Dehumidification Application

The choice for desiccant dehumidification®

The Pharmaceutical Industry

Bry-Air environmental control systems allow for consistent control to efficiently prevent the effects of humidity

Photo Courtesy of MCT Direct Photos

MOISTURE CONTROL

The moisture absorption properties and characteristics of each pharmaceutical material will determine the optimum control level for processing and packaging. In general, a dry, cool environment results in faster processing and greater product quality. The majority of tableting operations require humidity levels between 20 and 35% RH. If there is a question as to the ideal conditions for processing, the engineer might want to contact the manufacturer of the powder for specific recommendations. If this is not possible, it might be necessary to work with an independent laboratory that can perform a moisture equilibrium analysis of the material. This analysis can determine the moisture absorption rates of the powder at different relative humidity levels.

Photo Courtesy of MCT Direct Photos

MOISTURE LOADS

There are two types of moisture loads within most tableting areas - internal and external. In most tableting operations the moisture load generated inside the room (internal load, i.e., moisture given off by the product and moisture generated by a process) is low. Therefore, the designer's main focus should be on those moisture loads generated from the areas surrounding the tableting operations (external load). In general, they are:

PERMEATION

The amount of moisture that can permeate into the conditioned space from the surrounding areas must be considered. The method and type of materials used for construction and the materials and methods used to seal and make the space vapor proof are important factors that determine the amount of moisture that must be dealt with by the dehumidifier.

VENTILATION AIR

In many cases ventilation air can account for a large moisture load--as high as 50 -60% of the total load. The amount of ventilation air required depends on:

- The amount of the air required in order to maintain room pressurization.
- The amount of makeup air needed for exhaust hoods, fans and machinery.
- The amount of outside air required for occupants.

DOOR OPENINGS

It is important to be realistic about the number of door openings that will occur each hour. Each opening will introduce a substantial load to the conditioned space.

INFILTRATION AIR

In many pharmaceutical operations, the conditioned space must be kept under negative pressure in order to eliminate the leakage of active ingredients from that space into other areas of the building. If this is the case, it is important to remember to include in the calculations the additional moisture load from the untreated air that will be pulled in as a result of this negative pressure in the controlled space. In addition, it is important to control this air volume through the use of balancing dampers. Remember that even a slight increase in leakage airflow can result in a substantial increase in the moisture load.

OTHER LOADS

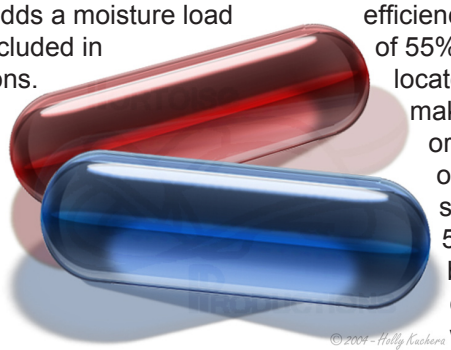
Refer to the Bry-Air Application Engineering Manual for additional information regarding the calculation of moisture loads. Although they are often less than the moisture loads listed above, product and/or process moisture loads, personnel respiration and/or perspiration, fixed or conveyor openings, etc. should be included in all moisture load calculations.

SYSTEM COMPONENTS
PRE-HEATING COILS

If the makeup air is a large part of the total system air, it might be necessary to use pre-heat during the winter, especially in applications where the makeup air is blended with return air before entering the dehumidifier and/or when chilled water pre-cooling is used. If left unheated, cold outside air could cause the moisture in the return air to condense or freeze which could cause damage to the chilled water pre-cooling coil. Of course, this is not a problem in warmer climates.

PRE-COOLING COILS

As discussed above, makeup/ventilation air adds a moisture load that must be included in one's calculations. If the makeup air is a large part of the total system airflow, it likely will need to be pre-cooled (using either DX or chilled water) before it enters the desiccant rotor. This might result in a substantial reduction in the size of the dehumidifier required, thus minimizing initial cost and operating expenses.



AFTER-COOLING COILS

If the dehumidifier is to be added to an existing air-handling system and adds only a small sensible heat load, it is probably not worthwhile to add after-cooling coils. The additional cooling can usually be done downstream by the main air conditioning system.

If such a coil is needed, the ideal location of the after-cooling coil is downstream of the dehumidifier and bypass, but upstream of the process/system fan. This allows for the air from the bypass to blend with the warmer dehumidified air before it contacts the coil, thus ensuring even temperature loading of the coil surface.

FILTRATION

In all pharmaceutical manufacturing applications, particulate contamination is unacceptable. Therefore, it is important to include filters in the makeup air system in addition to the filters located in the main air handling system. Makeup air not only is a great source of moisture, but it is also a great source of particulate contamination.

Bry-Air recommends that 30% efficiency pre-filters and a minimum of 55% efficiency final filters be located at the intakes of the makeup air and the system in order to reduce the amount of particulate that enters the system. In addition, 30%, 55%, or 95% filtration should be arranged in series at the outlet of the system. This will eliminate any residual particulate or dust from any upstream components. HEPA filters can be placed at the end of the system in order to capture smaller particles located in the air stream prior to that air stream entering the conditioned space.

HUMIDIFIERS

Many areas experience cold winters, during which time the air is very dry. If design conditions require a constant humidity level year-round, it may be necessary to include a humidifier in the system.

The humidifier should be located in the blended air stream, downstream of the dehumidifier,

bypass, and cooling coils. Be sure to allow enough space between the humidifier and any after/final filters so that all moisture is absorbed into the air stream before the air comes into contact with the filters.

OTHER CONSIDERATIONS
AIR DUCTS

At the points in the duct system where the system is under negative pressure, air leakage can be substantial. Also, due to the difference in vapor pressures between the air in the ductwork and the surrounding air, moisture can infiltrate ductwork with positive pressure. In most cases this infiltrating air is untreated and has the potential to both contaminate the air stream and introduce unwanted humidity. The designer/engineer should specify high-pressure ductwork standards for the humidity controlled spaces and require a pressure test of the room and ductwork system.

FLOOR, WALLS AND CEILING

It is important for the controlled room to have a continuous vapor barrier consisting of epoxy paint, poly film, Alumiseal, aluminum foil, etc. around the entire room, including the ceiling and floor. When the moisture barrier is consistent and continuous, the moisture permeation into the space is reduced substantially, thus reducing the initial size and cost of the dehumidifier.

CONTROLLING COST

Minimizing the initial cost of the dehumidification system is important to most budget-minded companies. The key to accomplishing this lies in the ability to reduce the moisture loads that are to be dehumidified. Two important factors which will assist in accomplishing this are (1) the use of construction techniques designed to minimize permeation and (2) the ability to keep ventilation air to a minimum. However, one must realize that the system should have adequate ventilation to compensate for equipment, occupants, fixed openings, etc. in the controlled space.

There are several methods that can be used to minimize operating costs. For example, adding modulating control to the unit's reactivation energy source will reduce the amount energy used in proportion to the changing moisture load. This can result in considerable energy savings. Additional savings can be realized by adding a heat recovery system to the reactivation exhaust/ supply.

Over the past 40 years, Bry-Air has soldmany units for pharmaceutical applications. Many companies in Europe, Asia, Canada, Latin America, Mexico, Africa and the USA have come to trust Bry-Air dehumidifiers for their critical tableting operations.

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Rev. 1610-03