"Green" approach to dehumidification inside water treatment plants

By Piyush Patel

Air handling unit.

In most water treatment plants, temperature and humidity control is crucial. When moisture condenses onto cold pipes, valves and pumps, a number of destructive effects can occur. High humidity can cause metal corrosion, paint deterioration and failure of electrical components. Moist locations also act as breeding grounds for bacteria, fungus and molds. To prevent excessive condensation, a dedicated dehumidification system is essential.

Typically, water treatment facilities are designed to avoid contamination and corrosion on the pipe surfaces to protect the potable water supply. However, the surface temperature of the piping may vary depending on water temperature and room condition. Condensation will occur whenever the surface temperature of the pipe or valve is below the dew point of the surrounding air. In general, condensation occurs during the spring, summer and fall months. In more humid climates, it may be throughout the year.

Conventional methods to prevent condensation

Two conventional methods can be used to avoid condensation:

1. Insulate all cold surfaces. Cold surface insulation is a best practice to save energy. However, inconsistent maintenance practices can reduce the effectiveness of insulation, as it is necessary to keep and/or replace the insulation on piping and valves to prevent condensation from occurring. The payback period for installation of insulation is around three to five years, depending on the amount of cold surface area.

2. Provide a dehumidification system. The two types of dehumidification systems commonly implemented are refrigeration and desiccant wheel. Refrigeration systems consist of a typical refrigeration DX cooling coil, compressor and condenser. Air is passed through the DX cooling coil to reduce air temperature below the dew point, in order to remove moisture from the air and reduce humidity. Refrigeration systems are initially attractive, due to low start-up costs and the availability of residential and commercial grade systems. However, this type of system consumes more energy than the desiccant wheel system.

Desiccant wheel dehumidification systems are quite different from refrigeration systems. Instead of cooling the air to condense moisture, desiccants attract moisture from the air by creating an area of low vapor pressure at their surfaces. Pressure exerted by the water in the air is higher, so the water molecules move from the air to the desiccant and the air is dehumidified.

However, the desiccant wheel system can be prone to fungus germination when nutrients are present along with condensate and frost. It also does not work effectively when room temperature is rising due to sensible heat gain from solar through windows, or heat dissipation from equipment.

Alternative control using process water

Using process water is an alternative method of controlling humidity that requires less energy than conventional methods. Process water is readily available in a water treatment plant or pumping station. If its temperature remains fairly steady throughout the year, it can be utilized for cooling purposes. It is necessary to review temperature data of the process water to verify that it can maintain room temperature between 18°C to 25°C throughout the year. Process water can then be reused, provided that refrigerant materials are totally isolated from it to avoid any chance of contamination. Coil, piping and valve material must also be NSF61 certified to meet potable water standards.

This approach to condensation control is far more "green" and sustainable than conventional methods. It may result in major energy savings and a reduced carbon footprint for two key reasons:

1. There is no potential for condensation if the supply air dew point temperature is maintained below the surface temperature of water piping, or other cold surfaces. Typically, the surface temperature of the water piping stays above 8°C for lake water, though this would need to be confirmed. As indicated by the Phy-

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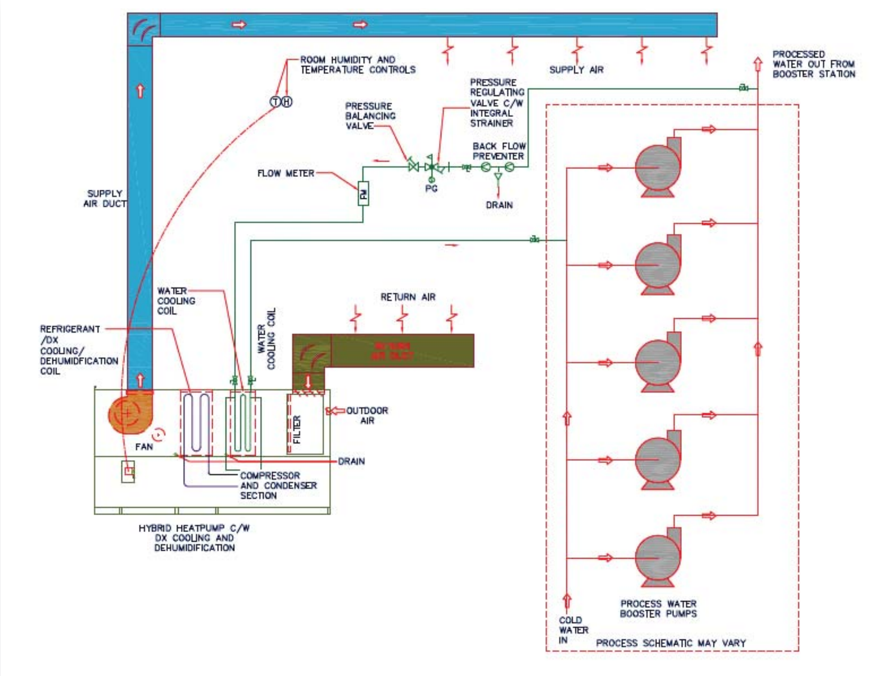

The design utilized the alternative dehumidification approach.

chrometric chart, condensation will be automatically avoided if supply air remains below the 8°C dew point. Requirements for additional insulation or dehumidification systems are reduced, saving costs and energy.

2. If the system is properly designed, the supply air will absorb heat dissipated from equipment and gained from the building envelope. In short, it will maintain room temperature at 18°C, minimizing the need for additional cooling

Case study: Halton Region

R.V. Anderson Associates was retained by Halton Region to design two new water booster pumping stations for Zones 4 and 5. The design utilized the alternative dehumidification approach to save energy and reduce the carbon footprint, in accordance with the region's commitment to achieving sustainability.

Air handling units (AHU) at these pumping stations were designed to use process water, running through a cooling coil, to absorb sensible heat released by the process equipment, prior to using a refrigeration type cooling and dehumidification system. This approach reduces air temperature and humidity before it enters the DX coil, reducing the amount of active cooling required.

A water-cooled condenser was built into the AHU, instead of an outdoor air-cooled condenser to increase performance efficiency in cold weather. A double wall cUL listed heat exchanger (suitable for potable water) was used for the condenser to maintain double wall separation between the refrigerant and water. This protected the water supply and allowed process water to be reused.

Only limited outdoor air is required to be brought in through the intake damper of the AHU to comply with ASHRAE Standard 62.1 and local standards. This helps reduce the dehumidification load, further reducing energy requirements. The system was designed so that the temperature of the outdoor air and return air mixture will never reach below freezing. Built-in freeze protection controls provide additional safety.

The ultimate energy savings seen at the booster pumping stations will depend on the amount of heat dissipation and air, solar heat gain, water temperature, air temperature, and outdoor and indoor atmospheric conditions.

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