EVAPACK™ VS. HIGH PRESSURE ATOMIZATION

WHITE PAPER

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EVAPACK VS. HIGH PRESSURE ATOMIZATION

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EvaPack™ provides the humidification and evaporative cooling benefits of High Pressure Atomization systems while using less energy and water, with reduced space requirements.

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INTRODUCTION

The Armstrong EvaPack™ is an adiabatic humidification system that incorporates aspects of traditional evaporative media without the control and biological concerns typically associated with evaporative media. High pressure atomization systems, also a method of adiabatic humidification, and the EvaPack™ Contact Panel Technology follow the same psychrometric process to humidify and cool air. Figure 1 shows the adiabatic humidification process plotted on the psychrometric chart.

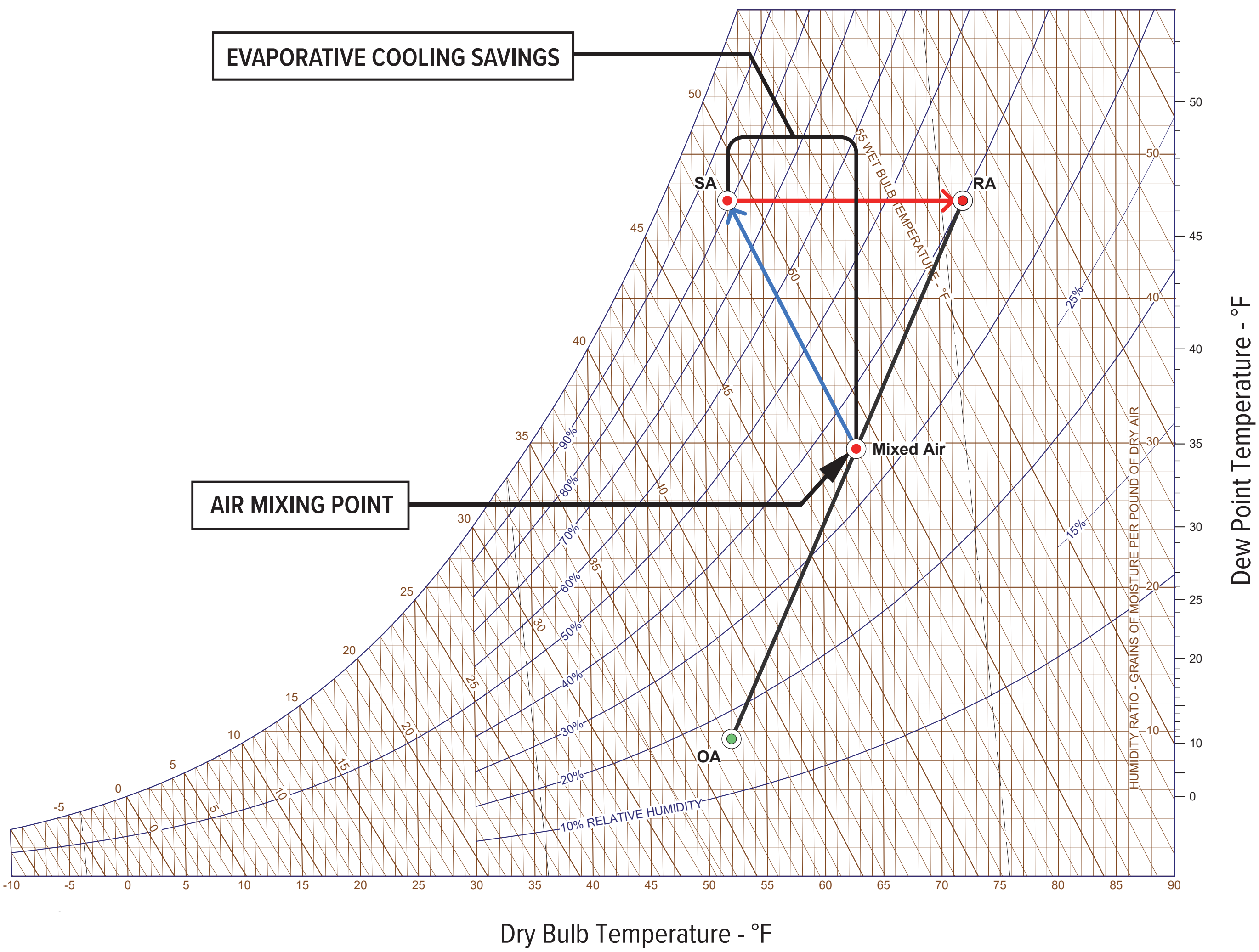


Figure 1: Adiabatic Humidification Process

While both high pressure atomization (HPA) and Contact Panel Technology (CPT) follow the same psychrometric process to humidify, each system employs different methodology to achieve this end. HPA systems employ a high pressure water pump (1000 PSI) to deliver demineralized water such as Reverse Osmosis (RO) or Deionized (DI) water through small orifice(s) to atomize water in a given air-stream. EvaPack™ Contact Panel Technology , using the same demineralized RO or DI grade water, incrementally saturates a geometrically formed media as a moving air-stream makes contact with the engineered media facilitating the change of state from visible water to gaseous water vapor.

Many applications benefit from the evaporative cooling associated with adiabatic humidification systems. Applications with high internal heat loads such as data centers, public venues, large manufacturing facilities as well as surgery suites, can reduce the mechanical cooling required especially when compared to isothermal steam systems. It is worth noting that evaporative media is not currently acceptable for health care applications in the United States per ASHRAE 170. While all adiabatic humidifiers achieve the same thermal benefit, not all adiabatic technologies afford the same reduction in RO/DI water use and maintenance while eliminating hygienic concerns. This article will compare the EvaPack™ CPT humidifier to HPA humidifiers.

MAINTENANCE

Unlike HPA systems the EvaPack™ does not employ pumps, manifolds, or nozzles, which provide a significant reduction in the maintenance and repairs required. The positive displacement pumps supplied with HPA systems require regular oil changes and seal replacements over the life cycle of the pump. Also, manifolds for HPA systems may require cleaning of nozzles as well as o-ring replacement to maintain proper operation and eliminate drips and leaks.

EvaPack™ media is made of inorganic fibers mechanically formed without the need for adhesives or glues. This allows for the use of ultra-pure water sources such as DI or RO water to be used for humidification. Traditional evaporative media formed with adhesives are not compatible with ultra-pure water sources. Using an ultra-pure water source will improve the pad life and will eliminate the need for routine cleaning of the media. Providing an ultra-pure DI grade water source has allowed for 5-7 years of media life for many current users.

CONTROLLABILITY

Controllability is another important consideration when comparing the EvaPack™ CPT to HPA. Due to the nature of high pressure atomization, control of the system involves both a variable frequency drive (VFD) on the pump as well as multiple solenoid valves assigned to headers with varying nozzle quantity. This requires the need for a control algorithm to properly modulate the pump while staging zone valves on and off. The result is an over-saturated air-steam that converts approximately 60-75% of the moisture emitted from the nozzles into water vapor (RH) with the remaining 25-40% falling out or impinging on a mist eliminator, downstream cooling coil, or the side-walls and floor of the duct or AHU, and eventually down the drain.

The Armstrong EvaPack™ CPT incorporates a high turn-down ECV valve(s) to vary the loading of the media with the ultrapure water source in response to the demand or control input signal. Additionally, the CPT system is engineered for specific project parameters by varying the height, width, and depth of the media, in a segmented arrangement, to optimize the efficiency of each application. The result is all of the DI/RO ultra-pure water introduced to the engineered media effectively converted to water vapor as the air passes through the media. With a properly controlled air-stream at +/- 0.2 FDB, RH can be controlled to +/- 1.5 %. With a dew-point control strategy +/- 1.0 FDP is achievable.

ABSORPTION DISTANCE

In HPA systems, water is sprayed into the airflow saturating the immediate area around each nozzle head. With time and distance the atomized water will eventually change state from a visible water droplets to an invisible vapor. The time and distance required is very much dependent on the temperature of the air-stream. The higher the inlet temperature the higher the efficiency.

With CPT media, moisture is naturally absorbed as there is 100% contact of the air-stream with the media as the air passes through the media. With HPA systems, when water is sprayed into an airflow, it will require more lineal distance to increase the efficiency of the water sprayed to convert, or change state, to a gaseous water vapor. This distance required for HPA systems will typically be between 4' and 12'. With CPT evaporative media, complete conversion to water vapor is achieved as the air-stream passes through the media. This means the entire length of duct or air handler length required for the Evapack™ CPT will always be 24", the length of the EvaPack™ unit assembly itself. Figure 2 illustrates this difference.

Air velocity will also have a substantial impact on absorption distance with HPA systems. HPA systems are best suited for an air velocity profile in the 250 – 550 FPM range. Duct velocities of 1000 FPM require twice the distance to allow for the change of state of water vapor. The Evapack™ will function as intended with air velocities between 150 and 1000 FPM, with the same 24" lineal distance required, offering greater application flexibility.

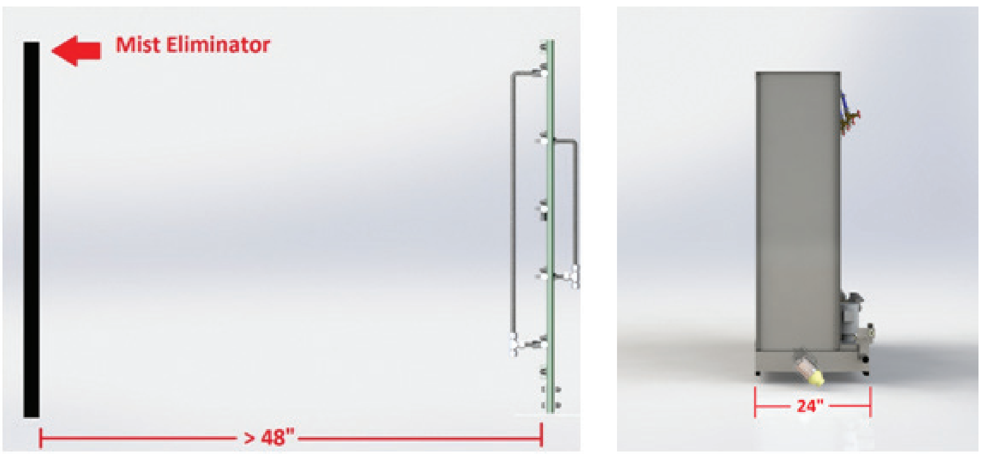


Figure 2: High Pressure (left) vs. Evaporative (right) Absorption

WATER EFFICIENCY

In all instances, EvaPack™ CPT media will be more efficient with water consumption than HPA systems. This means that less RO or DI water is wasted to drain. Figure 3 below illustrates expected water efficiency of a HPA system. EvaPack™ CPT converts 100% of the ultra-pure water to water vapor with none wasted.

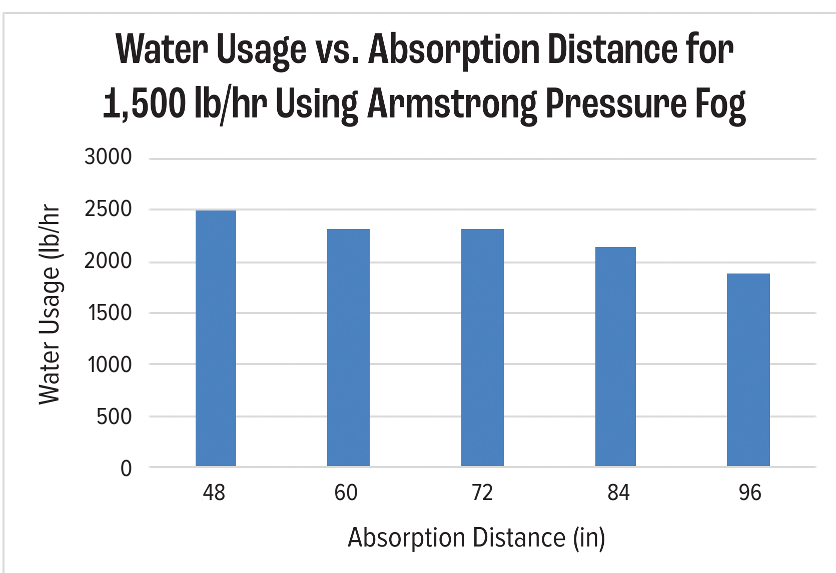


Figure 3: Pressure Fog Water Usage vs. Absorption Distance

PRESSURE DROP

HPA systems often require a mist eliminator to preclude visible water droplets from impinging on downstream devices. In most cases this mist eliminator will add .2 to.3 inches water column pressure drop when dry. Once saturated this pressure drop increases with degree of saturation.

EvaPack™ engineered media is in constant contact with the entire air-stream at all times and has a fixed pressure drop that is quantified in Figure 5 below. Pressure drop is minimized by the engineered geometry of the EvaPack™ media. The geometry, or flute angle, of many typical evaporative media sources currently available do not follow this carefully engineered process to reduce air friction on contact. With ducted applications over 600 FPM a droplet separator is recommended to be installed immediately after the media, within the 24" confine of the EvaPack assembly, requiring no additional lineal distance. A graph illustrating the pressure drop of the droplet separator can be found in Figure 4 below.

In some duct installations with velocities greater than 600 FPM, HPA systems may have a slight advantage over CPT with regard to pressure drop. However, in all instances, the elimination of the pump required for all HPA systems, will result in less operational cost with CPT.

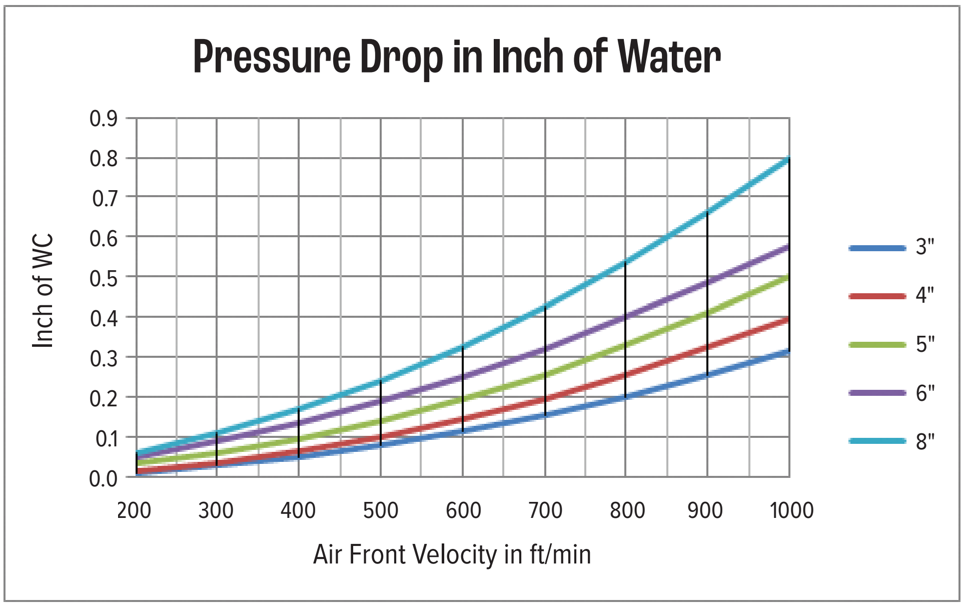
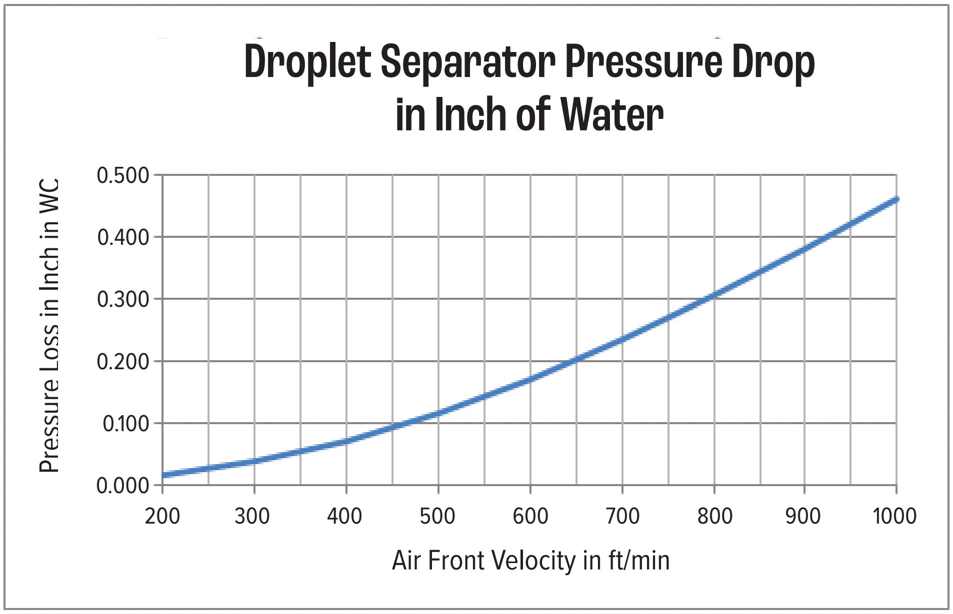


Figure 4: Evapack Pressure Drop vs. Air Speed



CONCLUSION

Evapack has many superior benefits when compared to high pressure atomization (HPA systems in duct and air handler systems. It offers lower maintenance, higher energy and water efficiency, and reduced space requirements. EvaPack also has the unique ability to use DI or RO water in the most demanding applications.

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