Cooling Tower: Regular Care Saves Time, Money, Energy

by Glenn A. Babcock

A cooling tower is a marvelous device that enables building owners and operators to take advantage of operating cost savings inherent in water-cooled systems. By conserving both energy and water, a well-maintained tower enables the cooling system to perform reliably and cost-effectively at optimum efficiency. Contractors who maintain existing cooling systems can provide their customers a great service by implementing a comprehensive, routine cooling tower maintenance program.

Unfortunately, for many years the cooling tower has been the forgotten component of the water cooling system when it comes to maintenance. A newly installed cooling tower reliably delivers the design fluid temperature and flow rate. However, since its heat transfer operation creates a “hurricane-like” environment and is a natural “air-washer”, the cooling tower needs routine inspection and maintenance to continue performing as designed.

This article takes a brief look at routine maintenance, and suggests ways to help you improve your customers’ cooling tower performance.

How They Work

Let’s start with a look at how a cooling tower works. In an open circuit cooling tower, warm water from the heat source is evenly distributed directly over a heat transfer surface called “fill” or “wet deck,” while air is simultaneously forced or drawn through the tower. This causes a small percentage of the water to evaporate. The evaporation process removes heat and cools the remaining water, which is collected in the tower cold water basin and is returned to the heat source (typically a water-cooled condenser or other heat exchanger). Similarly, in a closed circuit cooling tower or evaporative condenser, the heat is rejected indirectly from a fluid or vapor in the coil section by spraying re-circulated water over the coil section, evaporating a small percentage of the water.

The temperature at which the cooled fluid is returned to the system measures tower performance. This temperature can vary depending upon the actual cooling load, water flow, airflow, and ambient temperature conditions.

To perform properly, all tower components must be kept clean and free of obstructions. The following sections describe how this is accomplished through routine maintenance. Maintenance frequency will depend largely upon the condition of the circulating water and the environment in which the tower is operating.

Keep Strainer Systems Clean

Strainers in the tower provide a means of keeping debris out of the condenser system water loop. Strainers in the cold water basin outlet prevent debris from reaching the pump. Some towers feature low-pressure drop pre-strainers upstream of the hot water basin to prevent clogging of distribution nozzles. Inspect and clean both strainers as necessary. Some tower designs allow external access to the strainers, which enables maintenance to take place without the need to turn off the unit.

Maintain Even Water Distribution

The water distribution system should evenly distribute water over the wet deck surface or coil section via either a gravity distribution system or a pressurized spray system, using a series of nozzles. If water distribution is found to be uneven, the nozzles need to be checked. Clean clogged nozzles in accordance with the manufacturer’s recommendations.

In a gravity distribution system, the nozzles can be externally accessed, visually inspected, and cleaned by re-
moving the hot water basin covers on the fan deck. Some innovative spray distribution systems have nozzles and branches held in place by snap-in rubber grommets, which allow easy removal to clean and flush debris.

A well-designed cold water basin is sloped toward the strainer to keep dirt (which can accelerate corrosion) from accumulating. Keep these basins clean by occasionally flushing the dirt out of the system. Another way to accomplish this is to install accessories such as a sump sweeper piping system in conjunction with water filtration or separator devices. Water filtration saves maintenance costs by reducing the dirt in the cooling water system, which in turn reduces the time required to clean the cold water basins. It also reduces water treatment cost.

**Ensure Proper Make-up Level**

Though most of the water in the system is re-circulated, some water must be added to replace what is lost by evaporation and by “bleed” (the amount of water that is discharged to prevent the accumulation of solids in the cooling water).

The make-up water system provides the means to replace the water via a mechanical float ball and valve assembly or an electronic level probe assembly (with solenoid valve), which measures water depth in the cold water basin. The make-up water supply pressure should typically be between 15 psig and 50 psig to avoid problems with valves. When working with higher pressures, install a pressure reducing valve.

The operating water level of the cooling tower will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure. Some manufacturers offer access to the make-up assembly external to the cooling tower, which allows easy basin water depth inspection and adjustment without the need to turn off the unit. Set the tower water level in accordance with the manufacturer’s recommendations to ensure no air enters the pump suction.

**Adjust the Bleed Rate**

To conveniently discharge water and prevent the accumulation of solids, the tower should be equipped with a bleed line (including a metering connection and globe valve) connected to a nearby drain. One way to control the required bleed is install a conductivity meter. Also, installing a separate meter to measure bleed volume, since less water is discharged to the drain than supplied to the cooling tower, can reduce water costs. Adjust the bleed rate to prevent an excessive build-up of impurities in the re-circulating water. Constant bleed and replacement with fresh water will prevent the accumulation of impurities. To obtain specific recommendations, contact a competent water treatment company for your area.
Optimize the Drive Systems

The mechanical fan drive system has several components, which should be checked regularly. Before working on the mechanical system, follow proper lock-out/tag-out procedures, including locking-out all motor disconnect switches.

Cooling tower fans typically use belt or gear drive systems. Both require routine maintenance to ensure reliable, trouble-free performance.

Belt drive systems tend to be more popular, as they offer reliable performance, a single point adjustment, and no limit on turndown capabilities for variable speed applications. To ensure proper operation, tighten drive belts to manufacturer specifications.

In gear-drive systems, check the oil level and quality, as well as shaft alignment regularly in accordance with the manufacturer’s recommendations.

When starting up a new unit, lubrication for the fan shaft bearings is typically not necessary, since most units leave the factory already greased. However, for seasonal start-up, purge the fan shaft bearings with new grease (per manufacturer’s recommendations).

Fan shaft bearings should be lubricated after every 2,000 hours of operation or every three months (whichever occurs sooner). Motor bearings should be lubricated as recommended in the manufacturer’s instructions. For maximum life, it’s best to install motors with a “cooling tower duty” rating.

The Importance of Clean Operation

Cooling tower components must be kept clean and free of obstructions. Neglecting the cooling tower will lead to higher-than-desired return water temperatures to the system, which will result in higher energy usage from two perspectives. First, the system (chiller) will consume more energy because it must operate at a higher condensing pressure (head) to satisfy the load, due to the higher fluid temperatures provided by the cooling tower. As little as 2°F higher temperature can result in 6% more energy being consumed by the
chiller. Second, the tower must operate longer at maximum fan horsepower while trying to attain the design cold water temperature.

**Performance Improvements**

Product improvements (retrofit kits) can improve the performance of yesterday’s cooling towers with today’s technology. Older, structurally sound cooling towers can be retrofitted with upgrade kits to:

△ conserve energy
△ restore or improve performance
△ facilitate maintenance.

To conserve energy, pony motors and/or variable frequency drives (VFD’s) can be added to the mechanical drive system to take advantage of moderate operating conditions with lower horsepower.

To improve performance on water distribution systems, kits are available to replace older, small distribution nozzles or troughs with large-orifice, clog-free replacements. Retrofit fill kits now exist that easily replace existing fill that is clogged with scale or airborne debris. Access platforms can also be added to existing cooling towers to facilitate maintenance and improve worker safety.

**Better Performance, Longer Life**

Paying regular attention to the forgotten system component, the cooling tower, through routine maintenance, can save time, money and energy while increasing the tower’s life expectancy. A well-maintained tower is a viable candidate for retrofit kits designed to enhance performance and lengthen its life.

Contractors with a working knowledge of cooling tower preventive maintenance and upgrade technology have the opportunity to increase their value to their customers by making them aware of these cost-saving ideas and procedures.

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