Role of desiccants

Complex subject made easy

By Stephen L. Meisel

Would you want to consider a "climate" inside your insulating glass unit? Probably not. During manufacture, a volume of air is trapped in IG at a certain temperature and relative humidity, then exposed to the forces of nature, heat, cold and pressures. Without a desiccant to dry the air space, the trapped moisture condenses and creates "rain" inside the IG when the temperature drops a mere 20 degrees Fahrenheit. The desiccant also picks up any incoming moisture through the edge seal as well as adsorbing hydrocarbons made present by any number of culprits. Chemical fogging can be caused by the off-gassed organics in sealants, muntin bars, glass cleaners, corner pieces, polymeric spacers and cleaning solvents, to name a few.

Selection of suitable desiccants

Adsorption properties in Insulating glass unit conditions

	H2O	N2	O2	Solvents
3A	yes	no	no	no
4A	yes	yes	yes	no
5A	yes	yes	yes	yes
Silica Gel	no	no	no	yes

Selection of suitable desiccants

Dependent on the gasses and vapors in the insulating glass:

Water vapor	should be adsorbed
Air (nitrogen and oxygen)	should not be adsorbed
Argon or xenon	should not be adsorbed
Solvents or plasticizers	should not be adsorbed

Desiccants have three main functions. Absorbing moisture that permeates through the seal represents the most important function. Desiccants also absorb any off-gassed organics without causing deflection and adsorb the moisture included during manufacture of insulating glass units.

Types of desiccants

When we speak of desiccant types, we generally think of silica gel and molecular sieves. Silica gel is a highly porous granular-shaped desiccant ranging in pore sizes from 20 angstroms to 200 angstroms. Highly porous crystals of molecular sieves, on the other hand, come in uniform sizes and absorb more selectively. Although 3, 4, 5 and 10 angstrom pore-size sieves exist, industry experts seem to agree that a 3-angstrom molecular sieve does the best job in only adsorbing moisture. Unfortunately, a blend of 3A and 10A sizes, sometimes used to adsorb moisture and organics, respectively, both compete for the moisture, and the 10A also will adsorb nitrogen and oxygen from the trapped air, as well as argon and xenon. Please see the chart, left, showing the adsorption characteristics of the current IG desiccant products.

Both temperature and pressure play a part in glass deflection, as these gasses go through adsorption-desorption cycles. These cycles force the glass lites to either deflect away from or toward each other, causing additional stress to the sealant and edges of the glass. This can result in glass cracking, breaking or other IG unit failures.

Grace Davison in Curtis Bay, Md., manufacturers a silica gel and molecular sieve blend that has been developed to allow each desiccant to function independently. The 3-angstrom molecular sieve adsorbs trapped moisture in the air space during

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Proper handling by manufacturers remains critical for optimum performance of the desiccant

manufacture and any entering moisture throughout the life of the IG unit. The silica gel at this point adsorbs hydrocarbons, but not nitrogen, oxygen, argon or xenon (see diagram on p. 98). A desiccated matrix used for high-speed automated insulating glass manufacturing systems such as Intercept will be discussed later.

Handling desiccants

Generally, shipped desiccants come with certificates of analyses showing that they meet the manufacturers' specifications for those products. Proper handling at the IG manufacturer's location remains critical for optimum performance of the desiccant. Since the adsorbent is a "moisture scavenger," all efforts to minimize exposure to moisture become a must. Store under a roof in a dry area; bags and super sacks—large plastic lined bags for high volume applications—should be kept from exposure to ultraviolet radiation. Note dates of manufacture on the packaging. Keep drums for a maximum of four years, bags and bags-in-a-box for one year and super sacks for a maximum of six months. The square-wave diffusion model, right, shows that the desiccant will begin to saturate from the source of the moisture opening. For example, in an open drum of material, the desiccant will adsorb from the top surface first and then into the drum itself. A lot of times, discarding the top couple of inches will produce active product again without wasting the whole drum. This can be determined using a temperature rise or delta-T test. Generally, each supplier will have similar test methods and provide a kit to perform the test at the IG filling line. Adding the desiccant to a specified amount of water and measuring the temperature rise is an easy

Sources

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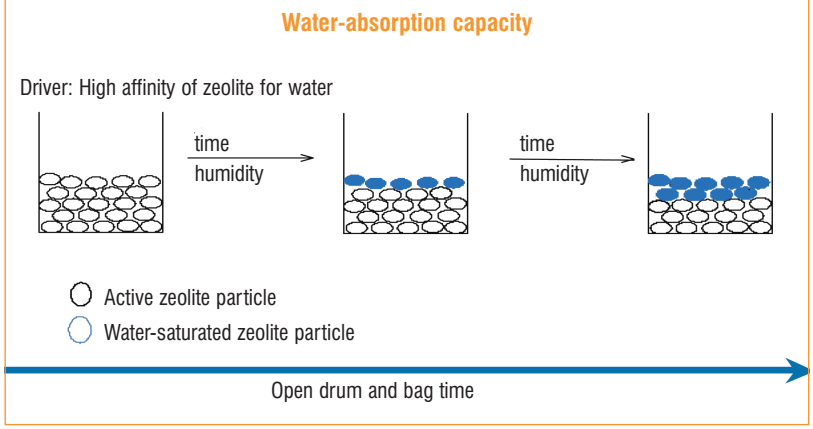
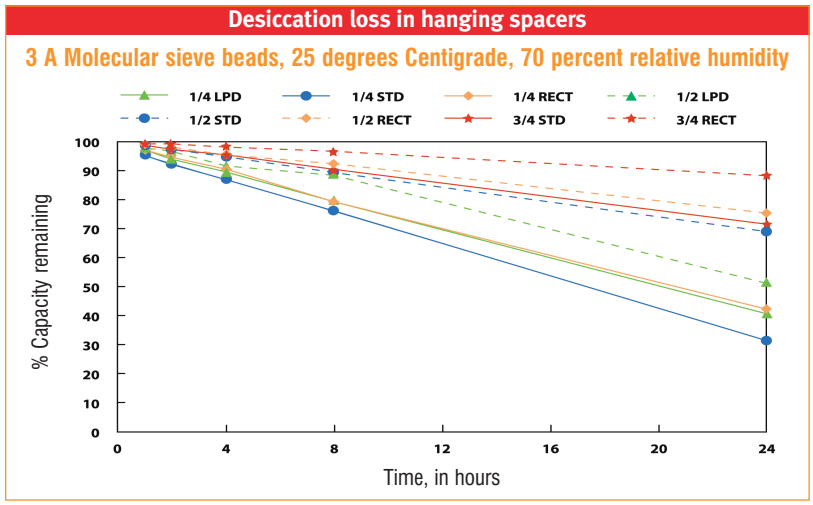
Correct handling of the desiccant illustrated in square-wave diffusion model





The graphic above shows desiccation losses by type of spacers and their dimensions, in inches. It features data on low-profile designs, rectangular and standard box spacers.

but rough way to check the adsorbent activity.

Another handling question: How long can a spacer hang awaiting assembly before the desiccant loses significant moisture capacity? Influencing parameters such as spacer size, perforations, number of filled sides, desiccant type, gas-filling, temperature and relative humidity at manufacture, all play a part in determining spacer hang time. A ¼-inch standard spacer can lose up to 20 percent of its drying capacity at 25 degrees Centigrade and 70 percent relative humidity in only four hours (see diagram above).

Supplier quality control

To produce a quality insulating glass desiccant, suppliers must consistently stay on their toes to monitor adsorption capacity, gas desorption, dust, particle size and packaging. Providing technical support and quality shipping also become important.

When comparing desiccants, ask:

- At what relative humidity and temperature is water capacity measured? Higher relative humidity and lower temperatures will show greater adsorption capacity.
- At what density? Know the density of the desiccant; IG manufacturers buy on weight but fill on volume.
- Compare the molecular-sieve bead size versus the spacer opening; will the unit fill correctly?
- Is the desiccant low-deflection?
- Is the supplier certified by the International Organization for Standardization?

Desiccated polymeric matrix

A desiccant matrix, unlike the loose-fill desiccants discussed above, adheres to a U-type spacer in an open channel. This type of system is used on high-speed automated IG lines. The required matrix properties include moisture adsorption, no off-gassing and no adsorption of argon, nitrogen and oxygen. Adhesion to the U-channel spacer, pumpability, spreadability, aesthetics and UV stability round out the list of desirable matrix properties.

Similar to loose fill, desiccant matrix must dry the unit down initially after manufacture. Units dry down to –90 F in 18 hours. They adsorb moisture that enter through the sealant during the lifetime of the IG unit and adsorb off-gassed organics from the desiccated matrix, sealants and muntins. Currently, there are hot applied matrix placed at temperatures greater than 200 F, warm applied matrix placed at temperatures around 160 F and ambient matrix applied at room temperature.

Application rates

The most frequently asked question from manufacturers is "How much desiccant do I use ?" In reply, I ask: How long do you want the want the IG unit to last? What is the moisture vapor transmission rate of the sealant? Have you taken into account manufacturing procedures, deflection and so forth? After these questions have been answered, we rely on calculations to answer the major issue. Fabricators often perform tests according to ASTM International's ASTM E773/E774 procedures, and compare the results to historical data and loadings. The calculation assumes perfect manufacturing and testing to quality level CBA as an industry standard. At the same time, most certification requirements and agencies use ASTM E2188/ 2189/2190 as of January 2005. See www.astm.org.

Suppliers should test for things such as adsorption capacity, slump, melt index, viscosity, grit and exposure to ultraviolet light for stability and off-gassing. As far as IG manufacturers' controls and checks, there is no real test, like the loose fill T-Rise test for hot- and warm-applied matrix.

Manufacturers would also want to measure the application rate on a routine basis and make sure clean spacers are used and hang times are no more than four hours.

When you purchase desiccant matrix, you purchase adsorption capacity. Ask your supplier how much desiccant is included, then ask your suppliers' competition. As mentioned above, there is no easy test for measuring the activeness of matrix; ask for a certificate of analysis. Based on how long you want your IG unit to last, study your application rates.

Remember, a quality desiccant eliminates the "climate" in insulating glass units. By adsorbing the moisture in the trapped air space, water droplets or spots cannot form on the inside surfaces of the IG.

Operators need to know what they put into IG units and why. Explaining the reason for moisture adsorption may prevent failures from occurring. Testing loose-fill desiccant for activity remains key to maintaining quality products in finished IG units and ultimately IG windows.

Quality IG desiccant represents a small percentage of the overall IG unit with regard to quantity and cost. This said, it can literally break a well-manufactured unit's chances of passing tests necessary to qualify for sought-after certification. g