Humidifier Performance Tied to Water Type

Softening a Cost-Effective Solution

Isothermal systems use heat from an external source to create humidity. Electricity, natural gas, hot water, and boiler steam are isothermal heat sources used to boil water into steam for humidification. Adiabatic systems use heat from the surrounding air to change water into vapor for humidification (evaporation). Foggers, ultrasonic, and pezio disk humidifiers are typical adiabatic systems.

Operators should choose isothermal humidification if they require predictable, controllable and short absorption distances; if there are low air temperatures in ducts; or if there is an on-site boiler or hot water source. Isothermal electric humidification enables application flexibility. Electric element humidification systems easily integrate into existing systems. They are available in a wide range of sizes, capacities and options, allowing them to meet the humidification demands of virtually any environment. However, there are economic benefits from gas-fired humidification systems, which offer substantial energy savings over electric systems.

Adiabatic systems require long absorption distances and often do not provide complete absorption in typical HVAC applications. They depend on very warm or preheated air for absorption to occur. If supply air is warm and dry, humidification needs may be met by an adiabatic system such as a fogger, which uses sensible heat in the air for its energy source.

In the right environment, these systems can be very economical due to they cooling effect they provide. Exercise caution, however, when applying adiabatic humidification to standard commercial applications where adiabatic humidification often provides incomplete absorption, resulting in wet ducts.

Humidification is the process of transforming water into vapor, and so it is not surprising that water type has a great impact on humidifier performance, maintenance requirements, humidification vapor quality, and efficiency of operation. There are four types of water used in humidifiers:

- Potable water (drinking, tap, or well water)
- Softened water (hardness reduced through an ion exchange process)
- High-purity water (deionized and/or reverse osmosis treated water)
- Boiler water (typically treated with anticorrosion chemicals)

How water type affects energy efficiency is closely related to how water type affects performance. Simply stated, the harder the water, the more water wasted down the drain to remove minerals and, therefore, the more water that will need to be replaced and reheated, resulting in increased energy costs.

From a maintenance point of view, the lower the mineral content in the water, the less maintenance required. Mineral buildup in improperly-maintained isothermal systems can cause humidifiers to malfunction: heater coils can fail prematurely, heat exchanger output is reduced by scale buildup, conductivity probe systems that measure water levels quit working, and drain valves become plugged.

MINERALS, MATERIALS AFFECT EFFICIENCY

Potable water can contain any number of living microorganisms, dissolved organic material, dissolved minerals, and suspended materials. This can significantly affect humidification vapor quality, humidifier maintenance, performance, and efficiency.

Living microorganisms (bacteria) are killed when water is heated to 180 °F (83 °C), and so bacteria are not a concern when using isothermal humidifiers where water is boiled to make steam (vapor). However, care should be taken to ensure that all harmful microorganisms

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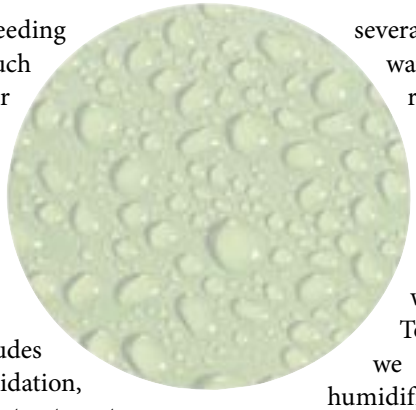
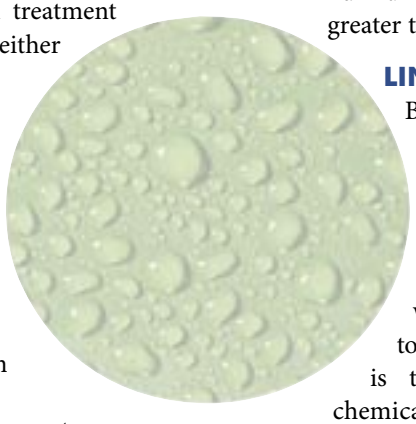
As published in Canadian Property Management Magazine, June/July 2003

are removed from water sources feeding nonboiling (adiabatic) humidifiers such as air washers, foggers, atomizers, or pezio disk systems. In addition, even though a water supply may be free of harmful bacteria, contaminants from the air can still cause microbial growth in wetted-media or wick systems.



Water treatment for bacteria includes filtration, reverse osmosis, chemical oxidation, and disinfection. The most common treatment for bacteria is chemical oxidation by either ozonation or by adding chlorine.



Dissolved organic material comes from three major sources:

- The breakdown of naturally occurring organic materials (plant and animal matter)
- Domestic and commercial chemical wastes (agricultural and urban runoff, or leaching from contaminated soils)
- Chemical reactions that occur during water treatment processes (from disinfection by-products or pipe joint adhesives)

DI/RO water has the lowest mineral content, but its use is cost-prohibitive unless needed for high purity humidification or to meet very strict performance requirements. (A well-maintained DI/RO system produces water that consists solely of hydrogen and hydroxides and is free of most or all of total dissolved solids (TDS) including chlorides and other molecules that cause metal corrosion.)

Dissolved minerals found in potable water are magnesium, calcium, iron, and silicon, with calcium and magnesium the primary elements causing "hard" water. Water hardness is commonly measured in grains per gallon (gpg). As water hardness increases, so does the need for humidifier cleaning to remove scale buildup. Downtime for cleaning, as well as time required to heat fresh water that replaces frequently skimmed or drained water (to remove minerals), can significantly affect humidifier performance and efficiency. Water softening is the most common method for reducing water hardness.

Softening water can dramatically improve humidifier performance, maintenance requirements, and efficiency. It is not unusual for systems using softened water to go several seasons without cleaning. However, water softeners need their brine tanks regularly replenished with sodium (so that there are sodium ions available to exchange with the magnesium and calcium ions). For this reason, owners should regularly inspect their humidifiers using softened water to verify softener operation. To lessen maintenance requirements, we recommend softening water for humidifier use where water hardness is greater than 12 gpg.

LINKS TO IAQ

Boiler steam is often directly injected into the air through steam dispersion units to provide humidification. Owners of existing boiler systems have found this a cost-effective, energy efficient, and easily controllable way to add humidity without adding additional equipment to make steam. However, boiler water is typically treated with anticorrosion chemicals that, when directly injected into the air as steam, negatively impact indoor air quality. Concerned owners wishing to make use of an existing boiler for humidification should consider a closed loop system such as our STS Steam-to-Steam system that provides chemical-free steam for humidification by running boiler steam through a heat exchanger.

In general, the quality of humidification vapor is only as good as the humidifier tank's fill water. High purity water (DI/RO) provides the purest humidification. Humidification produced through an isothermal process (boiling) is a bit more pure than humidification produced through an adiabatic process (unheated water turned into vapor by evaporation, pressure and/or compressed air). Some adiabatic systems using potable or softened water leave a fine dust on area surfaces, and wetted-media or wick systems may contaminate humidification vapour.

Process-critical environments, such as surgical suites, clean rooms, semiconductor manufacturing, or museums requiring artifact preservation, use high purity water to ensure very clean humidification vapor. Potable hard and softened water in isothermal systems typically provide humidification vapor that is adequately clean for comfort applications such as office or residential buildings.

As published in Canadian Property Management Magazine, June/July 2003