Add Water Vapor to Sanitary Gases at High Temperature

RASIRC RainMaker Humidifier purifies and controls the ratio of water vapor delivered to sanitary processes

The **RainMaker** High Temperature Humidifier is specially designed for pharmaceutical, medical and biotechnology processes. The **RainMaker** Humidifier controls the transfer and purity of water vapor or steam directly into a gas stream.

Many processes are developed with water vapor as a key component of the process. However, when moving from bench top to production, compressed air is often replaced with synthetic air or nitrogen for GMP reasons. These process gases are bone dry. To add water back reliably and repeatably is a technical challenge.

Technologies commonly used for humidity control typically use a porous hollow fiber and cannot go above 50ºC. This temperature is too low to prevent bacterial growth, a significant concern in biotechnology applications. In addition, water vapor loading at these low temperatures is limited to single digits. If instead high temperature water or steam is used then high concentrations of water vapor can be loaded into the process gas and then diluted downstream. This reduces the size, cost and complexity of the humidification system.

The **RainMaker** Humidifier uses a non-porous membrane to provide a barrier between the liquid source and the carrier gas to be humidified. The water vapor rapidly permeates across the membrane, while the carrier gas is excluded. This flow stops once the carrier gas has been fully saturated. Because the membrane has a known transfer rate based on pressure and temperature, **RainMaker** can be used as a flow control and gas delivery device. **RainMaker** Humidifier supports a high loading of water per liter of gas, rising to 1:1 over 82°C.

The **RainMaker** Humidifier has a 316L SS housing with sanitary fittings. All internal components are made from fluoropolymers to handle corrosion, high temperatures, and maintain purity needed for demanding biopharm process and validation requirements.

The contactor technology typically used for humidification does not provide an aseptic barrier between the water and the gas. Contactors also require water pressure be above the gas pressure which can be a real problem. RainMaker technology has a much greater operating range of pressure and temperature. The RainMaker is constructed to handle temperatures exceeding 80°C while most contactors breakdown above 50°C. The nonporous membrane prevents direct contact between the water and the process gases, so an extra level of protection is provided between the water source and the product.

The **RainMaker** can work with water, water vapor or steam. Each will deliver a different amount of water into the carrier gas. The amount of water vapor transferred into the carrier gas is limited by the pressure of the carrier gas, temperature of the water vapor source and energy available.

As water is transferred from liquid to gas phase, cooling occurs and additional heat is needed to prevent the carrier gas from being cooled. RASIRC can provide heaters and temperature control systems if needed.

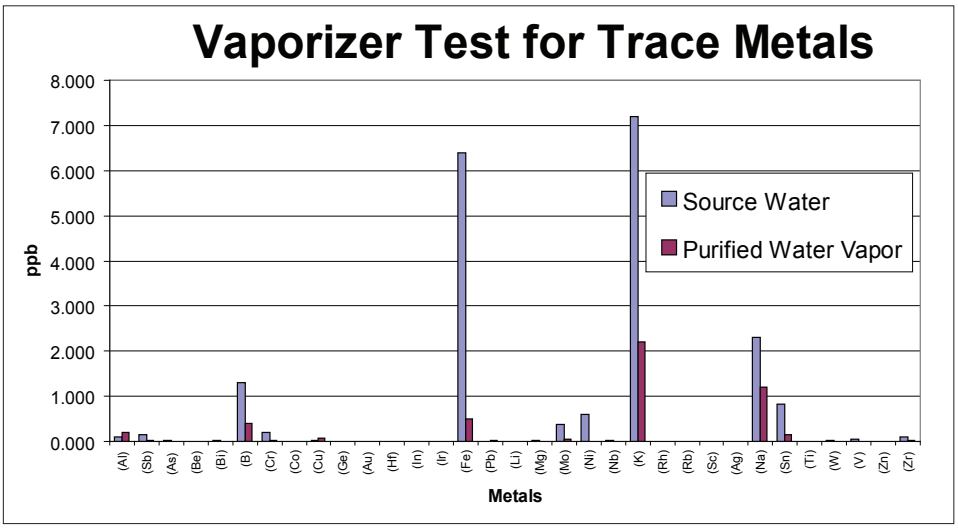

Figure 1: RASIRC's RainMaker purifies DI water and removes metals during humidification.

About RASIRC

RASIRC develops products that purify and deliver ultra pure liquids and gases, with a primary focus on water vapor. RASIRC dryers, humidifiers and steam generators are of critical importance for many applications in the semiconductor, pharmaceutical, medical, biological, fuel cell, and power industries. Custom systems are available upon request. Call RASIRC to see how they can solve your water vapor challenges.

RASIRC

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Advantages over Existing Technologies

	RASIRC RainMaker	Hollow Fiber Contactor
Materials of Construction	non-porous hollow fiber membrane	porous micro-hollow fiber
	hydrophilic membrane	hydrophobic membrane
	perfluoropolymer or 316L stainless steel	only with perfluoropolymer
Particle Filtration	Yes	Yes
Water Vapor Purification	Yes	No
Transfer Rate	High	Low
Prevent Gas Back Streaming into Water	Yes	No
Pressure Independent for Water/Carrier Gas	Yes	No - requires higher water pressure
Humidify Without Heat	Yes	No
Water Droplet Permeation	Cannot	Can wet out - Catastrophic Failure
Maximum Operating Temperature	>80˚ C (contact RASIRC)	50˚ C
Cost per Liter Humidified	Low	High
Size per Liter Humidified	Small	Large
Pressure Drop per Liter Humidified	Low pressure drop / large diameter fiber	High pressure drop / small diameter
Membrane Seal	Proprietary mechanical seal high integrity	Proprietary welded seal - low yield
Capable of 120 slm	Yes	No
Capable of 400 slm	Yes	No
Lead Time	3 to 4 weeks	3-16 weeks
Vacuum compatible	Yes	No
Steam sterilizable	Yes	No

How to Order

To determine the **RainMaker** needed for your application, provide the following information to your authorized RASIRC representative:

- Low Flow Rate
- High Flow Rate
- Low Operating Pressure
- High Operating Pressure
- Dew Point Range on Inlet
- Dew Point Range on Outlet
- Water Supply Temperature
- Water Supply Flow Rate
- Desired Gas Connections
- Desired Water Connections

Orders can be placed through authorized dealers or directly with the factory.

RainMaker Benefits

- **Robust Design**—Patent-pending Teflon® seal eliminates the need for epoxies, which limit operating temperature and can cause contamination.
- **Purity**—The non-porous membrane ensures only water vapor is added to the carrier gas. Microdroplets, dissolved gases, metals, ionic contaminants and most volatile contaminants are left behind in the source.
- **Yield**—Metals, hydrocarbons, and particles are rejected by the non-porous membrane to deliver the purest water vapor possible. Because only molecular water can transfer across the membranes, water droplets cannot penetrate. The carrier gas is humidified on a molecular basis and does not include droplets, which bubblers, atomizers and vaporizers can inject into the carrier gas stream.
- **Throughput**—Continuous unattended 24/7 operation.
- **Versatility**—handles very low to very high delivery (0.3 sccm to 1,000 sccm). Can be used to deliver into positive, ambient or vacuum pressure systems. **RainMaker** humidifies inert gases such as nitrogen, clean air, and argon; oxidizing gases such as oxygen and ozone; corrosive gases such as HCl; and flammable gases such as hydrogen.
- **Safety**—Highly selective membrane prevents most carrier gases from crossing over into the source. Minimizes pressure requirements between humidified gas and moisture source.
- **High efficiency**—Thin hydrophilic membranes allow rapid transfer of water vapor without the chance of wet out from hollow fiber contactors.
- **High temperature**—Can be steam sterilized.

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