Cooling Tower Tips

1. Optimizing Cooling Tower Performance

Reducing energy expenditures for your cooling tower may be as simple as regular maintenance. This Technical Brief explains how proper maintenance will optimize heat transfer and help your equipment operate more efficiently. It also identifies strategies for upgrading cooling tower performance.

How Does a Cooling Tower Work?

Cooling towers reject heat from the cooling water circulating through the condenser of a chiller. There are two basic types of cooling towers.

- Direct or open cooling towers expose the cooling water directly to the atmosphere. The warm cooling water is sprayed over a fill in the cooling tower to increase the contact area, and air is blown through the fill. The majority of heat removed from the cooling water is due to evaporation. The remaining cooled water drops into a collection basin and is recirculated to the chiller.
- An indirect or closed cooling tower circulates the cooling water through the tubes of a coil bundle in the tower. A separate external circuit sprays water over the cooling tubes to evaporatively cool the coils.

Why is Proper Maintenance Important?

An improperly maintained cooling tower will produce warmer cooling water, resulting in a condenser temperature 5 to 10 degrees F higher than a properly maintained cooling tower. This reduces the efficiency of the chiller, wastes energy, and increases cost. The chiller will consume 2.5 to 3.5 percent more energy for each degree increase in the condenser temperature. For example, if your chiller uses $20,000 of electricity each year, it will cost you an additional $500 to $700 per year for every degree increase in condenser temperature. Thus, for a 5 to 10 degree F increase, you can expect to pay $2,500 to $7,000 a year in additional electricity costs. In addition, a poorly maintained cooling tower will have a shorter operating life, is more likely to need costly repairs, and is less reliable.

What Causes Poor Performance?

The performance of a cooling tower degrades when the efficiency of the heat transfer process declines. Some of the common causes of this degradation include:

Scale Deposits

When water evaporates from the cooling tower, it leaves scale deposits on the surface of the fill from the minerals that were dissolved in the water. Scale build-up acts as a barrier to heat transfer from the water to the air. Excessive scale build-up is a sign of water treatment problems.

Clogged Spray Nozzles

Algae and sediment that collect in the water basin as well as excessive solids get into the cooling water and can clog the spray nozzles. This causes uneven water distribution over the fill, resulting in uneven air flow through the fill and reduced heat transfer surface area. This problem is a sign of water treatment problems and clogged strainers.

Poor Air Flow

Poor air flow through the tower reduces the amount of heat transfer from the water to the air. Poor air flow can be caused by debris at the inlets or outlets of the tower or in the fill. Other causes of poor air flow are loose fan and motor mountings, poor motor and fan alignment, poor gear box maintenance, improper fan pitch, damage to fan blades, or excessive vibration. Reduced air flow due to poor fan performance can ultimately lead to motor or fan failure.

Poor Pump Performance

An indirect cooling tower uses a cooling tower pump. Proper water flow is important to achieve optimum heat transfer. Loose connections, failing bearings, cavitations, clogged strainers, excessive vibration, and non-design operating conditions result in reduced water flow, reduced efficiency, and premature equipment failure. What Maintenance Should Be Performed?

The cooling tower manufacturer's operation and maintenance instructions should be followed whenever possible. Table 1 provides a guide for a reasonable cooling tower maintenance program. This is only a basic guide. Larger, more complicated cooling towers with special filters or controls will demand a more comprehensive maintenance program.

2. Prevention of Corrosion

Corrosion of condenser system components such as circulating pumps, condenser tube sheets and cooling towers can be very costly in terms of service disruption, loss of production, increased maintenance and capital equipment replacement. Implementing a properly designed chemical water treatment program is the simplest method of preventing these corrosion problems. Raw water quality must be taken into consideration when determining the most effective type of treatment program. For example, the Greater Vancouver regional water supply has an extremely corrosive tendancy due to the high concentration of corrosive dissolved oxygen, acidic pH and low mineral content.

3. Prevention of Scale

Formation of scale deposits will result in a loss of cooling transfer efficiency, translating directly into increased cooling costs. Raw water contains varying amounts of mineral salts such as calcium, magnesium, iron and silica. When these minerals exceed their solubility point due to increased cycles of concentration, the minerals precipitate out of solution and produce scale forming salts. Even in the Greater Vancouver Regional District, (where the raw water supply is extremely low in mineral content), this can promote scale formation in poorly maintained cooling systems. It is essential to maintain a proper bleed-off schedule to prevent excessive over cycling.

4. Prevention of Fouling

Air contains particles of dust and dirt of various kinds, (depending upon the local environment), causing recirculating water to become contaminated with a variety of materials. This creates fouling on the inside surfaces of condenser systems which can lead to under-deposit corrosion and loss of cooling transfer efficiency.

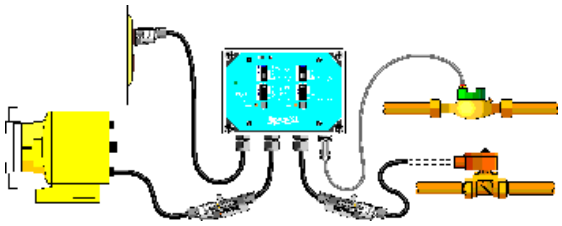
Since towers contain warm water, are open to sunlight, trap a variety of life forms and nutrient sources, they are perfect breeding grounds for algae, fungi and bacteria. Some of these forms circulate throughout the condenser system, while others attach themselves to convenient surfaces. Corrosion is frequently found beneath these deposits.

Cooling towers have been found to provide ideal breeding conditions for pathogenic bacteria such as Legionella pneumophila. Legionnaires' Disease is a potentially fatal form of pneumonia and is thought to be transited to humans via airborne water droplets.

Implementing a properly designed treatment program of biocides is most effective in controlling biological fouling. Installing a back-washable sand filter on a side stream of the condenser water will greatly assist in controlling the build up of suspended solids in the circulating water and on internal surfaces.

5. Treatment Dosing Equipment

In order for the treatment products to work effectively, they must be properly fed into the cooling system. Corrosion and scale inhibitors should be maintained at a constant level at all times, whereas biocides are most effective when applied in slug doses on a product alternated basis.



6. Cooling Tower Treatment

It takes only 3 to 6 months to dissolve 2 tons of solid impurities from the coiler in a cooling tower after the installation of the chemical free Aqua Correct physical water treatment The approximate 2 tons deposits was the amount, which was removed from the cooling towers at the worldwide known dairy company MD Foods / ARLA as well as at the Danpo Chicken Slaughterhouse and in hundreds of other cooling tower plants.

In Europe this physical treatment technique is to day installed in more than 3500 cooling towers. The benefits: No expensive chemical additives, no environmentally pollution and a long term economical advantage - the pay back time is in general less than 7-8 months! Further the reduced water surface tension increases dispersion of the water drops. Thus, a better heat exchange and cooling effect.

References:

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