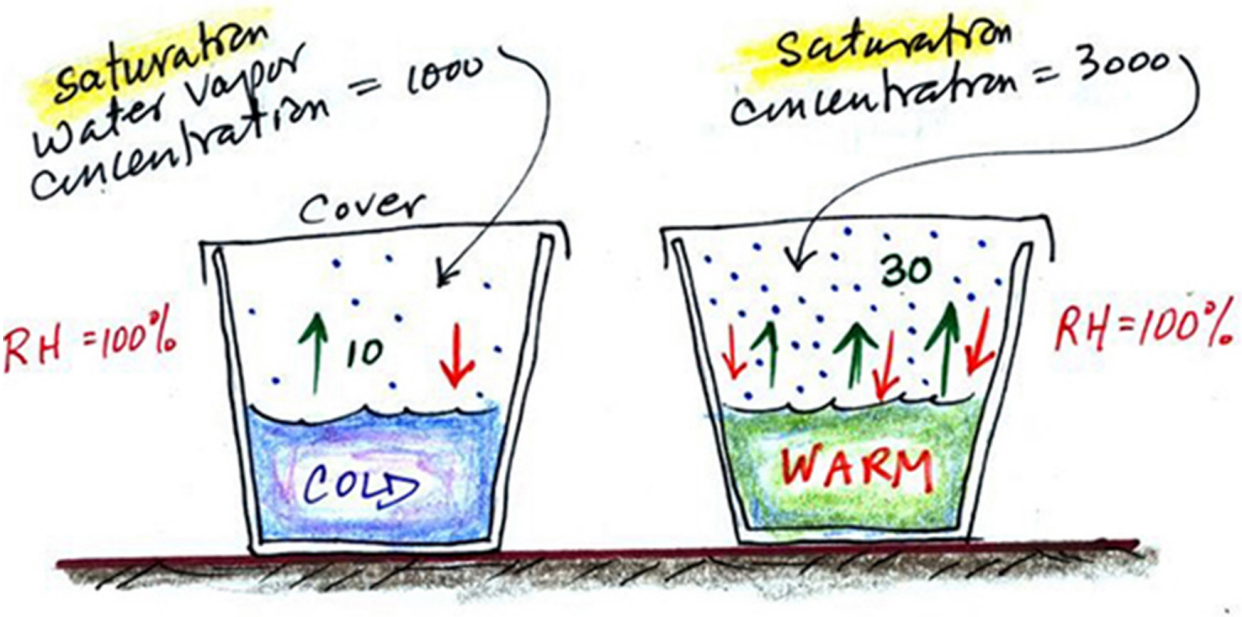
THE ADVERSARIAL RELATIONSHIP BETWEEN COMPRESSED AIR AND WATER

By Brian Mann



Condensate management is probably the most overlooked aspect of compressed air system design and operation. It shouldn't be. Condensate management is likely the only thing associated with compressed air that could involve regulatory compliance.

Why are we even talking about water and compressed air? How does the water get into the airstream and, if it's there, how can we remove it? To answer those questions, you must first understand the relationship between air, water, temperature, pressure and saturation.

Saturation defines the quantity of one substance that another substance can absorb.

A volume of water, at a given temperature, can dissolve a known quantity of salt. Once that known amount of salt has been added to the water, the water is in a saturated state. If more salt is added, it simply remains undissolved in the water.

The ability of compressed air to hold moisture is dependent upon temperature and pressure.

The ability of air to hold moisture increases as its temperature increases. As a rule of thumb, increasing the temperature of air by 20°F will double the mass of moisture that a given mass of air can hold.

The ability of air to hold moisture is inversely proportional to the pressure of the air. When air is compressed from atmospheric pressure to a common working pressure (100 psig) the increase in pressure is nearly eight-fold, meaning that the compressed air (at the same temperature) can hold 1/8 of the moisture that it could in its ambient condition.

During the compression process, the air temperature increases, keeping the water vaporized in the compressed air. Unfortunately, the temperature of the compressed air exiting the compression chamber is commonly 190°F or more and must be cooled for use in a plant.

The adversarial relationship rears its ugly head when the saturated compressed air begins to cool. The cooled compressed air is unable to hold the same amount of moisture as the warm air because it has reached its saturation condition, or dew point. As the air cools below its saturation temperature, moisture condenses (changes from vapor to liquid). The liquid water (condensate) must now be removed from the compressed air system and treated as a waste stream.

How do we manage this adversarial relationship between compressed air and moisture? We consider condensate management at the start of a compressed air system project, looking for every location in which condensate should be removed from the system, and planning accordingly. We consult the operating permits to define the oil-water separation technology that is needed, given the type of lubricant and the permit limitations.

What is the best way to mediate this adversarial relationship? Consult with a qualified compressed air system expert at the beginning of the project to ensure that no detail is missed.