1

Learning Objectives

- To understand the role of proper indoor humidification in improving health and cognitive functioning
- To understand that proper indoor humidification can be an intervention to prevent seasonal influenza spread in preschools
- **To understand how to properly design a high-pressure fogging system for health-care applications both for humidification and energy saving**
- To understand how to estimate the break-even point of the most common steam and adiabatic humidification systems

2

Agenda

1. Why humidify in health care?
2. Traditional humidification methods
3. ASHRAE Standard 170-2017 requirements
4. Adiabatic cooling process
5. High Pressure atomizing system principle of operation
6. Application and design considerations
7. Water quality requirements
8. Maintenance and hygiene

3

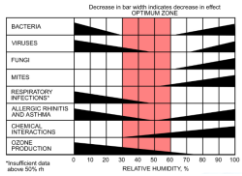
Why Humidify in Health Care?

Patient health and occupant comfort

- Transmission of airborne viruses is significantly reduced if the relative humidity is maintained between 30-60%
- Reduces dryness and irritation to the nose, throat, skin, and respiratory tract
- Helps to improve thermal comfort

Equipment

- Helps to reduce the risk of electrostatic discharges that can interfere or damage sensitive equipment

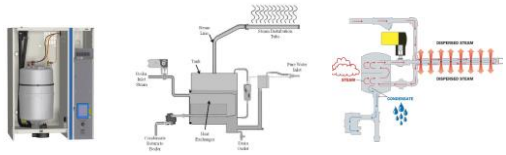


ASHRAE. 2016. ASHRAE Handbook - HVAC Systems and Equipment Handbook – Chapter 22. Atlanta: American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

4

Traditional Humidification Systems

- Traditionally steam humidification systems
  - Using electricity, gas, or facility boiler steam
- Steam can reach temperatures up to 212°F (100°C) and does not carry contaminants or bacteria
- Steam humidifiers can also be the most expensive to operate in terms of running costs
  - Requires a high amount of electricity (electric steam), especially for large systems



5

New Options! Fogging Systems in Health Care Applications

ASHRAE Standard 170-2017: Ventilation of Health Care Facilities

- Permits the use of adiabatic high pressure atomizing humidifiers

General Requirements

- Locate humidifiers within air-handling units or ductwork to avoid moisture accumulation in downstream components, including filters and insulation.
- A humidity sensor shall be provided, located at a suitable distance downstream from the injection source.
- Controls shall be provided to limit duct humidity to a maximum value of 90% RH when the humidifier is operating.
- Duct takeoffs shall not be located within the humidifier's absorption distance.
- Humidifier control valves shall be designed so that they remain off whenever the air-handling unit is not in operation.

6

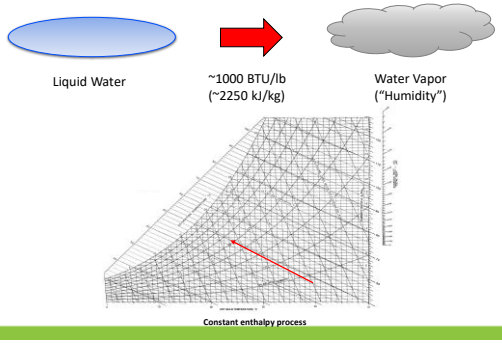
New Options! Fogging Systems in Health Care Applications

Adiabatic Atomization Humidifier Requirements

- Humidifier water shall be treated with a reverse osmosis process, a UV-C sterilization light source, and a submicron filter.
- Treated humidifier water shall be continuously circulated from the source to the humidifier valves. All valves, headers, and piping not part of the recirculation loop shall drain completely when not in use.
- Ports suitable for testing water quality shall be provided in the treated humidifier water piping system.
- Moisture eliminators shall be provided as required to prevent moisture accumulation in ductwork.

7

Adiabatic Process and Free Cooling



8

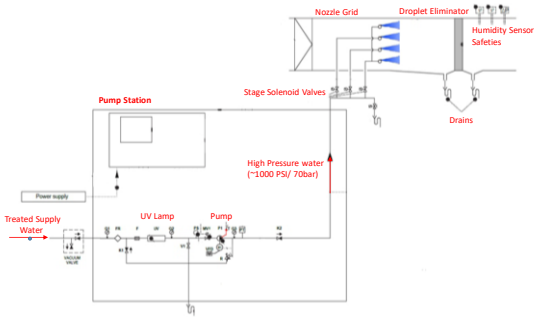
Is "Free" Cooling a Benefit?

High pressure atomizing systems may not be ideal for some climate zones

- Better suited for warm dry climates
- Adiabatic cooling effect can help to reduce cooling loads in summer months (~0.34kW per lb/hr / 0.75kW per L/hr of water evaporated)
- May result in additional heating costs to offset adiabatic cooling in heating mode
- Adiabatic cooling effect should be considered during the design phase to determine if high pressure atomization is a suitable technology

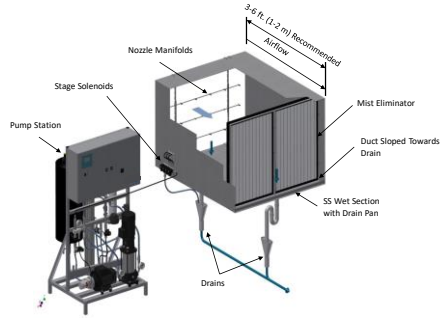
9

Principle of Operation - High Pressure Atomization



10

High Pressure Atomization - Typical Installation



11

Features and Benefits of High Pressure Atomization

- Capacity
  - Scalable systems with capacities >2200 lb/hr (1000 L/hr)
  - Multiple zones can be supplied from a single pump station
- Control accuracy up to ±2%
- Low energy consumption
  - Electric Steam - ~35kW per lb/hr of water evaporated
  - HP Atomizing - ~<4W per lb/hr of water evaporated
- Potential for free cooling

12

Design Considerations

Design conditions
- Sufficient absorption distance – 3-6 ft (1-2m)
- Air Velocity - <750 fpm (3.8 m/s)
- Entering air temperature and design set point

AHU/Duct Considerations
- Stainless steel wet section and drain
- Air Filtration (MERV 13 / F7 or higher)

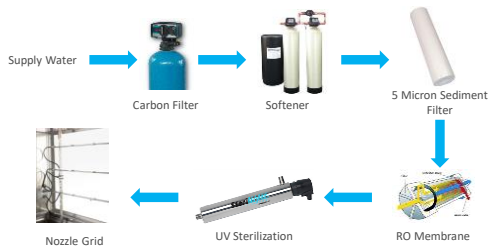
Capacity
- Fogging systems are generally better suited for larger systems (>250 lbs/hr / 115kg/hr)
- Can be used in conjunction with lower capacity steam humidifiers

Other Considerations
- Available water quality – RO/DI
- Multiple zones
- Redundancy

13

Water Quality

- Water quality is extremely important when using an atomizing system
- Reverse osmosis (RO) or Deionized water (DI) is required
  - Removes mineral salts before atomization



14

High Pressure System Maintenance

Component	Action	Frequency
Oil Lubricated Pump	Oil change	500-1500 hours
Water Lubricated Pump	Replacement/Refurbish	8000 hours
UV Light	Replace bulb	12 months
Nozzles	Inspection/Replacement (as needed)	2000 hours
Droplet Eliminator	Inspection/Filter Replacement	Inspect monthly
RO Membrane	Replacement	2-4 years
Micron Filters	Replacement	6-12 months
AHU/Duct Section	Inspection/Clean	2000 hours

- Maintenance should be performed as per manufacturers recommendations and be detailed in the water risk management plan

15

Hygiene and Risk Management

Atomizing systems must be designed such that they are hygienically safe

- Must not have water stagnation
- Must use filtered and treated water (RO or DO)
- Must have Ultraviolet light (UV) sterilization
- Must have a moisture eliminator
- Must have safeties - high limit and air proving
- Risk Management plan - Hygiene, water management, and preventative maintenance programs should be in place prior to commissioning

16

Conclusion

Adiabatic high pressure atomizing humidifiers can now be used in health care facilities,
- Need to be designed and operated/maintained correctly to ensure safe operation

Low cost humidification and the potential benefit of free cooling
- May not make sense in all climate zones

Hygiene, water management, and preventative maintenance programs are critical

17

Additional Standards and Guides

ASHRAE Standard 188-2018 Legionellosis: risk management for building water systems
- Risk management plan that includes:
  - Commissioning procedure
  - Maintenance schedule and procedure
  - Bacteria testing schedule and procedure
  - Disinfection and corrective action plans

Guideline 12-2000 - Minimizing the Risk of Legionellosis Associated with Building Water Systems

18

Bibliography

- ASHRAE Standard 170-2017 Ventilation of Health Care Facilities
- ASHRAE Handbook 2016 – HVAC Systems and Equipment, Chapter 22 "HUMIDIFIERS"
- ASHRAE Standard 188-2018 Legionellosis: risk management for building water systems
- Guideline 12-2000 - Minimizing the Risk of Legionellosis Associated with Building Water Systems

19

Questions?

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20