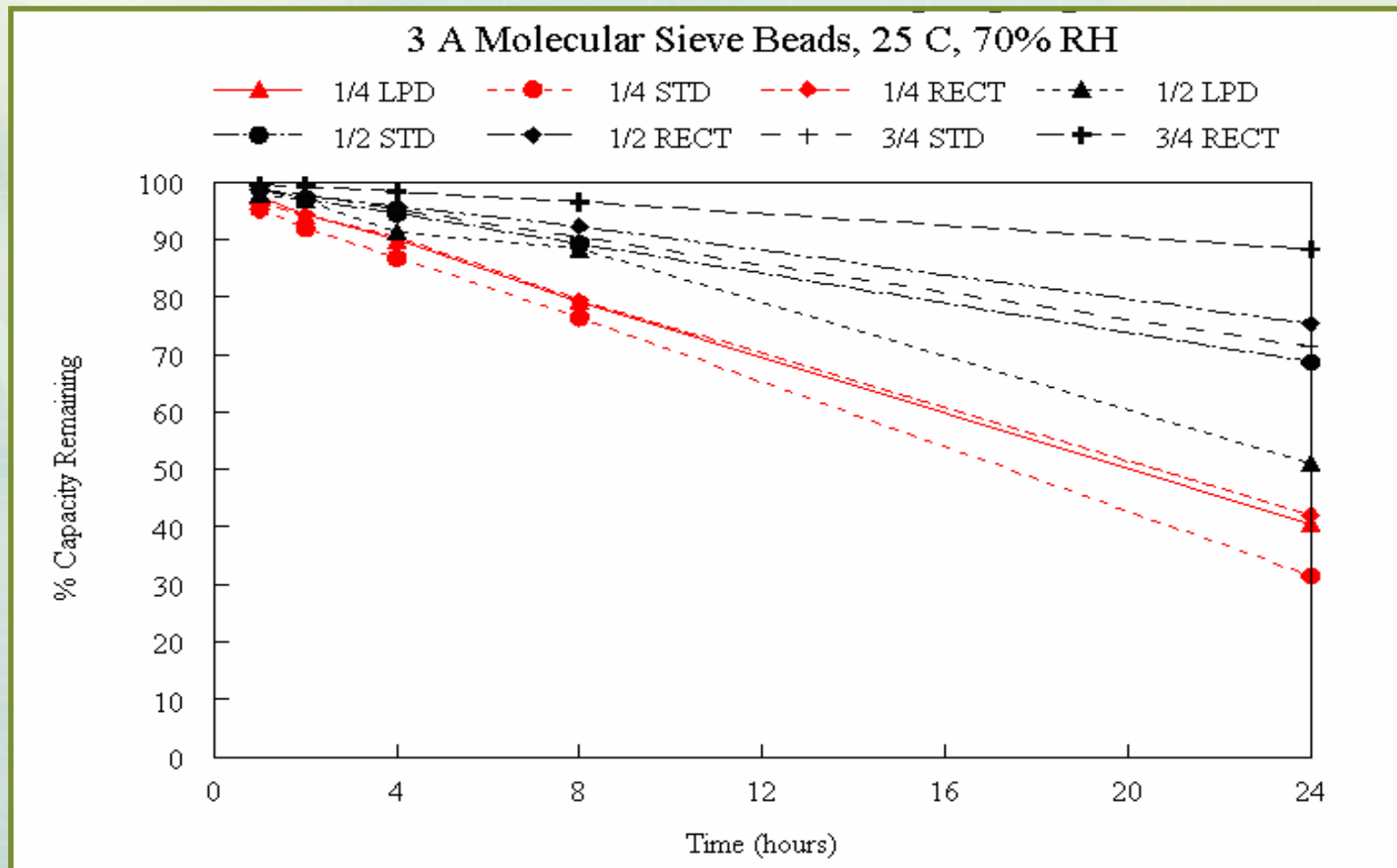
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# Desiccant Recommendation Based on Sealant Configuration

- |                  |                              |
|------------------|------------------------------|
| ■ Hot Melt Butyl | 3A or SiO <sub>2</sub> Blend |
| ■ Polyurethane   | 3A or SiO <sub>2</sub> Blend |
| ■ Polysulfide    | SiO <sub>2</sub> Blend       |
| ■ PIB/PU         | 3A or SiO <sub>2</sub> Blend |
| ■ PIB/PS         | SiO <sub>2</sub> Blend or 3A |
| ■ PIB/Silicone   | SiO <sub>2</sub> Blend or 3A |

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# Desiccation Loss in Hanging Spacers



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# Hang Time Studies

## Influencing Parameters:

- Perforation of the spacer bar
- Number of filled profile sides
- Spacer Size
- Desiccant type
- Gas filling
- Temperature at Manufacture
- Relative Humidity at Manufacture

# Supplier Quality Control

- Adsorption Capacity
- Gas Desorption
- Dust
- Particle Size
- Packaging
- Technical Support - Lifetime estimations, trouble shooting, hang time studies.....
- Shipping

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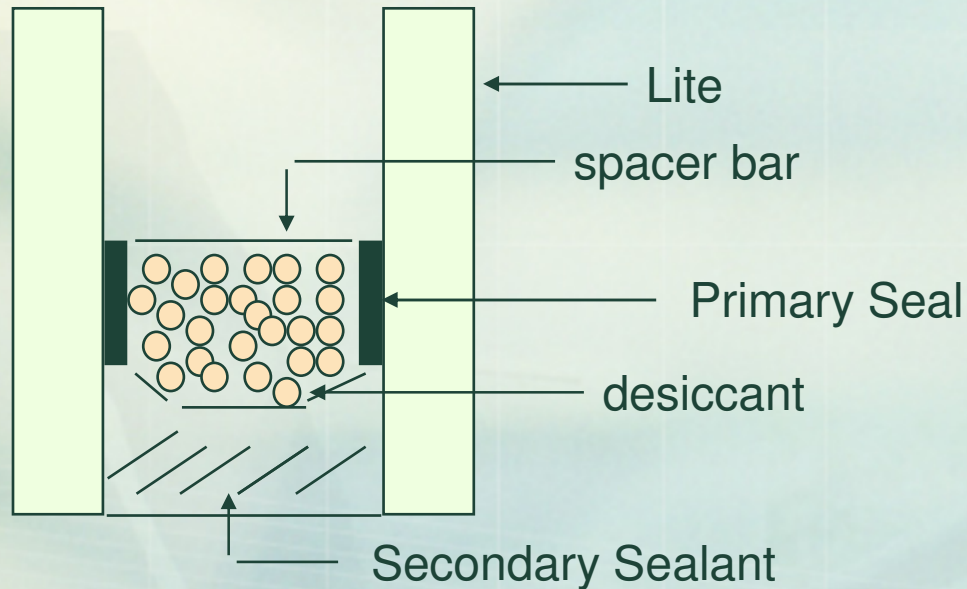
# Questions to Ask When Comparing Desiccants

- At what relative humidity and temperature is water capacity measured?
- When comparing desiccants what is the density? - manufacturers filling by volume
- Size vs. spacer opening - Will it fill correctly?
- Is material low deflection?
- ISO 9000

# Properties of a Desiccated Matrix

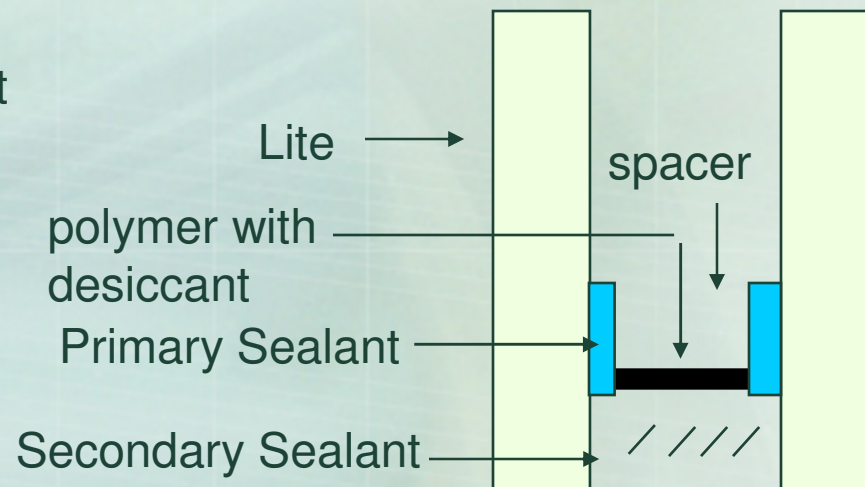
- Adsorb Moisture.
- No off-gassing.
- No adsorption of Argon, Nitrogen, Oxygen.
- Adhesion to the U-channel spacer.
- Pumpability.
- Spreadability - Aesthetics.
- UV Stable.

# Loose Fill or Matrix



**Intercept®**

## Conventional Insulating Glass



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# Functionality

## 1. Drying the unit down initially after manufacture.

- Typically only requires less than 0.5g of desiccant.
- Units dry down to -90°F in 18 hours.

## 2. Adsorbing moisture that permeates through the sealant over the lifetime of the insulated glass unit.

- Dependent on MVTR of sealants, sealant application and manufacturing.

## 3. Adsorbing off gassed organics from desiccated matrix, sealants, mantis...

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# Types of Desiccant Matrix Materials

## Hot Applied Systems

Requires Hot Melt pump.

Long shelf life.

No Cure times - Adhesion properties are constant

## Cold Applied Systems

Does Not require Hot Melt pump.

Liquid material - Chemically cures - Adhesion properties improve with curing.

Shorter shelf life.

## Warm Applied Systems

Hybrids of the Above

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# Types of Desiccant Matrix Materials

## HOT APPLIED (Over 200°F)

ADCO

Bostik

Grace Davison

H.B. Fuller

## WARM APPLIED (~ 160 °F)

Bostik

H.B. Fuller

## AMBIENT APPLIED (Room Temperature)

PRC Desota

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# Application Rates

- How Much do I use?
- Questions to ask yourself -
  - How Long do I want my IGU to last?
  - What is the MVTR of my sealant?
  - Is that MVTR result relevant to my sealant application?
  - Have I taken into account manufacturing, deflection.....

# Application Rates

Once questions have been answered

- Calculation - Assumes perfect manufacturing, no elongation of sealant due to deflection.
- CBA testing - Really a sealant test
- Comparison to historical data/loadings

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# Application Rates

Equivalent loading of rectangular spacer Allmetal 1/2" std spacer. Typical IGU size 3x5 foot with 2 side fill rate 16.6g/ft estimate of 75% sieve.

- 16.6g x 0.75 x 8ft = 99.6 grams of desiccant in a traditional unit

Equivalent loading of Desiccant Matrix with 57% sieve with 6.1g/ft four side filling.

- 6.1g x 0.57 x 16ft = 55.6grams of desiccant

Equivalent Loading of same unit with a desiccant matrix having 50% sieve and a 4 gram recommendation

- 4g x 0.5 x 16ft = 32 grams of desiccant

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# Application Rates

## IGMA FIELD CORRELATION STUDIES

10 Year Data: Class CBA 2.5% failures

15 year Data: Class CBA 4.3% failures

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# Quality Controls

## Supplier Checks -

Adsorption Capacity

Adhesion

Slump Testing

Melt Index

Viscosity

Grit Test

UV Testing - Stability and Offgassing

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# Quality Controls

## Manufacturers Controls/Checks

No activity test like loose fill  
(EXCEPTION PRC)

Application Rate - Measure on routine Basis  
(Equipment now available to lay down to the .1g)

Clean spacer

Hang times No more than Four hours

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# Conclusions

- Desiccants have three functions –
  - 1) Adsorbing the moisture included during the manufacture of the IGU
  - 2) Second most important is to adsorb any off-gassed organics WITHOUT causing deflection
  - 3) Adsorb moisture that permeates through the seal
- There are three commercially applicable desiccants available
  - 1) 3Å
  - 2) 3Å/10 Å Blend
  - 3) 3Å/Silica Blend

# Conclusions

- When you purchase desiccant matrix you are purchasing adsorption capacity - Ask your supplier how much desiccant is included. Then ask your supplier's competition
- Different types of adsorbent used in desiccant matrix materials.
- No Real Easy Test - Ask for Certificate of Analysis.
- How Long do you want your IGU to last - reinvestigate your application rate.

~ Davison



# THE ROLE OF DESICCANT IN INSULATING GLASS

— *Questions?* —

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