

PRODUCT APPLICATION

A technical bulletin for engineers, contractors and students in the air movement and control industry

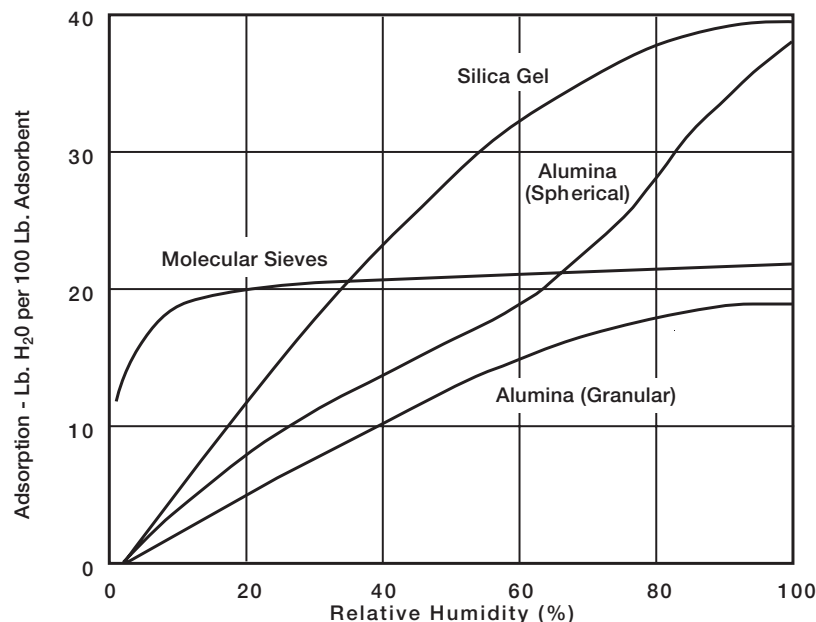
Silica Gel Desiccant

As codes and standards move toward more ventilation in buildings as well as higher energy efficiency, total enthalpy wheels are increasingly used in comfort HVAC applications to offset the energy costs of dehumidifying and conditioning outdoor air. When coated by the manufacturer with a desiccant such as silica gel or molecular sieve, total enthalpy wheels transfer both moisture and heat between supply and exhaust ventilation airstreams.

Silica gel is a highly porous solid adsorbent material that structurally resembles a rigid sponge. It has a very large internal surface composed of myriad microscopic cavities and a vast system of capillary channels that provide pathways connecting the internal microscopic cavities to the outside surface of the “sponge.”

The characteristic curve for adsorption of water on silica gel is shown in Figure 1 as percentage of weight adsorbed versus relative humidity of the airstream in contact with the silica gel. The amount of water adsorbed rises almost linearly with increasing relative humidity until RH reaches about 60%. It then plateaus out at about 40% adsorbed as relative humidity approaches 100%.

The curve for molecular sieves, by contrast, rises rapidly to plateau near 20% adsorbed at 20% relative humidity. This shows that the molecular sieve has a lower capacity for moisture. Silica gel is therefore a superior technology for the recovery of space conditioning energy from exhaust air because its moisture capacity per desiccant volume is higher, allowing it to handle higher outdoor air loads.



Source: Davison Chemical Co.

Figure 1

On the other hand, molecular sieves work better in dehumidification systems that are designed to reduce processed airstreams to very low relative humidities.

The use of silica gel on total enthalpy wheels involves a process cycle where the silica gel is alternately exposed to airstreams having nearly equal relative humidities somewhere in the middle range of this curve (typically between 40 and 60%). When the airstream with the higher relative humidity passes over the silica gel-coated wheel, moisture is adsorbed from the airstream into the silica gel. Then when the airstream with the lower relative humidity contacts the silica gel, moisture is desorbed (removed) from the silica gel and put into the airstream.

Silica gel has the additional advantage of not transferring contaminants. It has a greater affinity for water than any other chemical species. Therefore, in a ventilation energy recovery application, all of the silica gel's surface area is covered with at least a monomolecular layer of water. With all the adsorption sites occupied by water, the silica gel will not be able to transfer other chemical species by adsorption and desorption in its normal form.

Species that are soluble in water could become dissolved in the adsorbed water and then released when the water is desorbed, but this process is limited by kinetics and does not present a very efficient mechanism for contaminant transfer.

Stringent requirements for indoor air quality (IAQ) oblige engineers to provide higher outdoor air ventilation and consider energy recovery options for lowering the associated energy costs. Greenheck's energy recovery ventilators (ERVs) and Dedicated Outdoor Air Systems (DOAS) feature the option of total enthalpy wheels, which transfer both sensible and latent energy at up to 80% effectiveness. They transfer moisture to favorable zones, keeping it outdoors in humid summer months and indoors during dry winter months.

Aluminum wheels coated with a molecular sieve desiccant are available for dehumidification applications. For comfort cooling applications, the best performance is to be found from durable polymer wheels manufactured with a silica gel desiccant.