

# PRODUCT APPLICATION GUIDE

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

## Silica Gel Desiccant

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 % 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 at about 20% adsorbed at 20% relative humidity. This helps to explain why the molecular sieve is an excellent choice for regenerated applications such as desiccant cooling and dehumidification systems which are designed to reduce processed airstreams to very low relative humidities. On the other hand, silica gel has superior characteristics for the recovery of space conditioning energy from exhaust air.

The use of silica gel on rotary regenerators for energy recovery ventilation applications involves a process cycle where the silica gel is alternately exposed to airstreams having nearly equal relative humidities somewhere in the mid 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.

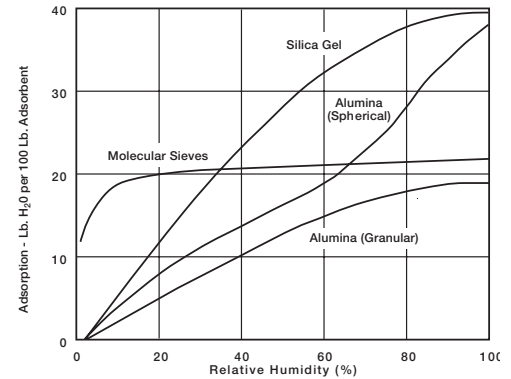
In this ventilation energy recovery application, the silica gel has all of its surface area covered with at least a monomolecular layer of water because it has a greater affinity for water than any other chemical

species. With all of 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.

An example of this phenomenon is formaldehyde, a gas which is very highly soluble in water. In the early 1980s when energy recovery ventilators were being used to mitigate excessive formaldehyde levels in mobile homes, concern was expressed by some people that enthalpy type heat exchangers that transferred moisture as well as heat might also transfer excess amounts of formaldehyde gas due to its high solubility in water. Accordingly, tests were conducted by the Lawrence Berkeley Laboratories of the U.S.D.O.E., on two enthalpy type exchangers to determine whether this suspicion was justified. Results were presented in ASHRAE paper No. CH85-03 No. 3 which reported that the rotary type enthalpy heat exchanger (using lithium chloride as desiccant) transferred formaldehyde with only 3-6% efficiency. They concluded that "formaldehyde transfer between airstreams by processes other than air leakage does not seriously compromise the performance of these enthalpy exchangers".



Source: Davison Chemical Co. Figure 1