Non-contact Cooling Water

Many facilities use non-contact, or single-pass, cooling water to maintain effective operating temperatures for equipment. Non-contact cooling water may be used to cool equipment such as air compressors, air conditioners, CAT scanners, condensers, electronics/ transformers, hydraulic presses, injection molding and rotomolding equipment, oven seals, vacuum pumps, vapor degreaser condensers, viscosity baths, welding equipment including spot welders and x-ray processors.

Non-contact cooling is a convenient, generally inexpensive, method of cooling. City or well water is piped to the operation and circulated to cool the equipment. This can be done through a heat exchanger, a trace cooling system that uses a conduit which makes contact over the surface area of the equipment, or a channel built into the equipment. Because water has a heat capacity two to three times greater than other common, nonflammable liquids and gases (e.g. air), it can efficiently carry heat away from higher temperature areas. In many applications, cooling water is sewered although it is as clean as the supply water.

Evaluate Use of Non-contact Cooling Water

A number of factors may prompt your facility to evaluate its use of non-contact cooling water. Although water is relatively inexpensive compared to other utilities, industrial water costs have increased for both water supply and sewering. Some cities impose a one-time service availability charge (SAC) on businesses, based on increases in the volume of water a company uses, to help pay for sewer infrastructure. Water shortages can be a problem for some parts of the state during dry months. Publicly owned treatment works (POTWs) do not want to manage excess water at their wastewater treatment facilities, because the clean hydraulic load dilutes the treatment process. Some POTWs prohibit discharge of non-contact cooling water.

Generally, water costs are absorbed as company overhead, without charges back to specific departments. Overhead costs tend to be hidden and may be considered part of the basic cost of doing business rather than as a potential opportunity for savings. Facilities may have the opportunity to reduce water use and cost if they have not evaluated their use of non-contact cooling water. Particularly if the facility is older it might be operating an old system using outdated procedures. While the system works, it may be inefficient.

Reducing Water Use

Quick Reduction Opportunity Check

Check your use of non-contact cooling water against the list below. If your system meets any one of these criteria, you have flagged a possible opportunity to reduce water use.

- The wastewater temperature is not significantly warmer than the incoming water.
- Water is manually turned on and left running.
- No flow rate specifications. Water valve is left wide open or set at the operator's discretion.
- Water goes to drain.

Set Flow Levels

Understand the need for cooling. Are you protecting equipment, tooling, operating fluids or something else? Know the safe range for operating temperatures and set flow specifications to match those parameters.

Cooling Specification Examples

Presses. Typical hydraulic oils degrade above 200˚F. This degradation can lead to fouling of internal surfaces, loss of oil additives and changes in viscosity. Oil seals can also be degraded by high temperatures, leading to leaks. To maintain a margin of safety, adjust water flow to keep the temperature at the outlet at 110˚F. This will keep the oil reservoir temperature safely below 130˚F.

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Power supplies are cooled to prevent heat degradation of electronic components. Too much cooling can create condensation under humid conditions, which can corrode sensitive equipment. When cooling electronics and transformers, be sure that you are not cooling below the dew point.

Install Controls to Set Flows

Eliminate operator guesswork by installing flow controls. Although inexpensive and commonly used, ball valves do not regulate flow well. The position of the handle does not indicate flow rate. Small changes in ball valve position can result in large changes in the water flow rate.

- Ball valves are best used as on/off controls in conjunction with a flow indicator, such as a flow meter or a metering valve. They allow easy shut off without needing to readjust the flow control device.
- A rotameter is a simple, relatively inexpensive flow meter that gives visual feedback so operators know how much water is being used and whether the flow changes. This float-style meter may have a needle valve to precisely control water flow.
- Metering valves, such as a gate valve, can be used to adjust flow rates.
- Flow restrictors can be used to control flow after the flow rate has been determined.
- Electronic temperature controls might be justified for equipment that once turned on has varying levels of use, such as air compressors with large shifts in demand or equipment with differing speeds of operation.

Lou-Rich Evaluates Temperatures and Installs Controls

By identifying the maximum allowable oil temperature for a 600-ton hydraulic press, Lou-Rich personnel reduced cooling water flow by 87 percent (from 24 to 3 gallons per minute (gpm)) and still did not approach the critical oil temperature. The company installed a flow meter and needle valve after an existing ball valve for $120.

Staff also reduced flow on four 50 to 150 kilo volt-ampere (kVA) spot welders by 92 percent by installing timers and solenoid valves so cooling water is only on for 20 to 30 seconds after the welder is energized. They also reduced the flow rate from 10 gpm to 1.5 gpm during those times by installing metering valves. The cost was under $300 per welder.

Alpha Ceramics Optimizes Cooling Water Use

Alpha Ceramics, Minneapolis, produces specialized ceramics for sonar and medical diagnostic ultrasound applications. Cooling the company's six kilns individually used about nine million gallons of water per year, making it one of the facility's main uses of water.

Planning to install six more kilns to meet production demand, Alpha Ceramics faced an $8,000 SAC unless it was able to reduce water use. After experimenting, the company was able to plumb three kilns together in a series before the non-contact cooling water became too warm. This reduced cooling water use to one-third of its original demand. Yearly water use at Alpha Ceramics was reduced by 6.57 million gallons, saving $40,200 annually in water use and sewer fees.

Reusing Water

Non-contact cooling water is ideal for water reuse if process demands match supply. Before reusing or recycling water, be sure it meets your water quality requirements and identify any treatment steps that may be needed. Reuse opportunities are better if non-contact cooling water can be segregated from other wastewater streams.

Nilfisk-Advance Reuses Cooling Water

Nilfisk-Advance, Inc., a floor cleaning equipment manufacturer in Plymouth, faced a SAC. During a site visit, a MnTAP engineer noticed that the non-contact cooling water from the injection molding process was being sewered. He suggested reducing the overall flow and diverting this water to the five-stage washer in the paint system.

After reducing the flow of the non-contact cooling water, maintenance staff ran approximately 400 feet of pipe and installed a three-way valve to provide the washer with water as needed. The company successfully reduced the volume of wastewater discharged into the sanitary sewer, saving $55,800 in sewer and water fees.

Hibbing Fabricators Recirculates Spot Welder Cooling Water Through a Reservoir

To reduce water use, Hibbing Fabricators converted its cooling water system for two large spot welders to closed looped. Welding tips must be cooled to achieve consistent, strong welds and to prevent operators from receiving burns. The equipment is used four hours a day, on average. Before the change, too often the cooling water had been left running, using nearly 5,000 gallons per day (gpd) at a cost of $20 a day.

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The company fabricated a 180-gallon water reservoir from scrap sheet aluminum and set up an interlocked, circulating pump for less than $500 and $30 a year to operate. The pump is interlocked with the spot welder power-supply to automatically trigger the cooling water on and off.

The system's only maintenance in its first year was one cup of bleach added initially to control biological growth and three additions of 10 gallons of water each to make up for evaporation. The company estimates that the closed loop system has reduced water used during welding by at least 116,000 gpy, saving $570. Interlocking eliminated the potential for water to be left running.

Domino's Pizza Recirculates Ammonia Compressor Cooling Water

To reduce costs associated with an impending SAC, Domino's Pizza Distribution Center changed from single-pass cooling of compressors in its refrigeration system to a closed-loop system that recirculates water through a holding tank. During the three winter months, circulating the cooling water through the holding tank is sufficient to reduce water temperature for reuse. The waste heat radiates to warm the workspace.

The rest of the year, water is circulated from the tank through an evaporative cooling tower to provide additional cooling. On the hottest days of the year, half of the contents of the storage tank will be drained and refilled with cool city water to maintain appropriate cooling water temperatures.

The company purchased a 1⁄12-horsepower circulator pump, costing $40 a year to operate. Creating a closed-looped system eliminated 2,400 gallons per day of single-pass flow, saving $3,400 a year in water and sewer charges. The company avoided an $11,000 SAC.

Capturing Waste Heat

Capturing waste heat picked up by non-contact cooling water for reuse would be ideal. Unfortunately, the water is generally a low-grade heat source and the timing of heating supply may not match other heating demands. One general way to recover this heat is to store the water in a reuse reservoir to preheat domestic water before going to a water heater.

Most waste heat reuse opportunities are facility specific. Using heat exchangers, Rock-Tenn, a paper mill in St. Paul, is able to reuse the waste heat from its non-contact cooling water used to cool compressor water, electrical turbines, paper machine rolls and vacuum pump seal water. The heat picked up in cooling is used in other parts of the process.

If reused, water needs to be potable or the heat is transferred to potable water, a double-walled heat exchanger can be used to ensure that the water remains uncontaminated after it passes through the heat exchanger. These systems are less efficient because heat transfer is reduced.

Other Cooling-Water Reduction Options

Look for sources other than fresh water for cooling, such as reverse osmosis reject water. Find another use for the single-pass effluent, such as landscape irrigation, boiler make-up supply or non-potable water supply for toilets.

When operations have more-extensive cooling needs or cannot sewer the clean non-contact cooling water, these options may be more efficient or appropriate:

- For small equipment, it may be possible to tap into an existing recirculating chilled water loop.
- Air-cooled equipment can replace water-cooled models when water costs are high or you are not allowed to sewer clean water.

For More Information

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that prevent pollution at the source, maximize efficient use of resources, and reduce energy use and cost. Our information resources are available online. Or, call MnTAP at 612/624-1300 or 800/247-0015 from greater Minnesota for personal assistance.

Lou-Rich, Inc. Saves Over $42,100 by Reducing Water and Chemical Use Water used in cleaning and cooling operations was reduced by 8.9 million gallons per year through design improvements and monitoring. < http://mntap.umn.edu/paint/resources/Lou-Rich.htm>.

A Water Conservation Guide for Commercial, Institutional and Industrial Users, New Mexico Office of the State Engineer, July 1999. <http://www.ose.state.nm.us/water-info/conservation/pdf-manuals/cii-users-guide.pdf>.

For more information about reducing water use visit MnTAP's water Web page.