The Need for Effective Cooling Tower Water Treatment …

By Mark Strahan

Here in the Phoenix metropolitan area, adverse water conditions require intelligent water treatment strategies to adequately maintain water cooled equipment. Proper management of the characteristics of the cooling tower sump water along with maintaining good tower hygiene in general accomplishes at least four positive things.

1) It avoids wasting excess water.
2) It inhibits scale formation.
3) It controls biological growth.
4) It reduces the corrosion rate of metal parts in the tower.

Let's discuss how a cooling tower operates to understand why proper water treatment is important.

Most residents in the valley are familiar with an evaporative cooler. Water from the evaporative cooler sump is circulated by a pump over pads in the evaporative cooler and outside air is drawn through the pads. As the air is drawn through the wet pads some of the water evaporates and cools the air. The cooler air is then circulated into the space where cooling is desired. In the process of cooling the air, the water being recirculated across the pads is also cooled.

That is exactly the same principle being employed in the cooling tower, but on a much grander scale. Rejecting large quantities of heat from a building's mechanical system requires a lot of water to be evaporated. For example, a one hundred ton water cooled chiller operating at full capacity for 24 hours would require the evaporation of more than four thousand gallons of water. That brings us to the subject of the characteristics of the make up water. Make up water is the water supply that replaces the water being evaporated in the cooling tower.

Here in the metro area, water conditions vary widely because our water comes from several different wells as well as surface sources. The water quality may change rapidly over a short period of time because different sources are utilized for the water supply. Each well has different water characteristics and they often vary widely from one side of town to the other. Water that comes from surface sources, like the Central Arizona Project will usually have significantly different characteristics than well water. Surface water quality may also be influenced by weather conditions such as drought or increased runoff.

As water evaporates in the cooling tower all of the non-volatile components stay behind in the sump of the cooling tower. There is actually a lot more in water than what we would call hardness (carbonates). There are also chlorides, suspended dust particles and biological microorganisms. As more and more water is added to replenish the water that is being evaporated, these dissolved and suspended

components in the sump water continue to accumulate. If no measures are taken to control the concentration of these components in the water, the solution eventually increases in concentration to a point where “stuff” starts coming out of solution. This “stuff” ends up getting deposited on the surfaces that the water comes in contact with.

Have you ever seen an evaporative cooler where the pads haven’t been changed for a long while? I’ve seen them so encrusted with mineral deposits that the blower could no longer pull air through them. I’ve also seen them produce a bounty of biological growth in the sump water. That is exactly what will happen in a cooling tower without adequate attention to hygiene and an appropriate water treatment strategy.

When solids that are dissolved in water come out of solution they are deposited first on heat exchange surfaces and surfaces where the water is being evaporated. Heat exchangers, water cooled condensers, drift eliminators, the tube bundle in closed circuit cooling towers and the fill in open cooling towers are a few examples of surfaces where this occurs.

Deposition of mineral scale, dirt and biological fouling on any heat exchange surfaces can result in reduced heat transfer, reduced tower efficiency and increased energy costs. While reducing deposition of these is important with regard to the cooling tower, it is absolutely critical to avoid scaling or fouling in the water cooled condenser. Scaling and fouling in the condenser significantly reduces heat transfer capability and will seriously impact energy costs, performance and reliability.

A two part strategy is usually employed to manage the mineral content of the sump water. Part one is to maintain the sump water pH within allowable limits and to feed the correct type and amount of chemicals to help the water keep more of the dissolved solids in solution. Part two is intentionally sending some of the sump water down the drain (blow down). Blow down reduces the highly concentrated mineral content of the sump water by diluting it with the fresh make up water being added to replace the intentionally wasted water.

Biological growth can also become a significant health risk depending on the particular organism involved. Allowing mud and biological growth to accumulate in the sump of a cooling tower can accelerate corrosion of the sump and shorten the life cycle of the cooling tower. It can also provide a haven for microbes to escape the effects of a biocide.

Proper water treatment strategy and good cooling tower hygiene is not a one size fits all solution. The quality of the make up water will require an adjustment of the type of the chemicals and biocide utilized. It may also require changing feed and blow down rates for proper control. In addition, these requirements may be altered by the characteristics of each individual cooling tower installation.

According to Alan Bateman of DB Water Technologies, there are several things a good cooling tower water treatment program should address in order to be effective. They are total dissolved solids (TDS), hardness, pH, chlorides, suspended solids, an appropriate method for biological control and a proper blow down strategy. Each cooling tower manufacturer publishes recommendations for maintaining proper water conditions of the sump water. The advice of a qualified water treatment professional is advised to ensure that each item above is included in your overall strategy for cooling tower water treatment.

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