

Conserving water with closed-loop, evaporative wet surface air coolers

By Jen Dorman

Water conservation and treatment have become important considerations for industrial facilities worldwide. Wet Surface Air Cooler (WSAC™) closed-loop, evaporative coolers and condensers optimize the use of scarce water resources, may reduce the amount of water required in a plant, and can also be used to maintain the required temperature in wastewater streams.

In addition to providing cooling and condensing solutions, a WSAC cooler or condenser can use low-quality water from almost any other source as spray makeup. Commonly used for adding capacity in “thermally challenged” plants, WSAC systems offer additional direct cooling without the need for additional tower capacity or makeup water.

Because the spray water never contaminates the process stream and there



Field erected Wet Surface Air Cooler.



WSAC drenching spray system.

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is no exposure of process fluid to the environment, low-quality water can be used as a makeup source. In addition, spray water does not cycle through surface exchangers. Due to wide tube spacing and non-clogging, large-orifice spray nozzles, higher cycles of concentration can be achieved. The fluid to be cooled flows through large-diameter prime surface tubes.

As an evaporative cooling device, a WSAC system has an operating approach (leading fluid temp) to the ambient wet bulb, not the dry bulb as with air-cooled units. This allows the process being cooled to be much cooler than the alternative system designs. The Niagara WSAC “single-source thermal responsibility” has proved to be a viable solution to control cooling capacity.

WSAC technology combines elements of a tubular heat exchanger and cooling tower in a single structure. This is a cost-effective heat transfer technology providing lower outlet temperatures while requiring less plot space and operating HP.

Each WSAC system is custom-designed to fit a specific heat transfer ap-

plication. To ensure efficient operation in all climates, design parameters are based on customer specifications for inlet and outlet temperatures as well as average weather conditions. Units can be manufactured with a wide variety of materials depending on water quality, water treatment and cycles of concentration. Varying in size from smaller packaged skidded to large field-erected units, WSAC equipment can be tailored to meet the most demanding applications.

WSAC coolers and condensers have been engineered for industrial applications in power, primary metal, petrochemical, refinery, and food and beverage facilities. Applications for these closed-loop, evaporative coolers and condensers include fluid-loop cooling, direct-vapour condensing, hydrocarbon desuperheating and subcooling.

Reusing low-quality water to condense steam

Engineered for a natural gas-powered, 25 MW power plant in Australia, a WSAC steam condenser reuses low-quality water as spray water. Because of the water quality and ambient air effects on the external surfaces, corrosive-resistant coil material and protective surface finishes were selected for this unit.

Regular service and cleaning are recommended for maintaining optimal performance, especially when low-quality water is used. Prime surface cleanable condensing coils offer complete internal access for inspection and cleaning, while an unobstructed view from above the tube bundles of the recirculating spray system and the outside tube surfaces permits daily visual inspection. This view is obtained by way of an external access package provided on this unit. WSAC system access packages typically include a ladder, cage walkway, handrail and access doors.

WSAC coolers and condensers offer several advantages for similar sites with low-quality makeup, including a reduc-

tion of freshwater makeup and the ability to reduce plant wastewater and obtain higher cycles of concentration.

Using existing cooling tower blowdown as makeup

An international petroleum company in the southwestern United States selected Niagara to engineer a large field-erected WSAC system to condense propylene. The WSAC condenser offered this plant the ability to use existing cooling tower blowdown as spray makeup and reduced the horsepower required to condense this service.

The WSAC system eliminated the need for an additional water source. Closed-loop, evaporative coolers offer an opportunity to reuse water that would otherwise be discharged.

Using low-quality river water

A field-erected, multi-cell hydrocarbon cooler and condenser were provided for a multinational oil company's plant in the Middle East. Closed-loop technology permits the use of high-chloride river water as spray makeup. The WSAC cooler and condenser system designed for this facility allows for observation

and maintenance of the spray water distribution system without the need for structure entry or fan shutdown.

An important design feature for this unit is individual tube bundle installation and removal by a vertical lift without affecting the operation of fans and remaining tube bundles. The straight-through mechanically cleanable individual tube bundles are hydraulically isolated for service or control. A self-draining, low-pressure, high-flow spray system that includes large-orifice non-clogging spray nozzles was designed so all spray nozzles can be inspected and serviced without removing any appurtenances while the equipment is in operation.

Issues such as water conservation will continue to have an impact on plant design and operation. Closed-loop, evaporative coolers can help maintain plant performance while utilizing water streams that are currently unusable with conventional towers and heat exchangers.

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