Adiabatic basics:

Types, applications and benefits of adiabatic humidification

Learn how adiabatic humidification can reduce cooling loads and energy costs

Also included:
• System design examples with psychrometrics
• How water quality affects performance, air quality, and maintenance requirements
• Focus on high-pressure atomizing systems

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IMAGE A LAZY, HOT, AUGUST AFTERNOON OF YOUR CHILDHOOD, cicadas buzzing, not a leaf stirring, and there's nothing to do. So, you ponder the drops of water on your cold Coke can. "It's sweating," your mother says. On such a hot day you almost believe her.

What your childhood mind was trying to understand was phase change caused by energy transfer: Heat in the air transferred to the cold can, causing water vapor in the surrounding air to convert to liquid water (condensation).

Of course you drink that refreshingly cold soda, get distracted (from the caffeine, no doubt), and return to find the can dry on the outside.

What happened? Heat in the air transferred to the liquid water droplets on the can, causing them to revert back to vapor (evaporation).

The above story serves as an example of an adiabatic process, for if that cold can were placed into a theoretically closed system, no heat would be extracted from or added to that system; heat would just transfer, changing vapor to water and water to vapor.

The coolest thing about an adiabatic process is that it can be harnessed to reduce air temperature and provide humidification via an adiabatic humidifier.

Adiabatic humidifiers utilize a variety of technologies to introduce water into air, either by dispersing water droplets or by allowing water to evaporate from a wetted media, causing relative humidity (RH) levels to increase and air temperature (dry bulb) to decrease.

Adiabatic basics: Benefits

Adiabatic humidifiers cause relative humidity (RH) levels to increase and air temperature (dry bulb) to decrease

Benefits of adiabatic humidification

Reduces cooling load. Perhaps the most touted benefit of adiabatic humidification is air cooling. Because adiabatic humidifiers draw heat from air for evaporation, they can produce a 20 °F or more temperature drop. In fact, every pound of adiabatic humidification added to air removes approximately 1000 Btu of heat. Twelve pounds of water added as humidification equals about one ton of cooling. This is a significant benefit in climates where air is consistently warm and dry, or in spaces where there is an additional heat load such as from equipment in a computer room.

Focus on psychrometrics

"Evaporation is a cooling process." This mantra, used by junior high school science teachers, rings in many of our heads to this day. While a true statement, it only scrapes the surface of understanding adiabatic humidification.

"Evaporation is a constant enthalpy process" would be a better phrase. For as water is absorbed by warm air it follows a constant enthalpy line up and to the left on the psychrometric chart.

Psychrometric (adjective): Relating to the measurement or determination of atmospheric conditions, particularly the moisture in air

The solid red process line in the chart at right describes the addition of 30 grains of moisture per pound of dry air with an adiabatic humidifier. Note that the temperature goes from 74 °F to 55 °F, but the total energy of the air remains the same, following the line for 20 Btu per pound of dry air. The only way to do this is to raise the relative humidity from 12% to 70%. Evaporative coolers follow the same theory when cooling air, so the main benefit of adiabatic humidification is obvious: When the process calls for both cooling and humidification, total system energy is the lowest. Adiabatic humidifiers can still be used when entering air conditions are cool, but additional heat may be needed to ensure that set point is met.

Continue reading about three examples illustrating how to use the psychrometric chart for adiabatic humidification system design.

Adiabatic basics: Types, applications, and benefits of adiabatic humidification
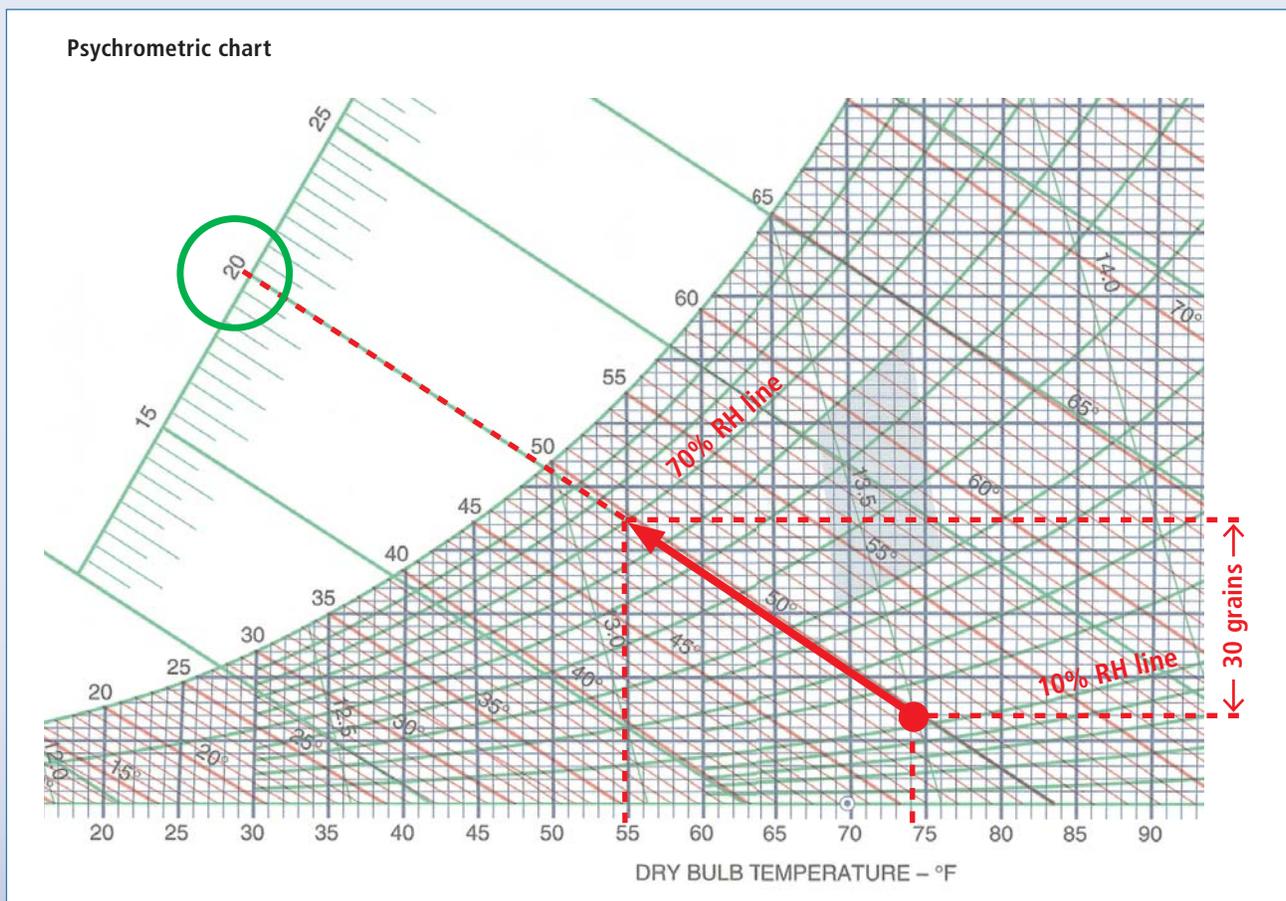
Adiabatic basics: Benefits

Energy efficient. Unlike humidification systems that boil water into steam, adiabatic humidification systems do not have a dedicated energy source to change water into vapor for humidification. Because adiabatic humidifiers use heat present in air to convert water to vapor, they consume relatively small amounts of energy to operate when compared to isothermal (steam) humidifiers. Adiabatic humidification systems require energy to operate compressors, pumps, or oscillators; and some adiabatic humidifier applications with low entering air temperatures require air preheating, which can decrease energy savings.

Twelve pounds of water added as humidification equals about one ton of cooling

Evaporation is a constant enthalpy process.

Enthalpy (noun):
The total energy in dry air and water vapor per pound of dry air

Psychrometric chart

Adiabatic basics: Benefits

Pressurized water humidifier

Minimal maintenance. Adiabatic humidifiers using reverse-osmosis-treated water (RO) or deionized water (DI) require the least maintenance. Adiabatic systems that use tap water require cleaning or component replacement to remove deposited minerals. Systems with moving parts (humidifiers with rotating disks and atomizers with movable nozzle pins) require periodic parts replacement.

High capacity potential. In open spaces, very large capacities can be met with a single adiabatic humidifier such as an atomizer, or with multiple smaller-capacity humidifiers. In ducts or air handlers, capacity is limited only by duct/AHU size and evaporation capability.

Pure, particulate-free humidity. When using DI or RO water, adiabatic systems with high-grade stainless steel parts can produce humidification as pure as the supply water.

Focus on psychrometrics

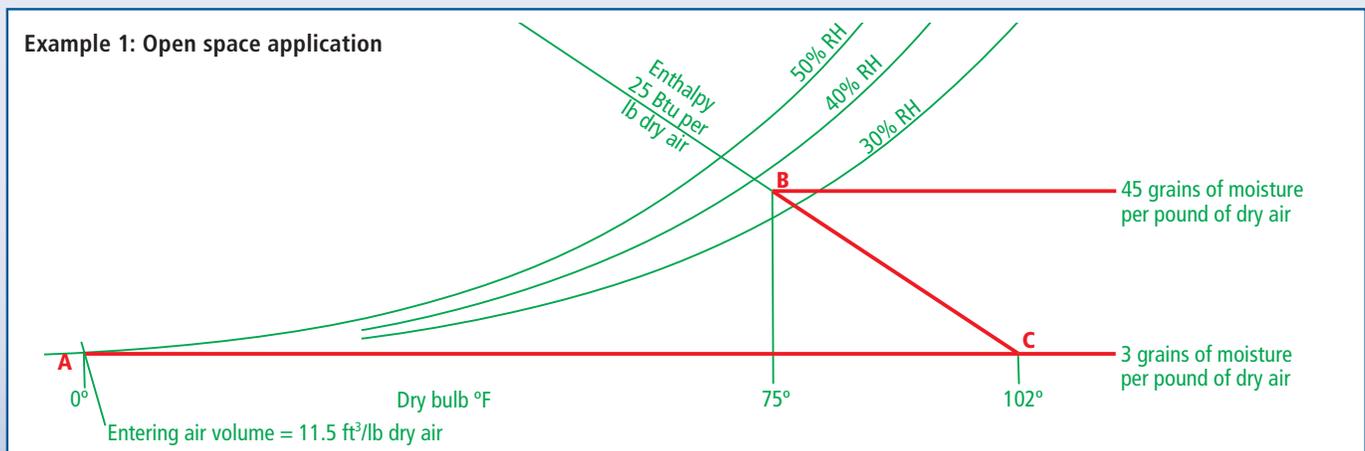### Example 1: Open space application

Entering air condition:
Dry bulb = 0 °F; RH = 50%; 2 air changes per hour

Desired space condition: Dry bulb = 75 °F; RH = 35%

Building dimensions: 200' W × 240' L × 25' H; volume = 1,200,000 ft³

Step 1: Locate and mark entering air condition (**A**) and desired space condition (**B**) on the psychrometric chart.

Example 1: Open space application

Enthalpy 25 Btu per lb dry air — 50% RH — 40% RH — 30% RH

B — 45 grains of moisture per pound of dry air

C — 3 grains of moisture per pound of dry air

A

0° — Dry bulb °F — 75° — 102°

Entering air volume = 11.5 ft³/lb dry air

Adiabatic basics: Applications

Application considerations

Warm, dry air. The evaporation rate of dispersed water or water from within a wetted media is affected by temperature, air velocity, and water droplet size. Because adiabatic humidifiers rely on warm air temperature to evaporate water, the most efficient systems will be in areas where the entering air temperatures are consistently warm and dry, or where there is an existing heat load such as from equipment or an industrial process. If the installation is in a climate with cool or cold seasons, air may have to be preheated, adding an extra energy expense.

Supply water type. Humidifier performance, humidification vapor quality, indoor air quality, and maintenance requirements are significantly affected by humidifier supply water type. Most adiabatic technologies can operate using either treated or untreated water; however, most contaminants in supply water pass through a humidifier system. Especially when misted or sprayed, supply water with minerals produces white dust, which along with other water contaminants can be an inhalation hazard. Settling white dust can also contaminate processes and accumulate in ducts and on furnishings. See Page 11 for more information about supply water.

> **The most efficient adiabatic systems are installed in areas where entering air is warm and dry, or where there is an existing heat load such as from equipment or an industrial process.**

Open space application

Step 2: Calculate grains of moisture to add.
Draw horizontal lines from (**A**) and (**B**) all the way to the right edge of the chart. Entering air has 3 grains of moisture per pound of dry air and space air will have 45 grains of moisture per pound of dry air.
45 − 3 = 42 grains of moisture per pound of dry air

Step 3: Determine required space air temperature.

Find the constant enthalpy line that intersects (**B**). In this example it is the 25 Btu per pound of dry air line. Draw a line along the enthalpy line from (**B**) until you intersect the entering air humidity ratio line, which is at 102 °F (**C**). This is the temperature outside air must be raised to by either the space load or by drop heaters in the space. This enthalpy line also describes the path the humidification process will take, dropping dry bulb temperature from 102 °F to 75 °F.

Step 4: Determine entering air volume.
Find point (**A**) from Step 1 above. Locate the entering air volume of (**A**) by finding the series of almost vertical lines going from approximately the 11 o'clock position to the 5 o'clock position. They range from about 11 cubic feet per pound of dry air in the negative dry bulb temperature region to 15 cubic feet per pound of dry air in the 100+ dry bulb temperature region. Point (**A**) is at about 11.5 cubic feet per pound of dry air.

Step 5: Calculate pounds of dry air per hour.
2 air changes per hour × 1,200,000 ft³
= 2,400,000 cfh ÷ 11.5 cubic feet per lb dry air
= 208,695 pounds of dry air per hour

Step 6: Calculate load.
208,695 pounds of dry air per hour × 42 grains of moisture per pound of dry air
= 8,765,190 grains per hour ÷ 7,000 grains per pound of water
= 1,252 pounds of water per hour

Pressurized water humidifier

Nozzle detail

Water inlet

Mist
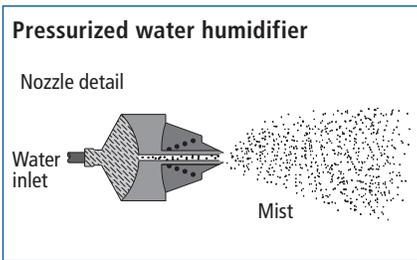
Adiabatic technologies

The five most common types of adiabatic humidifiers include:
- Pressurized water humidifiers.
- Wetted media humidifiers
- Ultrasonic humidifiers
- Pressurized air and water humidifiers
- Centrifugal humidifiers

Pressurized water humidifiers. Pressurized water systems are often used where high-quality humidification is required. Construction is typically all stainless steel. A high-pressure pump propels treated water through dispersion nozzles, fragmenting water droplets into fine particles that quickly evaporate

Focus on psychrometrics

Example 2: AHU/duct application, year-round cooling requirement
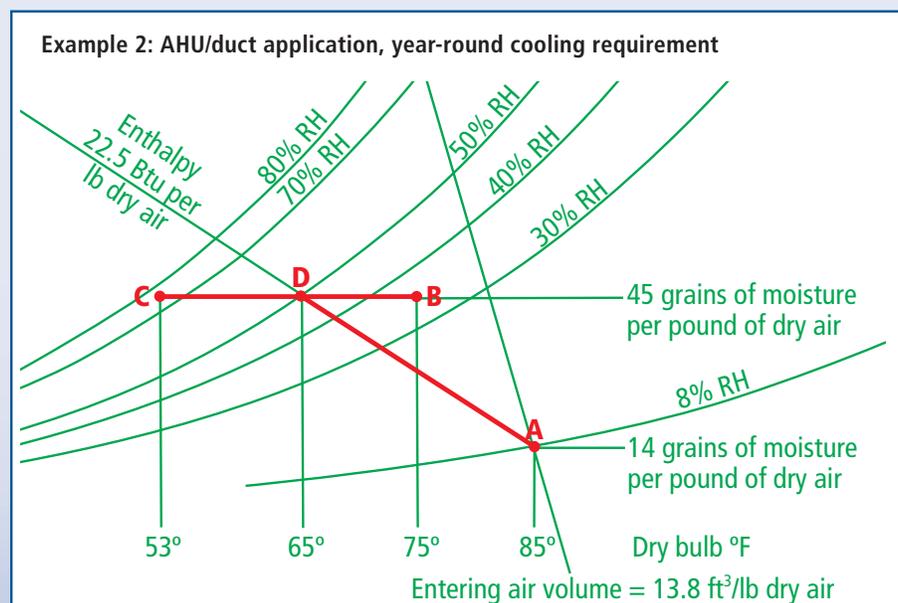
Entering air condition:
Dry bulb = 85 °F; RH = 8%; air flow = 20,000 cfm; outside air = 100%

Desired space condition: Dry bulb = 75 °F; RH = 35%

AHU dimensions: 60" H × 96" W; available evaporation distance = 4 feet

Step 1: Ensure that air velocity is in the recommended range of 250-750 fpm.
20,000 cfm ÷ [(60" × 96") ÷ 144 in²/ft²] = 500 feet per minute

Example 2: AHU/duct application, year-round cooling requirement

Enthalpy
22.5 Btu per
lb dry air

80% RH
70% RH
50% RH
40% RH
30% RH
8% RH

C · · D · · B — 45 grains of moisture per pound of dry air

A — 14 grains of moisture per pound of dry air

53°   65°   75°   85°   Dry bulb °F

Entering air volume = 13.8 ft³/lb dry air

in air-handler airstreams or open spaces. Water under pressure (800 to 1200 psi) is delivered to dispersion nozzles; no pressurized air is required, making the system simpler than air/water systems thereby reducing operating and maintenance costs. AHU systems typically have a mist eliminator installed downstream of the humidifier.

Wetted media humidifiers. Wetted media humidifiers have a water-absorbing mesh placed in a duct or AHU airstream. Water flows over the media or is wicked from a basin as the water evaporates into the airstream. A humidistat or building management system turns supply water on and off.

It is more difficult to achieve tight RH control with wetted media humidifiers, compared to other adiabatic humidifiers. Once water is pumped onto the media it remains until evaporated. This results in a lag between a call for

Wetted media humidifier

Media

Pump

Reservoir
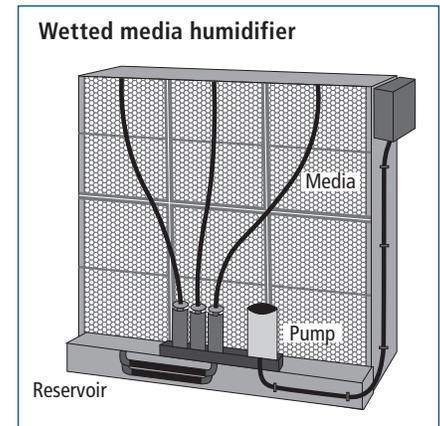
AHU/duct application, year-round cooling requirement

Step 2: Locate and mark entering air condition (**A**) and desired space condition (**B**) on the psychrometric chart.

Step 3: Calculate grains of moisture to add.
Draw horizontal lines from (**A**) and (**B**) all the way to the right edge of the chart. Entering air has 14 grains of moisture per pound of dry air and space air will have 45 grains of moisture per pound of dry air.
45 – 14 = 31 grains of moisture per pound of dry air

Step 4: Find the maximum recommended leaving RH%
Draw a horizontal line from (**B**) until you reach the 75% RH curve (**C**), which is the maximum recommended AHU RH% before excessive water fallout occurs. The horizontal lines crosses the 75% RH curve at approximately 53 °F, which is the lowest temperature when humidifying without excessive water fallout.

Step 5: Determine leaving air condition after the humidifier.
Starting at the entering air condition point (**A**), draw a line up and to the left along the constant enthalpy line, 22.5 Btu per pound of dry air in this example, until it intersects the line drawn in Step 4. These two lines meet at the 50% RH curve (**D**). This temperature is 65 °F, but will rise to the desired space condition of 75 °F in the humidified space due to additional heat from computers, lights, people, etc.

Step 6: Determine entering air volume.
Point (**A**) is at about 13.8 cubic feet per pound of dry air. See Example 1 for guidance on finding entering air volume.

Step 7: Calculate pounds of dry air per hour.
20,000 cfm ÷ 13.8 cubic feet per lb dry air
= 1450 pounds of dry air per minute × 60 minutes per hour
= 87,000 pounds of dry air per hour

Step 8: Calculate system load.
87,000 pounds of dry air per hour × 31 grains per pound of dry air
= 2,697,000 grains per hour ÷ 7,000 grains per pound of water
= 385 pounds of water per hour

humidity and delivery, and also for continued humidification delivery after demand is satisfied (the wetted media continues to evaporate until it is dry). However, while a wetted media humidifier may overshoot RH set point, it cannot oversaturate airstreams.

If untreated water is supplied to a wetted media humidifier dissolved solids will be left on the media after the water evaporates. This will foul the media and increase duct static pressure, requiring media replacement. The basin of water for media wicking or to catch overflow can be a breeding ground for harmful bacteria and mold.

Focus on psychrometrics

Example 3: AHU/duct application with heating requirement

Entering air condition:
   Dry bulb = 55 °F; RH = 30%; air flow = 20,000 cfm; outside air = 100%

Desired space condition: Dry bulb = 70 °F; RH = 40%

AHU dimensions: 60" H × 96" W; available evaporation distance = 4 feet

**Step 1:** Ensure that air velocity is in the recommended range of 250-750 fpm.
    20,000 cfm ÷ [(60" × 96") ÷ 144 in²/ft²] = 500 feet per minute

Step 2: Locate and mark entering air condition (**A**) and desired space condition (**B**) on the psychrometric chart.

Example 2: AHU/duct installation with heating requirement
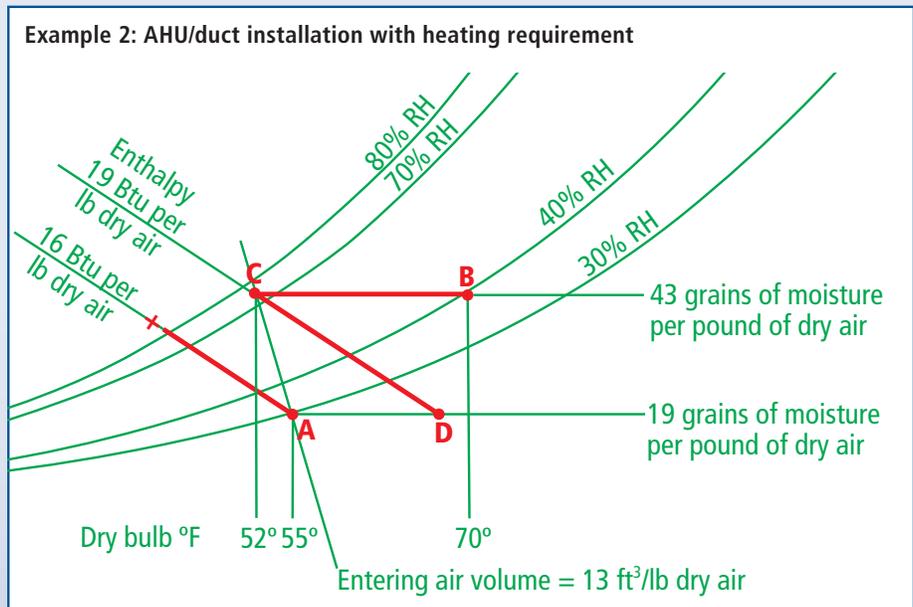
Adiabatic basics: Technologies

Ultrasonic humidifiers. Ultrasonic humidifiers have a submerged vibrating disk that creates a high-frequency oscillation, expelling small water droplets into air. Many of these systems use DI or RO water and are used in applications where particulate-free humidity is essential but where a large capacity is not required. The disks require replacement after approximately 10,000 operating hours, which can be a concern for applications that cannot tolerate off-line time or the expense of disk replacement. Water droplets are generally small and maximum capacity is approximately 80 lbs/hr per unit. Multiple, rack-mounted units can meet higher capacities.

Ultrasonic humidifier

Mist outlets

Water inlet
Drain outlet
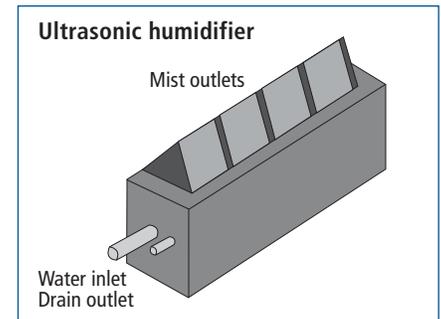
AHU/duct installation with heating requirement

Step 3: Calculate grains of moisture to add.
Draw horizontal lines from (**A**) and (**B**) all the way to the right edge of the chart. Entering air has 19 grains of moisture per pound of dry air and space air will have 43 grains of moisture per pound of dry air.
43– 19 = 24 grains of moisture per pound of dry air
Step 4: Find the maximum recommended leaving RH%
Draw a horizontal line from (**B**) until you reach the 75% RH curve (**C**), which is the maximum recommended AHU RH% before excessive water fallout occurs. The horizontal lines crosses the 75% RH curve at approximately 52 °F, which is the lowest leaving air temperature when humidifying without excessive water fallout.

Step 5: Determine leaving air condition after the humidifier.
a) Starting at entering air condition (**A**), draw a line along the constant enthalpy line, in this example 16 Btu per pound of dry air, with intent to intersect the line drawn in Step 4. But because these two lines do not intersect, additional energy will need to be added in order to evaporate enough water to reach set point. Adjust the economizer set point or use a heating coil to add energy.
b) For this example let's assume a heating coil is used to heat the air to the same enthalpy as the 75% RH point on the line drawn in Step 4. This is on the 19 Btu per pound of dry air line.
c) Draw a line starting at 52 °F and 75% RH (**C**) down to where the 19 Btu per pound of dry air line crosses 19 grains per pound of dry air (the original entering air conditions). This is at about 68°F (**D**). This indicates the requirement to add 3 Btu per pound of dry air to reach desired set point. This temperature will rise to the desired space condition of 70 °F in the humidified space due to additional heat from computers, lights, people, etc.

Step 6: Determine entering air volume.
Point (A) is at about 13.0 cubic feet per pound of dry air. See Example 1 for guidance on finding entering air volume.

Step 7: Calculate pounds of dry air per hour:
20,000 cfm ÷ 13.0 cubic feet per lb dry air
= 1538 pounds of dry air per minute × 60 minutes per hour
= 92,280 pounds of dry air per hour

Step 8: Calculate system load.
92,280 pounds of dry air per hour × 24 grains per pound of dry air
= 2,214,720 grains per hour ÷ 7,000 grains per pound of water
= 316 pounds of water per hour

Step 9: Calculate energy added to incoming air.
3 Btu per pound of dry air × 92,280 pounds of dry air per hour = 276,840 Btu per hour

Pressurized air and water humidifier

Nozzle detail

Water inlet

Compressed air inlet
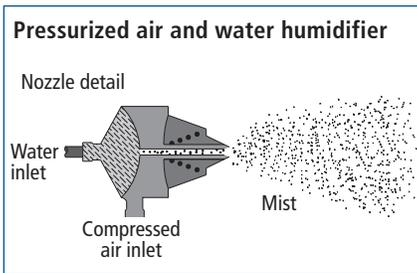
Mist

Pressurized air and water humidifiers. Many misters, sprayers, and atomizers combine compressed air with water to emit water droplets into open spaces, ducts or AHUs. Most systems use untreated water and are typically installed in industrial environments, such as woolen and carpet mills, where air cleanliness is not a critical issue. Some pressurized air and water systems have automatic nozzle-pin shutoffs that prevent dripping and also provide some nozzle cleaning. Mineral buildup and nozzle-pin failure can create additional maintenance. Pressurized air and water humidifiers are the noisiest; and require piping runs for both the air and water lines to all nozzles. Some systems installed in AHUs have mist eliminators installed downstream from the heating coil to prevent wetting farther downstream and to improve evaporation efficiency.

Focus on psychrometrics

System design considerations

Keep in mind the following when designing adiabatic humidification systems:

- Because no energy is added or lost in the system, and the liquid water added to the airstream must be evaporated, energy must transfer from air to water. Assuming 75 °F supply water in Example 3, the air gives up 19% of its energy to evaporate the water:

  Total air energy
  = 90,240 lbs of dry air/hr × 19 Btu/lb of dry air
  = 1,714,560 Btu

  Energy to evaporate water
  = 1,050 Btu/lb of water × 309 lbs of water/hr
  = 324,450 Btu
  = 19% of total air energy

- The two most important things to determine are the desired space condition and the maximum load condition. The maximum load condition will occur at some combination of the driest entering condition and economizer maximum outside air condition.

- When preheat is required to ensure adequate energy for evaporation, it is critical that the system controller can anticipate this need and react appropriately. Reacting too fast to space changes, or increasing humidifier demand too quickly can cause control issues. In AHU applications, utilizing dew point sensors both up- and downstream of the humidifier will allow the system to anticipate the available energy in the entering air and humidify appropriately. Additional heat will need to be added to the entering air if set point is not met.

- In addition to understanding system psychrometrics, it's important to understand the application and installation requirements of your chosen humidifier technology. Variables such as air stratification; pressure drop; and nozzle quantity, size and placement affect evaporation efficiency and system operation. To ensure optimal operation, choose an experienced manufacturer who can guide you through the specifics of your system.

Adiabatic basics: Technologies, water quality

Centrifugal humidifiers. Centrifugal humidifiers deliver supply water to a fast-spinning disk that fractures water into small drops. Most operate using tap water and disperse only in open spaces and where mineral dust fallout is not an issue. Dispersed water droplets are large, requiring very warm air and/or high ceilings to achieve evaporation, and the systems tend to be noisy. Centrifugal humidifiers are easy and inexpensive to install.

Water quality affects performance, air quality, and maintenance requirements

Water is often called the universal solvent because almost everything is soluble to some degree in water. This property causes water to become contaminated by virtually any material it contacts, with the mix of contaminants varying greatly from one location to another.

There are three types of water used in adiabatic humidifiers:
• Tap or well water
• Softened water (hardness reduced through an ion exchange process)
• High-purity water (reverse osmosis and/or deionized treated water)

Tap or well water can contain living microorganisms, dissolved organic material, dissolved minerals, and suspended materials. While all of these substances can affect humidification vapor quality, humidifier maintenance and performance are significantly affected by dissolved minerals and suspended materials.

Living microorganisms (bacteria). Care should be taken to ensure that all harmful microorganisms are removed from water sources feeding adiabatic humidifiers.

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.

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); and
• Chemical reactions that occur during water treatment processes (from disinfection by-products or pipe joint adhesives).

Activated carbon and microfiltration, and reverse osmosis processes remove dissolved organic material.

Centrifugal humidifier

Spinning disk

Fan

Reservoir

Pump
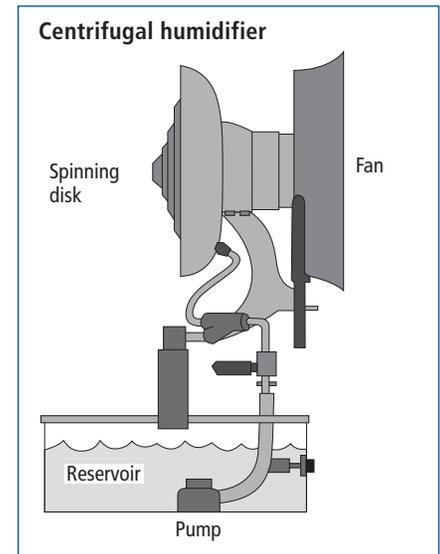
Adiabatic basics: Water quality

High-purity water. High-purity water yields high-purity humidification for critical-process environments. Semiconductor, pharmaceutical and electronics manufacturers, as well as laboratories and industrial clean rooms often require high-purity humidification. To avoid water contaminants that can be carried into air with water vapor, these types of environments use highly processed — and very pure — water in their humidification systems. For these environments, water is cycled through several prefilters, a dechlorinator, a water softener, reverse osmosis permeable membranes and, sometimes, also through a chemical deionization process.

Water softeners remove calcium, magnesium and iron. Water softeners remove dissolved minerals from supply water using an ion-exchange process. For applications where high-purity humidification is not a requirement, water softening can significantly reduce humidifier maintenance requirements. Systems requiring high-purity humidification typically soften water before it enters other processes. For example, water not properly softened damages reverse osmosis membranes and also causes atomizing nozzles to clog.

Dechlorinators remove chlorine. Use a dechlorinator to remove chlorine from supply water before it enters reverse osmosis membranes. Dechlorinators have charcoal sieves that neutralize chlorine. Some dechlorinators automatically backflush whenever a programmed calendar date or water meter usage is met. During automatic backflushing, clean water flows through the dechlorinator to rinse the charcoal, and then flows to drain.

Reverse osmosis filtration provides ultra-pure humidification. Some adiabatic systems require most minerals removed from water in order to keep components operating properly. Before entering a reverse-osmosis system, potable water passes through a dechlorinator and water softener. This water is then pressurized and forced through reverse-osmosis membranes, which remove most dissolved minerals. The water is now purified and contains minerals at less than 10 parts per million.

Deionizing removes remaining minerals. Deionization removes all mineral ions from water, producing water similar to distilled water. Like reverse-osmosis filtration, water is pretreated before entering the deionizing process.

Adiabatic basics: Evaporation efficiency

Evaporation efficiency in air handlers and ducts

Once water is dispersed into a moving airstream, many factors affect how much of that water becomes actual humidification. Factors that affect the evaporation rate are described in the example bullet points and are illustrated in the chart below. This chart is one method for calculating evaporation efficiency.

In this example, the following are known:
- Humidification load = 385 lbs/hr
- Available evaporation distance = 4 ft
- Leaving air temperature = 55 °F
- Air velocity = 500 fpm
- Entering air grains of moisture per pound of dry air = 15
  Entering air dew point temperature = 20 °F
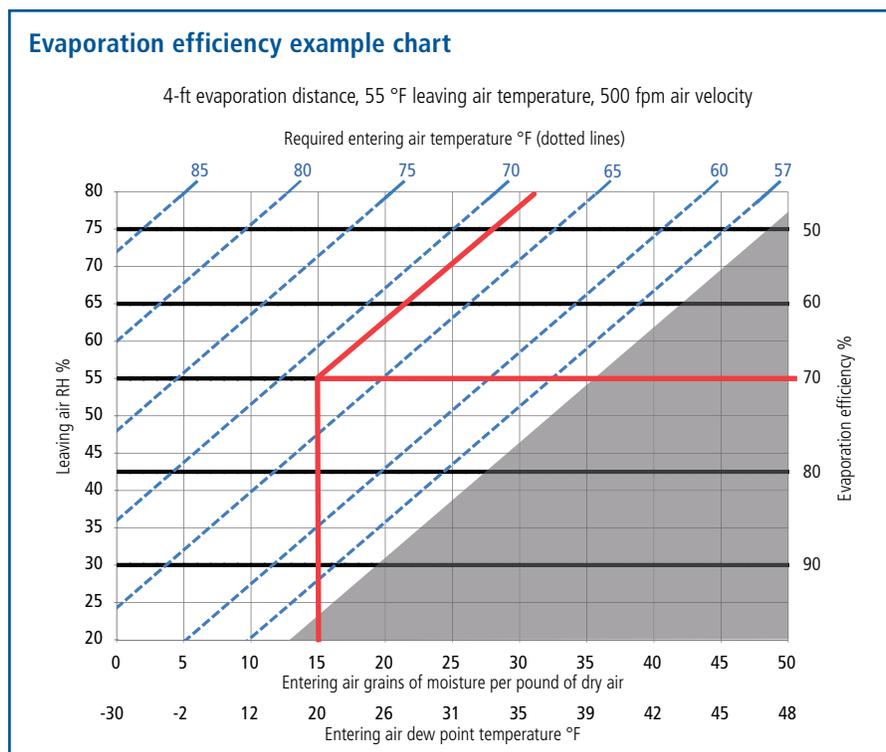- Leaving air RH = 55%

From these values, the evaporation efficiency chart below identifies:
- Required entering air temperature = 68 °F
- Evaporation efficiency = 70%

Now required system capacity can be calculated:
- Load ÷ evaporation efficiency = required system capacity
  385 lbs/hr ÷ 70% = 550 lbs/hr

To accurately size an adiabatic humidification system, make sure that you can define **all** the values above. This will ensure a system that maximizes efficiency while consistently meeting set point.

Evaporation efficiency example chart

4-ft evaporation distance, 55 °F leaving air temperature, 500 fpm air velocity

Required entering air temperature °F (dotted lines)

A high-pressure atomizing system with water treatment

Nozzle detail

9₁ Plenum zone 1 **9₂** Plenum zone 2 **9₃** Plenum zone 3 **9ₙ** Plenum zone n

1 Municipal water inlet

2 Dechlorinator Brine reservoir

3 Duplex water softener

4 Particulate filter (behind control cabinet)

7 Controller

5 Reverse-osmosis membrane(s) behind control cabinet

6 High-pressure pump

8 High-pressure line

Pumping station

Purified water reserve tank
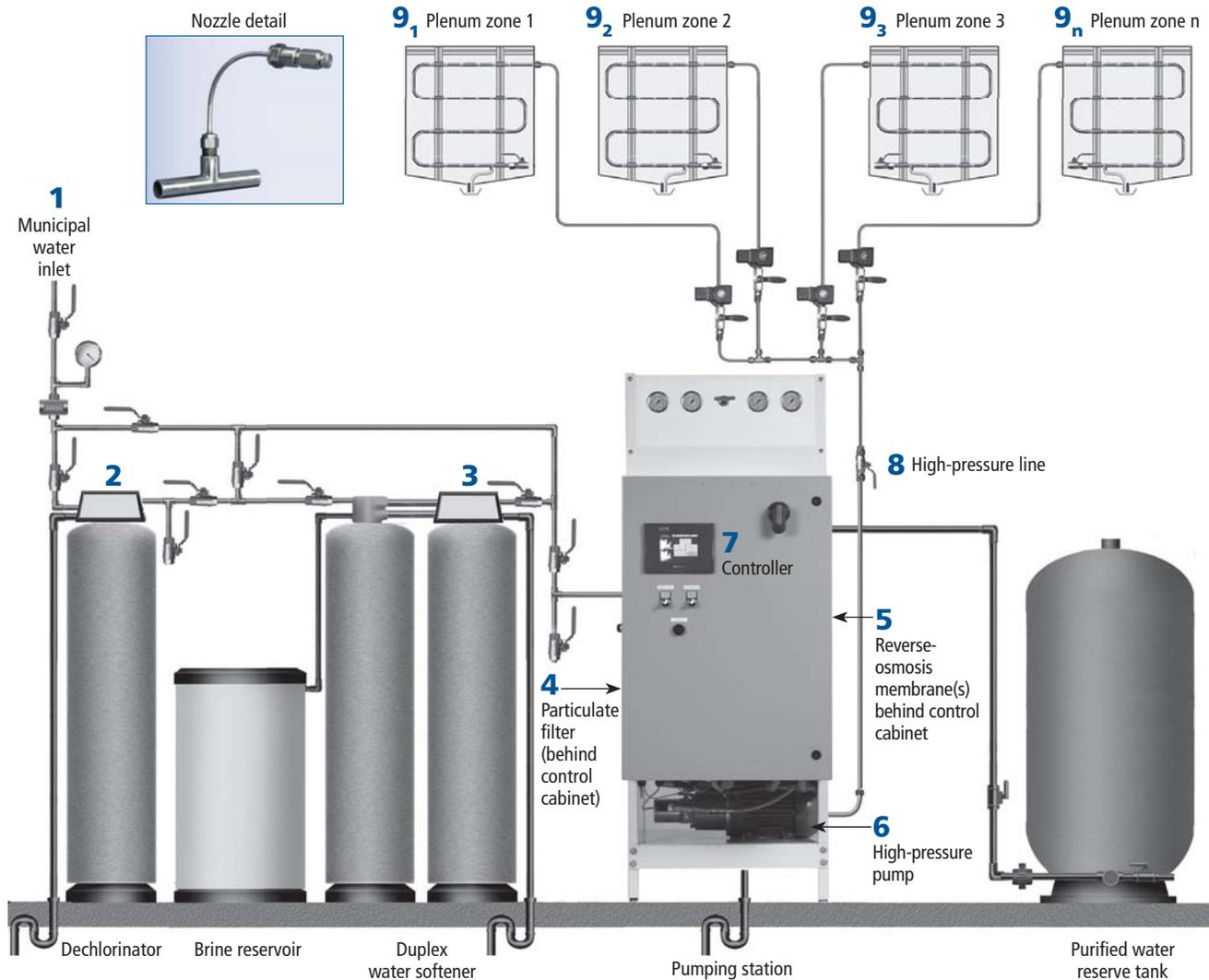
Sequence of operation

1 Water enters humidification system from municipal water supply and travels to:
2 Dechlorinator (located within pumping station on smaller models)
3 Duplex water softener
4 Particulate filter (located within pumping station)
5 Reverse-osmosis membrane(s)
6 High-pressure pump delivers purified high-pressure water to atomizing nozzles
7 One control system optimizes absorption in multiple humidification zones
8 Main water line feeds network of high-pressure stainless-steel piping
9 Nozzles disperse purified, ultra-fine water droplets into AHUs and/or open spaces
10 Final evaporation media (not shown) downstream of AHU heating coil prevents wetting farther downstream

Focus: High-Pressure Atomizing Systems

High-pressure atomizing features and benefits

- *Location:* Humidifies in air handlers or open spaces
- *Capacity:* System capacities to 8500 lbs/hr or more
- *Pump type:* High-pressure pump can be brass or stainless steel. Stainless-steel pumps are maintenance-free because they are cooled by purified humidification supply water. Brass pumps require regular maintenance, have a shorter life than stainless steel, and can contaminate humidification vapor.
- *Nozzle design:* Sophisticated nozzle designs can include integral check valves to prevent dripping when the system shuts off and internal micro-turbines that fragment water droplets into fine particles.

Advanced control

- Algorithmic controllers with sensors monitor multiple conditions
- Nozzle staging and pulsed modulation allow high turndown of system output
- Remote assistance and diagnostic capabilities via internet or building automation network
- Modbus® and BACnet® interoperability
- Color LCD touchscreen displays
- Multiple-zone humidification with one pumping system and one controller

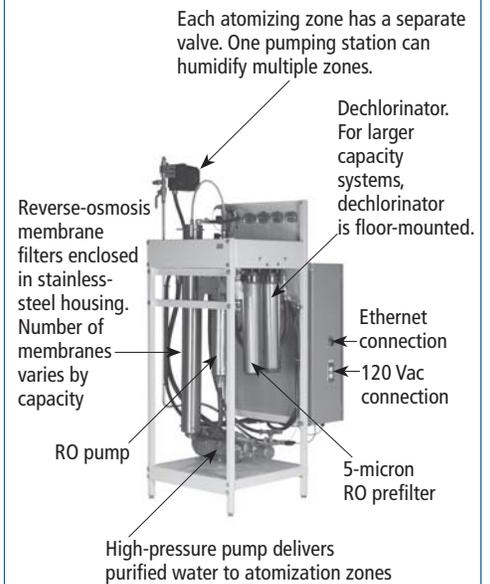## Ultra-pure humidification requires thorough filtration

- High-pressure atomizing systems can include reverse osmosis hyperfiltration, particulate filtering, dechlorination, and duplex water softening
- Thorough water filtration recommended to protect stainless-steel components from corrosion and undue wear
- Systems with automatic back-flush technology ensure long RO-membrane life
- Proper water treatment eliminates white dust fallout and bacteria/virus proliferation that can occur when using potable water

Nozzle component detail

3   1   2

1 **High-pressure water flows past a micro-turbine, breaking water into fine particles.**

2 **Water exits calibrated nozzle orifice, where water particle size reduces further to 10 microns or less.**

3 **Integral check-valve eliminates dripping when nozzle shuts off.**

High-pressure pumping station detail (back view)

Each atomizing zone has a separate valve. One pumping station can humidify multiple zones.

Dechlorinator. For larger capacity systems, dechlorinator is floor-mounted.

Reverse-osmosis membrane filters enclosed in stainless-steel housing. Number of membranes varies by capacity

Ethernet connection

120 Vac connection

RO pump

5-micron RO prefilter

High-pressure pump delivers purified water to atomization zones

Atomizing system installed in an open space

DRI STEEM®
The humidification experts

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Choose humidification system to meet requirements

While adiabatic humidification systems offer many advantages, it's important to choose the right system based on application, performance and economic requirements. Questions to consider when making an adiabatic system choice include:

- Will the humidifier be installed in a new facility or is it a retrofit? Retrofit applications limit technology choices. New facility air handler designs can be optimized to meet application requirements. For example, the more area available in an AHU for evaporation, the higher the evaporation efficiency.
- What are your energy- and water-efficiency requirements? Adiabatic humidification systems are very energy-efficient. Water efficiency varies by application, technology and manufacturer. When operating correctly, open-space adiabatic humidifiers can convert 100% of supply water to vapor. Sprayers and atomizers in AHU applications can send a large percentage of supply water to drain, depending on air temperatures and area available for evaporation.
- What are your operating cost and capital expenditure requirements? Adiabatic humidification systems can have extremely low operating costs. Low energy costs can produce utility rebates for adiabatic humidification systems, which can offset capital costs.
- How often can the system go off-line for maintenance? High-pressure atomizing systems using reverse-osmosis or deionized-treated water have the highest ability to stay on-line. This is a critical issue for some environments, like semiconductor manufacturing, which are seriously affected by changes in humidity.
- How clean does your humidity need to be? If particulate-free humidity is required for process or health reasons, then water treatment will also be required.

Finally, when choosing a humidification system, consider all costs. Cost analysis of a humidification system should be based on lifetime costs, and include equipment, installation and operating — especially energy — costs.

For more information contact: