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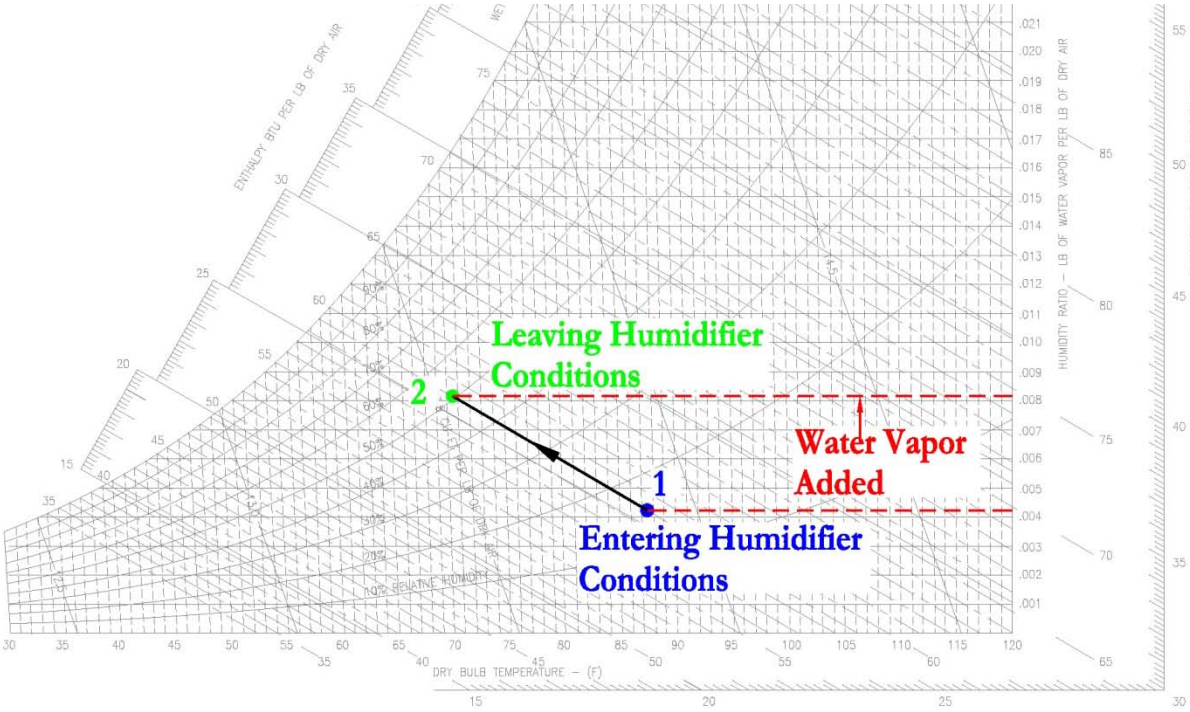
(2) Evaporative Humidifiers, also known as **adiabatic humidifiers**, add moisture to air without a change in enthalpy. Evaporative humidifiers do not require an external energy source like Steam Humidifiers. Evaporative humidifiers work by blowing dry air over water or through water droplets. The energy to vaporize the water comes from the dry air. As the air releases heat to vaporize the water, the air also cools. On the psychrometric chart, adiabatic humidification is shown as an upward-left movement, along a constant enthalpy line. It is constant enthalpy because the enthalpy lost to sensible cooling is gained by latent heating [humidification].



Evaporative humidifiers operate on the same principle as air washers, evaporative coolers and cooling towers. These principles will be discussed further in the Cooling Tower section.

3.10.2 De-Humidifiers

De-Humidifiers are used to remove moisture from air in order to achieve the best conditions for human occupancy, equipment or produce. In humid areas, high humidity causes the feeling that it is much hotter than the dry bulb temperature indicates. Other times de-humidifiers are used to maintain best humidity levels for equipment or produce. De-humidifiers are especially important in preventing mold and mildew from forming.

There are two main types of de-humidifiers, (1) Condensing and (2) Desiccant de-humidifiers.

(1) **Condensing de-humidifiers** or **cooling humidifiers** work by decreasing the temperature of the incoming air so that it is unable to hold moisture, which causes condensation. A cooling coil acts a dehumidifier. In the Psychrometric chart below, hot, humid air enters the coil and leaves as cool air. The amount of water vapor removed from the air is shown in red. In some cases the air is reheated in order to lower the relative humidity and increase the dry bulb temperature.

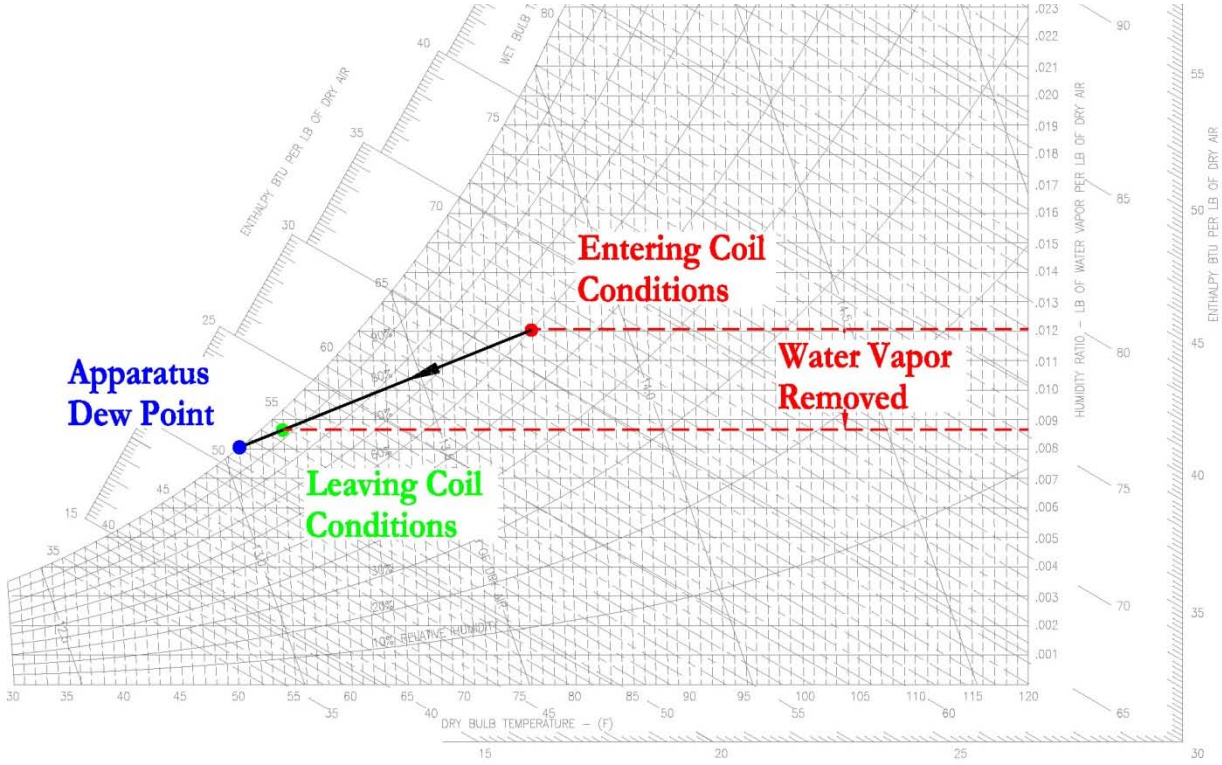


FIGURE 19: COOLING COIL - DEHUMIDIFIER

(2) **Desiccant de-humidifiers** or chemical dehumidifiers use desiccants to adsorb or absorb water from air. As the air loses its water vapor, the heat from condensing the water vapor is gained by the air stream, which causes the air to increase its dry bulb temperature. A desiccant de-humidifier is shown as a downward-right movement, along the constant enthalpy line (adiabatic).

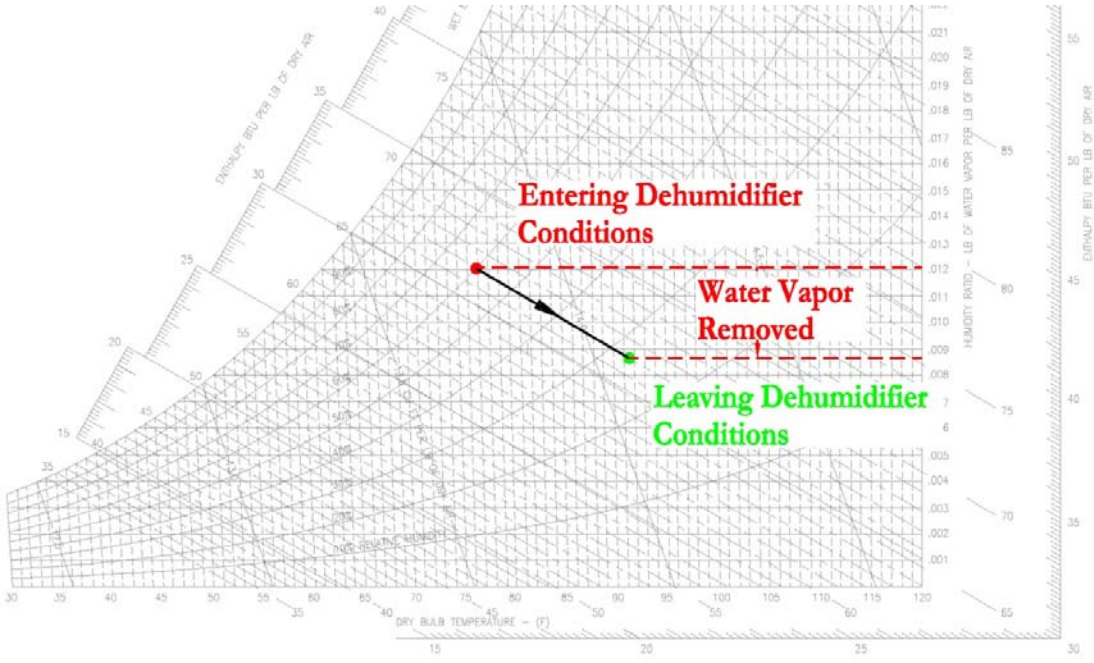


FIGURE 20: DESICCANT DEHUMIDIFER

PROBLEM 6 – COILS

Background: A new cooling coil has an apparatus dew point of 53 F. The air entering conditions are 80 F DB, 70% Relative Humidity. If the bypass factor of the coil is 0.05, then what is the enthalpy of the air leaving the coil?

(a) 21.6 Btu/lb

(b) 22.7 Btu/lb

(c) 35.2 Btu/lb

(d) 36.4 Btu/lb

Solution 6 – Coils

Background: A new cooling coil has an apparatus dew point of 53 F. The air entering conditions are 80 F DB, 70% Relative Humidity. If the bypass factor of the coil is 0.05, then what is the enthalpy of the air leaving the coil?

First determine the enthalpy of the air entering the coil.

$$h_{entering} = 36.15 \frac{Btu}{lb}$$

Next determine the enthalpy at the apparatus dew point (ADP) of 53 F DB/53 F WB.

$$h_{ADP} = 22.01 \frac{Btu}{lb}$$

Use the bypass factor to find the resulting coil leaving enthalpy.

$$h_{leaving} = 22.01 \frac{Btu}{lb} * (.95) + 36.15 \frac{Btu}{lb} * (.05)$$

$$h_{leaving} = 22.72 \frac{Btu}{lb}$$