Dehumidification Basics 101

Tech to Tech Column—April 08

"Make daily deposits to your box of knowledge, soon it will have many reference cards."--Randal S. Ripley

Spring has finally reached New England and I don't know about you but this winter seemed exceptionally long. Since many technical columns will focus on air conditioning start up and/or service, I thought I would go with something different—***dehumidification*.**

We know in simple terms that *humidity* is water vapor in the air. We also know that warm air can hold more water vapor than cold air and that *relative humidity* is the ratio of water vapor in the air to the amount of water vapor the air can hold at a given temperature.

ASHRAE's (American Society Heating Refrigeration Air conditioning Engineers) published optimal comfort zone for relative humidity is 30-60%. Dust mites that cause allergies can be best controlled below 50%.

High relative humidity levels of 60% or higher on a hot day can make a human being uncomfortable to miserable (in my case). The reason for this is that we are human furnaces that are always releasing heat and never absorbing it. When it is hot and there is little temperature difference between your body and the ambient temperature, your body tries to release heat through another one of its cooling mechanisms—"evaporative cooling" or sweating as we call it.

Our evaporative cooling systems works well on days with low relative humidity and in places like Las Vegas with its very low relative humidity, you may not even realize you are sweating because the water evaporates so quickly.

But when it is hot and the relative humidity is high making it so that your body can't evaporate this water to the air that is already saturated and can't hold much more water vapor; this moisture is not going to evaporate from your skin leaving you soaked and uncomfortable.

For those hot & humid days that we humans need relief from the unbearable humidity, we use our air conditioning systems that cools the air temperature (sensible heat removal) and also removes some humidity (latent heat) from the air as a function of its operation.

High levels of humidity can cause mold, mildew and bacteria and mold growth is a growing problem in today's tighter homes and can be quite a tenacious foe to defeat once it starts appearing. In addition to this, it has a detrimental effect on our belongings, especially those in storage facilities or the basement. Books, clothing, and other belongings can turn yellow, smell badly and develop mold growth on them.

"The Dehumidification Handbook—Second Edition, published by Munters of Amesbury, MA, makers of Dehumidification equipment states, "Mold and fungus are present in almost all materials. They can survive without moisture, remaining dormant for decades, even centuries. But, when moisture and a food source become available they will multiple rapidly. This moisture does not have to be in liquid form. Microscopic organisms can use moisture present in solid materials because they need so little."

"Two classic examples of this phenomenon are the prehistoric cave paintings in Lascaux, France, and the Egyptian artifacts preserved in the pyramids. The cave paintings survived virtually intact for 16,000 years. Then tourists began bringing moisture into the caves in their clothes and through their respiration. The paintings have deteriorated through microbiological attack in less than 40 years. Egyptian artifacts have had the same difficulty, with tragic consequences for history."

So how do we solve these humidity problems, Dehumidification of course? Many experts say that dehumidification is probably the most effective tool we have of controlling moisture that can have a serious impact on mold growth.

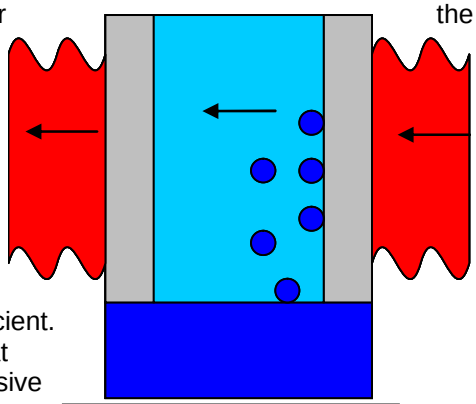
Many Palaces, Churches and Museums in Europe do not have air conditioning. These buildings are full of beautiful, centuries old paintings, cloth wall murals, etc. that are stored in non-temperature controlled areas because of dehumidification—providing great savings in equipment and operational cost.

Humidity can be removed from a space by several different methods but the one we will focus on in this column is the cooling based dehumidification-reheat method using a direct expansion system instead of chilled liquid for cooling the air.

Cooling based dehumidification is basically a standard refrigeration system with a twist. After the air is cooled at the evaporator, it is blown over the condensing coil (reheated) and then discharged to the space. Most residential and whole house dehumidifiers use this configuration.

Cooling systems operate at their highest efficiency levels provided all other variables are constant, when the condenser air temperature is low & the cooling coil air temperature is high.

Cooling the condenser coil with the cool air from the evaporator is ideal since the low air temperature makes the refrigerant condenser very efficient. The reheat energy is essentially free, because it is heat rejected from the cooling process and saves on expensive extra energy from outside the process.



Warm moist air entering evaporator coil, moisture being removed, and drier reheated air returning to space

If you are still wondering why we need to reheat the air let me explain.

Remember, warm air can hold more moisture than cool air and moisture will move to a dry object or media such as air; making reheated, drier air a moisture absorbing sponge.

If the air entering the evaporator is warm and very moist, coupled with the leaving air dew point being high, cooling based dehumidification-reheat systems operate at their peak efficiency and are a cost effective method of dehumidifying a given space.

Whole House Dehumidifiers:

Since Air Conditioners remove some humidity but are not designed to remove excess humidity, you may need to use some type of supplemental humidity removal such as a whole house dehumidifier.

A whole house dehumidifier works on the cooling based—reheat method and has an expansion valve regulating the flow of refrigerant to maximize the moisture removal under constantly changing load conditions.

Many whole home dehumidifiers have a 50-50 sensible to latent heat removal ratio instead of the 80-20 sensible to latent ratio of conventional air conditioners but unlike conventional air conditioners that have a cooler supply temperature, the discharge air supply temperature (supply air) of the whole house humidifier has been reheated and can raise the sensible temperature of the space in some applications.

These units can be installed as stand alone systems for dehumidifying basements & storage spaces or homes to remove excess humidity for those who can live with the heat, just not the humidity. They can also be tied into your conventional A/C system for extra humidity removal.

Situations where moisture removal is necessary because of high humidity levels but comfort cooling is unnecessary due to low outside ambient temperatures can occur in the Northeast between May and October.

If the average dry bulb temperature was less than 75 degrees and the average dew-point was greater than 60 degrees, a relative humidity greater than 65 % would exist making most people uncomfortable. The A/C would not run because the thermostat which senses dry bulb temperature would not be calling in most homes and humidity is a wet bulb temperature which requires a humidity type of control.

Other situations that can require supplemental dehumidification are partial load conditions (moisture removal of a cooling coil degrade at part load), and over sized A/C systems that cool the sensible load quickly but never really get to dehumidify the space.

Consult the equipment specifications and installation instructions for the specifics on application & installation.