## WHITE PAPER

# UNDERSTANDING HUMIDIFICATION SOLUTIONS: SELECTING THE RIGHT TYPE OF HUMIDIFIER

### **EXECUTIVE SUMMARY**

Humidifiers play a vital role in maintaining the right balance of moisture in the air in commercial facilities, safeguarding materials, optimizing processes, and contributing to a healthier and more comfortable working environment. With various types of humidifiers on the market, including steam and evaporative humidifiers, understanding their unique features and benefits is essential.

Achieving optimal indoor air quality requires an informed approach to humidity management, and selecting the right type of humidifier is a important step in this process. This document aims to explore the considerations involved in making an informed choice regarding humidification solutions. From the impact of relative humidity (RH) levels on indoor environments to the diverse range of available humidifiers, we cover the crucial factors that should guide decision makers in choosing the most suitable option for their needs.





#### Why Humidify?

The term "humidity" refers to the amount of water vapor in the air and is measured in terms of relative humidity (RH). Relative humidity is a function of both moisture content and temperature. It describes the actual amount of water vapor in the air as a percentage of the maximum amount of water vapor which the air could hold at a given temperature.

Optimal relative humidity levels play a critical role in safeguarding the integrity of building materials and equipment, as well as maintaining a balanced and healthy indoor environment. In commercial and industrial spaces, controlling relative humidity levels is essential for several reasons:

- **Optimize processes:** Certain industrial processes require precise humidity levels for optimal performance. Industries like printing, paper manufacturing, and food processing rely on controlled humidity to ensure quality and efficiency.
- **Prevent static electricity:** Maintaining optimal relative humidity levels helps prevent the buildup of static electricity, which is common in dry environments. Adding humidity is particularly important in commercial settings with electronic equipment, as excessive static electricity can damage sensitive devices.
- **Preserve assets:** In industrial environments, proper humidity control is vital for preserving materials and products. This is particularly crucial in industries such as pharmaceuticals, electronics, and museums where humidity-sensitive items are prevalent.
- Improve energy efficiency and thermal comfort: Maintaining proper humidity levels can contribute to energy efficiency because Raising the RH level in a room slows the evaporation rate and will make the room feel warmer. Well-humidified air feels warmer, allowing for lower heating requirements in colder seasons.
- Enhance health and well-being: Maintaining optimal humidity levels enhances occupant comfort by preventing dry skin, irritated eyes, and respiratory issues. It also reduces the risk of airborne infections.

A key study<sup>1</sup> from 1986 showed that the optimal conditions to minimize risks to human health occur between 40-60% relative humidity (RH) at normal room temperatures. This study is still referenced by HVAC professionals today and forms the basis of standards for healthy built environments set by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).

The relative humidity level should generally fall between 40% and 60% RH for optimal conditions in most facilities. Simply use an inexpensive hygrometer to determine the RH levels in a facility.









<sup>1</sup> Arundel, A V, et al. "Indirect Health Effects of Relative Humidity in Indoor Environments." Environmental Health Perspectives, U.S. National Library of Medicine, Mar. 1986, www.ncbi.nlm.nih.gov/pmc/articles/PMC1474709/.



## **TYPES OF HUMIDIFIERS**

There are two types of humidification system technologies for commercial buildings – steam (isothermal) and evaporative (adiabatic).

#### **Steam Humidifiers**

Steam, or isothermal, humidifiers produce humidity by boiling water and releasing the steam into the air. This is achieved through a heating element that brings water to its boiling point, creating a controlled steam output.

Steam humidifiers can use electricity, natural gas, propane, or even pressurized boiler steam as an energy source. Each energy source has its own set of advantages and considerations. Electric steam humidifiers are often easier to install and maintain, while natural gas and propane options might be more cost-effective in certain regions. This choice is often dictated by the specific requirements of the facility where the humidifier is installed.

Steam humidifiers are ideal for applications that demand precise control of RH. They find extensive use in industrial settings, laboratories, and healthcare facilities where maintaining specific RH is critical.

Pros: Rapid response, precise RH control.

- Rapid response: Steam humidifiers provide quick results, as they can precisely modulate steam output.
- Precise humidity control: These humidifiers offer precise control, allowing users to maintain exact RH percent as required by their specific applications.

**Cons:** Higher energy consumption, maintenance requirements.

- Higher energy consumption: Steam humidifiers tend to have higher energy consumption than evaporative, or adiabatic, humidifiers due to the energy required to boil water.
- Maintenance requirements: Regular maintenance is essential to remove hard scale from the tank and heating elements and ensure optimal performance. This issue can be mitigated by adding a water treatment system ahead of the humidifier to remove minerals and other dissolved solids from the water before it is heated to steam.



DriSteem's RTS® humidifier RX series (electric resistive steam humidifier)



DriSteem's XT series electrode humidifier



DriSteem's GTS<sup>®</sup> humidifier LX series (low NOx gas-fired steam humidifier)



#### **Evaporative Humidifiers**

Evaporative, or adiabatic, humidifiers operate on the principle of natural evaporation. A high-pressure system is an adiabatic system that uses heat already present in air to evaporate evenly distributed water droplets dispersed by the system. As these atomized water droplets are absorbed, the evaporation causes air temperature to drop, reducing the cooling load and providing significant energy savings when cooling and humidifying simultaneously.

High-pressure systems are well-suited for areas where maintaining proper RH is essential. The added humidity enhances indoor air quality, optimizes manufacturing processes, and protects material longevity while taking advantage of this technology's free cooling and energy savings.

**Pros:** Energy efficiency, low maintenance.

- Energy efficiency: Evaporative humidifiers are energy-efficient since they do not require energy to boil the water.
- Low maintenance: Stainless steel dispersion nozzles and manifolds require no regular maintenance if water treatment is incorporated in the system.

**Cons:** Limited coverage, potential for mineral buildup.

- Limited coverage: Evaporative humidifiers may have limitations in humidifying large spaces, making them more suitable for individual rooms. This issue can be resolved by selecting a high-pressure system because they can handle large spaces.
- Mineral buildup: In hard water areas, minerals from the water can accumulate on surfaces as white powder. This issue can be solved by adding a water treatment system ahead of the humidifier to remove minerals and other dissolved solids. Most high-pressure systems require reverse osmosis water to prevent clogged atomizing nozzles (and the white dust).



DriSteem's Adiatec<sup>®</sup> high-pressure system pump and nozzles



DriSteem's Adiatec<sup>®</sup> high-pressure system in manufacturing facility



DriSteem's Adiatec<sup>®</sup> high-pressure system in print shop



DriSteem's Adiatec<sup>®</sup> high-pressure system in hockey arena



## SELECTING THE RIGHT HUMIDIFIER

Proper humidification is very important for many applications and must be considered up front during the building design process. Factors to consider include the intent (humidification or cooling), the humidification load, available energy sources, quality of the supplied water, where the moisture will be dispersed, and the level and type of controls needed.

Failure to consider all factors may result in a system that operates inefficiently, doesn't meet the intended requirements, or can cause unintended consequences due to poorly managed moisture. With a good design, properly controlled humidification can promote health and safety, improve productivity, extend the life of materials, and enhance occupant satisfaction.

#### **Critical Design Considerations**

- Environment: Selecting the right humidifier begins with a thorough understanding of the environment. Consider the size of the space, ambient temperature, and the desired humidity levels.
- **Application:** Different commercial and industrial environments have different needs, and the selection of a humidification system should align with the intended application.

If the purpose of the humidification is to provide cooling or add moisture without adding heat, an evaporative (adiabatic) humidifier is appropriate. High-pressure humidifiers utilize evaporation to add moisture to the air.

The alternative to an evaporative humidifier is to use a steam (isothermal) humidifier. Gas, electric, and steam powered humidifiers add moisture to the air by boiling water to generate steam which absorbs into the air quickly.

 Load: For any system, it's important to determine the required humidification load so the proper size of the equipment can be selected. The risks of under sizing or oversizing must also be considered as this will impact the cost and performance of the humidification system.

Consider how outside air enters the building whether through natural ventilation, mechanical equipment, or an economizer which will vary the

Humidity control is critical in pharmaceuticals, food processing, and electronics manufacturing industries. These sectors often require stringent numidity levels to ensure the integrity and safety of their products.











amount of outside air and impact the load.

• Energy source: Steam (isothermal) humidifiers can use electricity, natural gas or steam as the energy source. Evaporative (adiabatic) systems use electricity. The most appropriate choice will depend on the cost of the energy source at the location where the humidifier will be installed, the humidification load, the availability of the energy source, the budget available, and whether rebates are available.

Electric powered isothermal systems are generally simpler to install than gas or steam powered systems, but the cost to operate them will be higher. If a building already has steam available, a steam-to-steam system is a good option.

- Water: One thing that all humidification systems have in common is their use of water. The quality of the water can have an impact on the performance, level of control, maintenance, and overall cost of any humidification system.
- Maintenance: Consider the required maintenance and cleaning. Understanding and aligning with the maintenance expectations ensures the longevity and optimal performance of the selected humidifier
- **Dispersion:** There are many options to disperse the moisture generated by a DriSteem humidifier. It could be dispersed into an Air Handling Unit (AHU), into a duct, or directly into open spaces. The placement of the dispersion system is very important. Dispersion systems can be located in the incoming air, makeup air, supply air, or within the humidified space. Factors to consider when selecting the location include available absorption distance, location of downstream components (i.e. elbows, fans, vanes and filters), and materials of construction.
- **Control and monitoring:** Some applications demand precise control over humidity levels, whether it's maintaining a specific humidity range for manufacturing processes or ensuring comfort in a commercial space. Controllability varies based on technology and configuration.

Sensors for detecting high humidity or low airflow are recommended for safe operation. Both can be used to shut down a humidifier to prevent a buildup of excessive moisture. Setback setpoint sensors can also be used to monitor the relative humidity in cold weather conditions to prevent frost from building up on cold surfaces such as windows. In industrial settings, the specific humidity requirement for a building depends on its function. For example, a typical manufacturing facility will rely on proper humidity control to ensure product quality and safety.











## **COST CONSIDERATIONS**

When considering humidification systems, stakeholders should carefully evaluate the investment cost, operation cost, and expected return on investment. This comprehensive analysis ensures an informed decision during the initial purchase and a clear understanding of the system's long-term impact on comfort and cost-effectiveness.

#### **Investment Cost**

The investment cost of a humidification system encompasses the upfront expenses associated with its purchase and installation. This includes the cost of the humidifier unit itself, any required accessories, and professional installation services.

Different types of humidification systems, such as steam humidifiers, may vary in their initial costs. Factors influencing investment costs include the size of the system, the technology employed, and any additional features or customizations required for specific environments.

#### **Operating Costs**

Operating costs are mostly affected by the energy source (electricity, natural gas, propane, or pressurized steam).

Additionally, maintenance costs should be considered, covering routine inspections, component replacements, and any unexpected repairs. Evaluating the long-term efficiency and reliability of the humidification system can help estimate the overall operational expenses.

#### **Return on Investment**

Assessing the return on investment (ROI) involves weighing the long-term benefits against the initial and ongoing costs. These benefits may include improved indoor air quality, enhanced comfort, and protection of equipment or products sensitive to humidity levels.

Energy efficiency is crucial to ROI, as systems with lower operating costs over time contribute positively to the overall return. A well-designed and properly maintained humidification system can lead to energy savings, reduced equipment wear, and increased productivity, all of which contribute to a favorable return on investment. In industrial settings, the specific humidity requirement for a building depends on its function. For example, a typical manufacturing facility will rely on proper humidity control to ensure product quality and safety.











## **NEXT STEPS**

Humidification technology can be installed either as a retrofit for existing buildings or for new construction. The type of indoor space, air quality goals, energy source, required level of maintenance, capacity, etc. will determine the best technology for each building. Of course, energy management and the analysis of energy usage drive the selection of humidification efficiencies and sustainability.

If a building currently does not have a humidification system, it is time to add one to protect processes, equipment, health, and safety. If a humidification system exists, it should be reviewed to ensure it is properly sized, operating correctly, and energy efficient since building usage often changes over time.

DriSteem is a premier leader in providing innovative humidification solutions tailored to meet the diverse needs of different environments. With a commitment to delivering high-quality products and cutting-edge technology, DriSteem has established itself as a trusted partner in the following areas:

- **Broad product range:** DriSteem offers a comprehensive range of humidifiers, including steam and evaporative technologies, dehumidifiers, and water treatment systems for one-stop humidity control solutions. This diverse product portfolio allows customers to choose the most suitable solution for their specific requirements.
- Customization and integration: DriSteem understands that each environment is unique and offers configurable options to address specific challenges and integration capabilities to ensure seamless compatibility with existing systems.
- **Expert guidance:** DriSteem's products are backed by experts with indepth knowledge of humidity control technologies. They are dedicated to guiding and supporting customers in selecting the most effective and efficient humidification solutions for their applications.

The importance of proper humidification cannot be overstated. DriSteem is a reliable partner with the expertise and product offerings to address the diverse humidification needs across commercial and industrial sectors.

Go to <u>www.dristeem.com/find-a-rep</u> to find your local DriSteem representative. They are ready to provide more information about DriSteem products and how to proceed with project planning.



DriSteem in Eden Prairie, MN



Servicing GTS<sup>®</sup> humidifier in outdoor enclosure



Replacing reverse osmosis membrane for Hydrotrue® water treatment system



#### **DRI-STEEM Corporation**

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#### Expect quality from the industry leader

Since 1965, DriSteem has been leading the industry with creative and reliable humidification solutions. Our focus on ease of ownership is evident in the construction of DriSteem products. DriSteem leads the industry with a Two year Limited Warranty and optional extended warranty.

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