Flow Dry Technology®

Sealing, Drying and Protecting Your Products Since 1946

YOUR GUIDE TO SELECTING THE RIGHT DESICCANT

Humidity and water can be ruinous in the welfare of a wide variety of products. But there are ways that you can control this threat, and it is as simple as understanding how a specific desiccant can protect your product. By comparing the capabilities of each type of desiccant, as well as the protective needs of the package, proper selection of the desiccant can be made. In this document we take a look at six common desiccants, break down the properties of each, and discuss the comparative features in relation to product factors.

When deciding on the proper desiccant, it should be known how much water vapor can be adsorbed by the desiccant at various relative humidities, or the equilibrium adsorption capacity. Note that the equilibrium moisture capacity of the desiccant in a package is defined by the relative humidity chosen as the maximum that the contents of the package can tolerate, not by the starting humidity conditions of the packaging room. This can be seen in **Figure 1**, which shows in comparison the equilibrium adsorption capacity of various sorbents.

Figure 2 summarizes the general capabilities of molecular sieves, silica gel, montmorillonite clay, calcium oxide and calcium sulfate. It is up to the packaging engineer to decide which properties of the desiccant are important to the packaging situation and to select the appropriate desiccant.

Water Capacity of Various Sorbents at Different Relative Humidity Levels

Figure 1

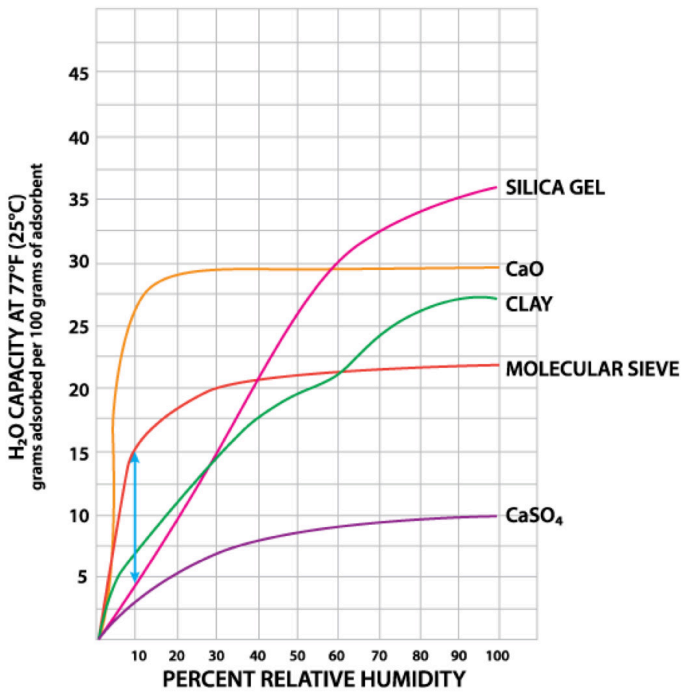

Figure 2

	MOLECULAR SIEVE	SILICA GEL	CLAY	CAO	$CASO_4$
Absorptive Capacity At Low H_2O Levels	Excellent	Poor	Fair	Excellent	Good
Rate Of Adsorption	Excellent	Good	Good	Poor	Good
Capacity For H_2O At 77F And 40% Rh	High	High	Medium	High	Low
Capacity At Elevated Temperatures	Excellent	Poor	Poor	Good	Good
Separation By Molecular Sizes	Yes	No	No	No	No

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CLAY

When referencing clay as a desiccant, it is referring specifically to Montmorillonite Clay – a naturally occurring, porous adsorbent that is mined and then dried for use as a desiccant. This clay will successfully regenerate for repeated use at very low temperatures. However, this property also causes the clay to release moisture into the container as temperatures rise, causing potential for moisture issues. When used within normal temperature and relative humidity ranges, clay is an inexpensive and effective desiccant option, as seen in Figure 2. Care should also be taken to be sure that any low-level impurities in the clay are compatible with the packaged product.

SILICA GEL

The most commonly used desiccant in the pharmaceutical and nutraceutical industry is silica gel. This partially dehydrated form of polymeric colloidal silicic acid has a unique structure, enabling it to adsorb a wide variety of chemical substances. Silica gel is most adsorbent with water – adsorbing up to 40% of its weight in water, under the right conditions (below 77° F and high humidity – see Figure 1). It should be noted that, much like clay, some of this adsorbed water will be released as temperatures begin to rise, and packaging that uses a silica gel desiccant should be stored in a cool location. Much of silica gel's popularity is due to its non-corrosive, non-toxic nature – having first received U.S. government approval for use in food and drug packaging.

MOLECULAR SIEVE (SYNTHETIC ZEOLITE)

When your product has the potential to see a wide range of environmental conditions, a molecular sieve desiccant may be the best option for your packaging. Molecular sieves – formally porous crystalline aluminosilicates, a type of ceramic – have a distinctive feature in the uniformity of the pore size openings in their crystal lattice structure. Due to this uniformity, molecular sieves gain a major advantage over other desiccant types, as they have a high adsorption capacity at low relative humidity. Additionally, molecular sieves will not desorb moisture into the package as temperatures rise, unlike silica gel or clay desiccants. These desiccants are slightly higher in cost per unit; however, due to the extremely large range of adsorptive capabilities, molecular sieves may often be the best value where a very low relative humidity is required.

CALCIUM OXIDE (CAO)

If you have a product that will be stored or transported in areas with high temperatures, calcium oxide is a cost-effective desiccant that should be considered. Calcium oxide (also known as Quick Lime) is a calcined lime, distinguished by its ability to adsorb a much greater amount of water at low relative humidity than other materials (see **Figure 1**), and also retains that moisture at high temperatures. This desiccant removes water from a package very slowly, often taking days to reach its maximum capacity. Furthermore, calcium oxide swells as it adsorbs moisture, requiring proper desiccant packaging so that it is utilized effectively. Due to these factors, calcium oxide has found usage primarily in the packaging of dehydrated foods and as a cargo desiccant.

CALCIUM SULFATE (CAS04)

Calcium Sulfate – better known commercially as Drierite – is a general purpose desiccant, perfect for use in sterile environments. Created by the controlled dehydration of gypsum, it is chemically stable, non-disintegrating, non-toxic, non-corrosive and does not release its adsorbed water easily when exposed to higher ambient temperatures. Because of these features, it is geared mainly towards laboratory use. The low cost of calcium sulfate must be weighed against it's equally low adsorptive capacity: it adsorbs only up to 10% of its weight in water vapor (Figure 1).

ACTIVATED CARBON

If odors or organic compounds may cause issue to your product functionality or consumer experience, activated carbon may be the desiccant solution for you. Interestingly, most desiccant applications utilizing activated carbon are created from oxidized (burned) coconut shells. The structure of these shells has a high surface area, and readily adsorb hydrocarbon molecules. When combined with silica gel or molecular sieve, this sorbent material can be an effective choice in some nutraceutical or pharmaceutical applications.

CONCLUSION

It is important to understand how each desiccant does its job of protecting the product. By comparing the capabilities of each type of desiccant and the needs of the package for protection, you can find the right desiccant for each of your packaging solutions.

For more information, call **1-800-533-0077** or visit **flowdry.com**

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