ENGINEERING WHITE PAPER

Internal use only

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Humidity Basics: Part 2—Dehumidifying

We all know about space temperature but when it comes humidity not many have a grasp of the subject. This engineering white paper (EWP-7.b) is a supplement to the humidity basics engineering white paper EWP7. While the previous white paper focused on preventing dry conditions by maintaining relative humidity generally ≥40%rh, this white paper focuses on preventing humid conditions. We used dehumidification equipment (removal of moisture from the air) to maintain relative humidity generally ≤60%rh. But before we dive into dehumidifying let's do a quick review on humidity in general.

What do we mean when we say "control humidity" in a building?

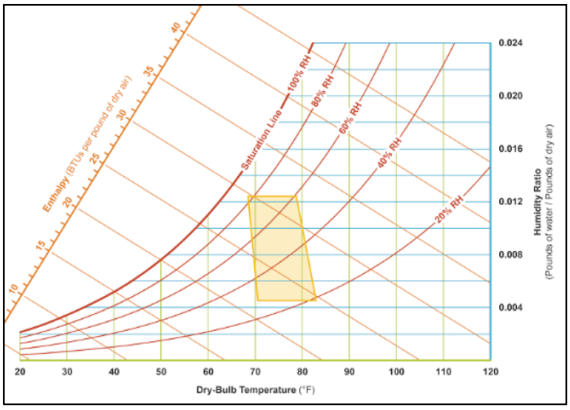

Figure 1 Psychrometric Chart

- First, we must understand the difference between absolute & relative humidity. For this we go to the psychrometric chart (Figure 1).
- Absolute humidity is the ratio of lbs of water per lb of dry air shown in fractional values on the right vertical axis in black.
- Relative humidity is the percent of water in air vs the amount of water that air could hold at a fixed dry bulb temp.
- The warmer the air temperature the more its capacity to hold water. Think Minnesota in winter & Miami in summer.

We can control a space to absolute humidity or relative humidity by either adding or removing moisture. But the more common and useful method is to control to relative humidity. The focus of this document is controlling the space at or below a maximum %RH to avoid an overly humid environment and removing moisture through a dehumidifier is necessary to achieve this goal.

Why do we control humidity in a building?

If we only controlled the dry bulb temperature in a building the %RH can fluctuate significantly creating an adverse environment in many cases. Since we spend the majority of time indoors an adverse environment can affect the people, materials, furnishings, & processes.

- **People:** Controlling relative humidity between 40-60%RH reduces the risk of infection along with other respiratory illnesses (see Figure 2 below). It also makes for a comfortable environment.

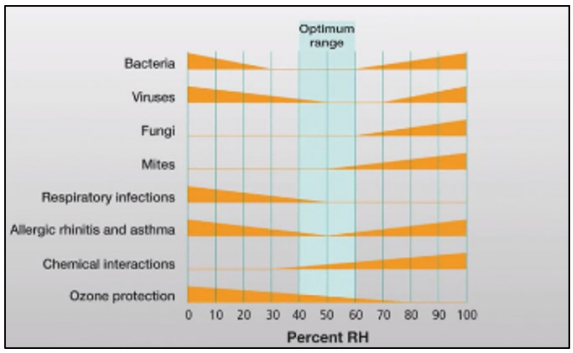

Figure 2 Health Impacts of Relative Humidity

- **Process:** Many industries require control of relative humidity (textiles, printing, semiconductor assembly, data centers, MRI, etc.).
- **Preservation:** Many building materials, artwork, finishes, & furnishings are hygroscopic. This means that they absorb, retain, & release moisture. In humid environments mold & mildew can form while in dry environments these materials can release moisture and shrink causing damage. By controlling the humidity in a room, you can avoid this type of damage to materials.

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- **Moisture Barriers:** Without an effective moisture barrier, water vapor will pass from an area of higher moisture content to areas of lower moisture. Water vapor can pass through brick, wood, plaster board and other building materials. A moisture barrier is strongly recommended when trying to maintain minimum humidity levels in a space.

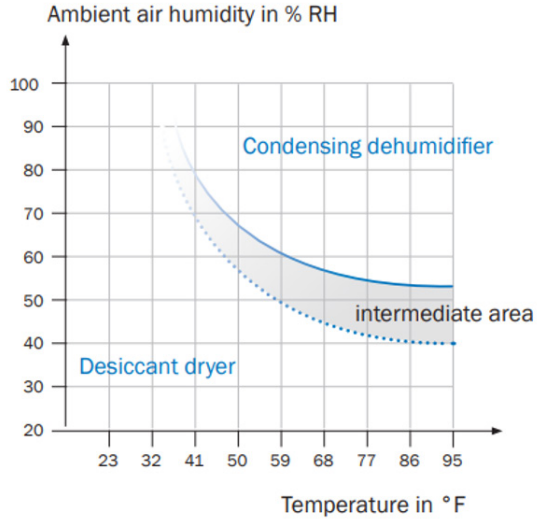
What type/methods of dehumidifiers are there?

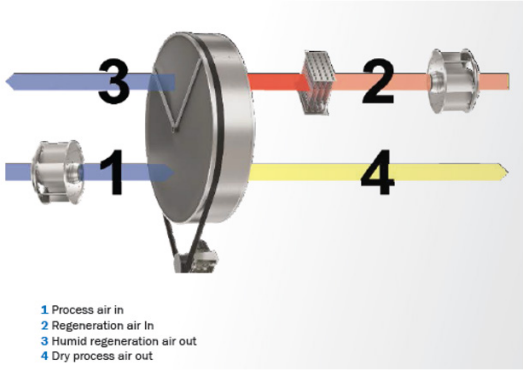
We can dehumidify with either condensing (dx) or desiccant dryer systems.

- ***Condensing dx*** dehumidifiers use the carnot cycle to condense moisture from the air. It cools the air with a refrigeration process and moisture condenses from the air as the temperature hits the saturation curve (dew point). This happens coincidentally with hvac dx or chilled water units. But it can be controlled actively using hot gas reheat (or another form of reheat) which adds sensible heat to move the state point from left (near saturation) to the right decreasing the relative humidity (see psych chart).
- ***desiccant regenerative*** dehumidifiers use some type of molecular sieve (typically silica gel) and the principle of sorption to bind water vapor to a surface. Sorption uses the extremely low water vapor partial pressure near these molecular sieves to diffuse water in the air to these surfaces (sorbents). Air has relatively high water vapor partial pressure compared to the silica gel surface. Typically, a slow spinning silica gel wheel is employed to capture moisture from the incoming air stream on to the wheel's surface and then reject that moisture in a separate hot air stream the wheel also traverses. Because it's a spinning wheel the process continues uninterrupted. See image to the right

What type of dehumidifier should I use for my application?

Condensing (dx) type dehumidifiers are an affordable method of control when the temperature & relative humidity being controlled to are typically higher. Desiccant/regenerative type dehumidifiers are more costly but required when either or both the dry bulb temperature & relative humidity must be controlled to low levels. see chart below





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