

Tips:

## How to combat moisture-related flow problems by using a desiccant dehumidifier

Moisture can cause your hygroscopic material to build up on silo walls or form lumps that block pneumatic conveying lines. The results? Lower productivity, higher production costs, and poor product quality. Read this tip to learn how a desiccant dehumidifier can combat humidity problems affecting your material's flow.

Humidity can create headaches in three main areas of dry bulk materials handling: silo storage, pneumatic conveying, and truck and railcar unloading. The following information explains how a desiccant dehumidifier can be used to control humidity in each application.

### Silo storage

Once a dry powder or granular material is loaded into a silo, it can absorb moisture. This is especially true for a

hygroscopic material such as sugar or starch. When moist, the material becomes sticky, building up on the silo wall and forming lumps throughout the stored material. The buildup and lumping can lead to discharge problems (such as bridging at the silo outlet), bacterial growth in the material, and costly downtime for silo cleaning.

The moisture comes from air and condensation. Condensation can form on the wall or ceiling of an outdoor silo when it's colder than the ambient temperature. This often occurs at night when the temperature drops.

Any or all of these can contribute to condensation:

- Humid, conditioned air that enters through silo vents when the vessel is emptied.
- Moisture from the material.
- Humid, unconditioned air that enters the silo from a truck or railcar unloading system, pulse-jet filter, pressurization fan, or fluidized discharge bottom's blower.

When the material's moisture content is proportional to the air's relative humidity, the material and air in the silo are *in equilibrium*. But when a dry material contacts humid air in a silo, the material will absorb moisture until its surface water vapor pressure is the same as the air's vapor pressure.

The material's surface vapor pressure depends mainly on its chemical and physical structure and, to some degree, on the material's temperature and moisture content. For each different material and air temperature, the equilibrium relationship between moisture content and relative humidity differs.

You can keep the air and material in equilibrium and prevent condensation in the silo by using a desiccant dehumidifier to condition the air entering the silo, which will control its temperature and relative humidity to your specified

level. How much dehumidifying the air requires depends on factors such as the climate in your area, your silo's location indoors or outdoors, and your material's characteristics. A silo typically requires three dehumidified air changes per hour to control the air temperature and humidity.

### Pneumatic conveying

In a pneumatic conveying system, a material that would otherwise flow smoothly can regain moisture from humidity in the conveying air. This can cause the material to become sticky and build up in the conveying line. The result can be slow material transfer and excessive downtime for system cleaning.

To prevent these problems, you can install a desiccant dehumidifier upstream from the pneumatic conveying system's blower. The unit can condition the conveying air to meet your material's requirements.

### Truck and railcar unloading

A truck or railcar unloading system pneumatically conveys large quantities of material from the truck or railcar to silos or hoppers in a high-volume manufacturing plant. On a humid day, moisture regain from humidity in the conveying air can cause a dry material such as calcium phosphate to become sticky and build up in the system's conveying lines. The buildup can slow the material transfer and eventually cause downtime for cleaning.

Installing a desiccant dehumidifier upstream from the system's blower can help you combat these problems. The unit can condition the air to meet your material's requirements.

**Dry air blanketing for stored material.** You can also use the dehumidifier when your truck or railcar unloading system is idle. Between unloading operations, the dehumidifier can supply dry air through the conveying system to blanket the material stored in the silo or hopper in your plant. This dry air blanket prevents humidity from

causing material to build up on the silo wall or form lumps that can slow discharge from the silo. It also prevents condensation inside the silo that can lead to bacterial growth, as well as reduces silo cleaning frequency.

**Dry air for railcar's fluidized bed.** If your plant's receiving area has a dedicated conveying system for both truck and railcar unloading, the dehumidifier can supply dry air for the railcar's fluidized bed when the truck isn't being unloaded. This application requires the truck's air volume and pressure rating to match those of the railcar's fluidized bed. The dry air can prevent sticky buildup and lumping, thus speeding material unloading from the railcar.

#### How the dehumidifier works

The desiccant dehumidifier is typically installed outside the plant or near an outside wall so it can draw outside air into the system. This air contains less dust than plant air, and drawing air from outside prevents the problem of creating negative pressure when a large volume of plant air is drawn from one room in the plant.

The desiccant dehumidifier is available in several types, all using a desiccant material that easily attracts and holds moisture. In some types, the humid airstream passes through a vertical bed or over a horizontal tray of desiccant, which removes the moisture from the air. Moisture is removed from the desiccant by another hot airstream; this process, called *reactivating*, readies the desiccant for further dehumidification.

In another type of dehumidifier, the desiccant is impregnated into a wheel made of corrugated ceramic composite material. The humid airstream passes through the slowly rotating wheel, giving off moisture to the desiccant. The moisture-laden wheel slowly rotates into a smaller, hot, counterflow airstream, which

reactivates the desiccant and exhausts the moisture. The wheel rotates the dried desiccant back into the humid airstream.

In a pneumatic conveying or truck or railcar unloading application, you can also use additional components to increase the dehumidifier's efficiency. A precooler can cool and partially dehumidify the airstream before it enters the dehumidifier, and an aftercooler can further cool the airstream after it exits the system's blower.

—*Katharine Speltz,*  
*food marketing engineer,*  
*Cargocaire div.,*  
*Munters Corp.,*  
*Amesbury, Mass.;*  
*813/269-9319*  
*(fax 813/269-9016).*

#### For further reading

Find more information on dehumidifying in articles listed under "Moisture prevention," page 103, in *Powder and Bulk Engineering's* comprehensive "Index to articles," December 1997.