Cooling Towers: Water Minimization

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Cooling towers require makeup water to function and generate wastewater as blowdown. There are a multitude of technologies, control schemes, operational changes, etc. available to minimize the water usage requirements. The purpose of this T.U.T.O.R. article is to briefly list some cooling tower water saving methods that can be applied to save water, sewer, and energy costs.

Cooling Towers Soft Water Makeup

Calcium and magnesium are typically the two primary scale formers in a cooling system. By removing these ions with a water softener, the cooling tower is able to operate at higher cycles of concentration. This reduces the amount of blowdown and makeup water required.

Blended City/Soft Water Makeup

The softener regeneration costs (salt and water) may make using 100% soft makeup uneconomical for a cooling tower. By using a blend of hard water and soft water, the cooling tower may still be able to operate at higher cycles requiring less blowdown and makeup water. The most economical balance for the blend will have to be calculated.

Water Chemistry

It is always a good exercise to re-evaluate the water chemistry of the cooling tower system. If makeup water quality changes, the control parameters will change accordingly. If the water quality gets worse, perhaps softened makeup water becomes viable. If the water quality improves, the cooling tower may be able to operate at higher cycles, which will reduce blowdown and makeup rates. Also, there are improved treatment chemistries becoming available that may allow the Langelier Saturation Index (LSI) of a system to approach 3.5 instead of the standard 2.5. Operating at a higher LSI would allow for higher cycles that would reduce blowdown and makeup. It should be cautioned, though, that precise control of the cooling tower water chemistry

becomes vitally important as the LSI is increased. The risk of scale formation on heat transfer surfaces can be greatly increased even with small system upsets. The benefits of operating at higher LSI versus the risk to the system must be weighed.

Acid Feed

Feeding acid to a cooling tower system will increase the solubility of calcium and magnesium salts, and allow for higher cycles to be achieved. Many facilities have acid-handling safety concerns that make them shy away from this alternative. None-the-less, feeding acid to a system can reduce the blowdown and makeup rates required.

RO Concentrate

If a facility has a reverse osmosis (RO) unit nearby, the concentrate (or reject) from the unit may be used for cooling tower makeup. RO concentrate is typically discharged to the drain. Reusing the concentrate could almost be considered "fee water" if this is the case. If the water is softened prior to the RO, the concentrate will be soft water. Quite often, RO concentrate is high in alkalinity though. A degassifier may be required, and care must be taken to ensure this high alkalinity soft water is not mixed with hard city or well water. High alkalinity plus hardness can result in scale on heat exchange surfaces.

Recycled Wastewater

Some wastewaters are of high enough quality to use as cooling tower makeup without any extra treatment. The RO concentrate just described is an example of this. Waters used for once-through cooling can be collected and used for makeup. It may also be possible to treat wastewater to achieve a high enough quality for cooling tower makeup. This has the double benefit of reducing the wastewater discharged from a plant and reducing the blowdown and makeup water required.

Blowdown Controller

Cooling towers are far too dynamic for manual control or for malfunctioning controllers. Having a good controller to keep the system operating at the proper conductivity will help minimize water usage and the risk of scale. Remember, if a cooling tower's conductivity is below parameters, more water is used than necessary. If the cooling tower's conductivity is above parameters, the risk of scale and corrosion increases.

Fixing Leaks

Water leaks in the process or in the cooling tower itself are uncontrolled water loses that could be considered another form of blowdown. Leaks start to become a problem when the cycles of concentration or conductivity in a cooling tower cannot be maintained. This occurs because the rate of water loss due to leaks has exceeded the rate of water loss required for blowdown. If a cooling tower system is not blowing down but is still having trouble maintaining the set conductivity, this is a sign of an excessive leak in the system. As a result, the cooling tower will also require more makeup water than it normally would.

These are the main ideas on how water usage can be minimized for cooling towers. With a little creativity, more can be found. When striving to minimize water usage, be sure to stay within the recommended operational parameters for the system.

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