APPLICATION GUIDE

PROTECTING WATER TREATMENT INFRASTRUCTURE:
WHY DESICCANT DEHUMIDIFICATION IS THE MISSING LINK IN CORROSION PREVENTION

Every water treatment plant in the country has the same humidity problem, and most of them are spending money on the wrong solution. Repainting corroded pipe is not corrosion control. Controlling the humidity in the building is.

THE MOISTURE PROBLEM

Your water treatment plant has a corrosion problem no amount of paint can solve, and the real culprit isn't the water, it's the air. Fresh water treatment facilities are among the most condensation-prone environments in municipal infrastructure. Open basins, clarifiers, flocculation tanks, and chemical feed areas continuously release moisture into the surrounding air. At the same time, raw water piping carrying water at temperatures between 32 and 55 degrees F creates cold surfaces throughout the building. When warm, humid air contacts those cold pipes, condensation forms.

That condensation isn't just a nuisance, it's the starting point for a chain reaction with substantial costs for U.S. water utilities. Moisture on steel pipe surfaces provides the electrolyte corrosion requires. Add the chlorine-based disinfection chemicals present in every treatment plant, and the corrosion rate accelerates. ASHRAE Applications guidance confirms corrosion rates increase once relative humidity exceeds 60%, and in many treatment facilities, interior RH routinely climbs above 70% during warmer months or when HVAC systems cycle off.

The consequences compound. Some facilities spend six figures annually repainting corroded piping and structural steel, treating the symptom rather than the cause. Electrical panels, variable frequency drives, PLCs, and instrumentation are equally vulnerable.

WHY REGULAR AIR CONDITIONING IS NOT ENOUGH

Conventional HVAC systems are engineered to control temperature, not humidity. Moisture removal happens as a secondary effect of cooling: air passes over a cold evaporator coil, and if the coil surface temperature drops below the air's dew point, some moisture condenses out. This works reasonably well when cooling loads are high and the system runs continuously. In a water treatment plant, sensible cooling loads are often modest, especially during shoulder seasons and at night. When the thermostat is satisfied, the system cycles off, and humidity rebounds immediately.

There's a deeper engineering limitation. Cooling-based systems have a practical dew point floor around 40 to 45 degrees Fahrenheit, limited by coil temperature control. Preventing condensation on pipe surfaces at 40 degrees Fahrenheit requires holding space dew point at 35 degrees Fahrenheit or lower. That's below the threshold cooling can reliably reach. Adding hot gas or primary energy reheat to manage supply air temperature doesn't extend the coil's dew point floor; the physical limit of the coil remains the constraint. Refrigeration-based dehumidifiers face the same physics: their moisture removal capacity drops as temperatures decrease, precisely when cold-pipe condensation is at its worst. Temperature-based dehumidification cannot maintain the dew point margin this application demands.

HOW DESICCANT DEHUMIDIFIERS REMOVE MOISTURE

Desiccant dehumidification works on an entirely different principle. Instead of cooling air to condense moisture, a desiccant system passes process air through a slowly rotating wheel comprised of a hygroscopic material, typically silica gel. The desiccant surface adsorbs water vapor directly from the airstream regardless of temperature. A separate heated reactivation airstream passes through another section of the wheel, driving off the captured moisture and exhausting it outside. The wheel rotates continuously between these two airstreams, providing a steady supply of dry air to the space.

Because the adsorption process removes moisture without cooling the airstream, space temperature and space dew point become independently controllable. The HVAC system handles sensible loads on its own schedule; the desiccant system holds dew point continuously regardless of where the thermostat is set or what the ambient temperature is doing. In a water treatment plant, where space temperatures may be moderate while surface temperatures are near freezing, that independence is the fundamental reason desiccant works where conventional dehumidification does not.

The technology delivers consistent dew point suppression regardless of ambient temperature. Whether it's January or August, the system holds air dew point below the coldest pipe surface in the building. The engineering target is straightforward: maintain space dew point at least 5 degrees F below the coldest expected surface temperature. For a plant with raw water at 40 degrees F, that means holding a space dew point of 35 degrees F or lower, corresponding to roughly 40 to 45% relative humidity depending on space temperature.

Cold-weather performance is the second advantage, and it matters here more than in most applications. Refrigeration-based dehumidifiers lose capacity as ambient temperatures drop and hit a limitation as dew point requirements get below 40F, precisely when cold-pipe condensation risk is at its worst. Desiccant systems have no such limitation. ASHRAE Systems and Equipment (Chapter 24) identifies preventing condensation on cold process equipment and preserving industrial infrastructure as primary use cases for desiccant dehumidification. Water treatment is exactly the scenario the technology was designed for.

Unlike catalog equipment designed for general-purpose dehumidification, Desiccant Air Solutions engineers each system for the specific process conditions and moisture loads of the application. Wheel media selection, pre-cooling capacity, reactivation temperature, and control logic are all configured for the target environment rather than selected from a standard product line.

AUTOMATIC DEW POINT CONTROL BASED ON WATER TEMPERATURE

One of the most practical advantages of desiccant dehumidification in a water treatment plant is the ability to tie the control strategy directly to actual condensation risk rather than a fixed humidity setpoint. Most humidity control specifications target a relative humidity, often 50% RH. That's a reasonable starting point, but it misses the real constraint. A room at 50% RH and 75 degrees F has a dew point of approximately 55 degrees F. If the raw water piping is at 42 degrees F, condensation will form regardless of what the wall-mounted hygrometer reads.

The better approach uses a direct water, or surface-mounted temperature sensor (RTD or thermocouple) on the coldest raw water pipe in the space, paired with a dew point transmitter monitoring room air. The dehumidifier's PLC or building automation system continuously compares these two values, maintaining space dew point at a fixed margin below the measured pipe surface temperature. When water temperature drops in winter, the system automatically increases moisture removal by modulating reactivation heat upward. When water temperatures rise in summer, reactivation energy is reduced, saving operating cost without manual adjustment.

PID logic controls reactivation energy through SCR controls on electric heaters, modulating gas valves, or steam control valves. The system maintains humidity within plus or minus 2 degrees dew point of the target while matching energy input to the actual load. Seasonal adaptation happens automatically: raw water temperatures in many municipal systems swing from the mid-30s in winter to the mid-50s or higher in summer. A fixed RH setpoint either over-dries in summer, wasting energy, or under-dries in winter, allowing condensation. By tracking actual pipe temperature, the system responds to real physics rather than an arbitrary number on a specification sheet.

System controls use PID logic with dew point sensor feedback to modulate moisture removal continuously. Standard configurations include BMS integration for remote monitoring, alarm management, and setpoint adjustment.

SIZING: STARTING POINTS FOR WATER TREATMENT APPLICATIONS

Sizing a dehumidification system for a water treatment plant begins with two calculations: the moisture load entering the space and the recirculation airflow needed to distribute dry air effectively. On the moisture side, the dominant sources are evaporation from open water surfaces such as basins, clarifiers, and filter galleries, followed by outdoor air infiltration through doors, louvers, and building envelope gaps. Chemical feed areas where liquid chemicals are mixed or diluted can contribute localized humidity spikes requiring zone-specific treatment.

Recirculation airflow sizing starts with the volume of the space being controlled. A practical starting point for enclosed water treatment plant buildings is approximately two air changes per hour, calculated by multiplying room volume in cubic feet by 2 and dividing by 60 to arrive at CFM. A 50,000 cubic foot filter gallery might require 1,700 CFM of recirculated process air. Tighter, well-sealed buildings may operate effectively at that rate. Facilities with large overhead doors, open bays, or minimal vapor barriers may need to increase airflow to account for higher infiltration.

Size for peak moisture events, not steady-state conditions. Summer weather and open-door maintenance periods drive the highest loads, and a system sized only for average conditions will struggle at exactly the wrong moment. Redundancy deserves serious consideration at critical facilities: a single unit with no backup leaves the plant unprotected during service or equipment failures.

WHY IT MATTERS

Fresh water treatment plants sit among the most condensation-vulnerable infrastructure in any municipality. The combination of omnipresent cold surfaces, chlorine-laden atmospheres, and continuous moisture generation creates conditions no conventional HVAC system can manage on its own. Desiccant dehumidification, controlled to maintain a true dew point margin below the coldest pipe surface, addresses root-cause condensation rather than painting over its consequences year after year.

Contact Desiccant Air Solutions at Sales@DesiccantAir.com to discuss sizing, system configuration, and corrosion prevention strategy for your water treatment facility.

REFERENCES

AWWA Standards List (American Water Works Association standards for treatment facility design)

ASHRAE Applications: Water Treatment Facilities

NACE International SP0169: Control of External Corrosion on Underground or Submerged Metallic Piping Systems (industry standard for corrosion prevention in high-humidity infrastructure environments)

Desiccant Air Solutions designs and builds custom dehumidification systems combining cooling and desiccant technology for demanding water treatment applications. Contact us at Sales@DesiccantAir.com.