

Boilers & Cooling Towers: Water Minimization

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Boilers and cooling towers are integral components of many facilities. Boilers supply steam for process heating, space heating, power generation, etc. Cooling towers provide process and equipment cooling. Both boilers and cooling towers require makeup water to function and both 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 article is to briefly list some boiler and cooling tower water saving methods that can be applied to save water, sewer, and energy costs.

Boilers

- **High Purity Water Makeup:** Pretreatment equipment such as reverse osmosis and demineralization will allow the boiler to run at higher cycles of concentration than just softened and dealkalized water alone. Running at higher cycles of concentration means the boiler can run at a higher conductivity. This will result in lower makeup water and blowdown rates and less energy consumption to heat the fresh makeup water.
- **Increase Condensate Return:** Condensate is a high-purity, high-heat content water that should be returned to the boiler system if possible. The more condensate that can be returned to the boiler, the higher the cycles of concentration will be and less blowdown, makeup, and heat energy will be required. The value of condensate can quickly pay for

the cost to fix a bad condensate pump or install new piping to get the condensate to return to the boiler system. Reducing steam leaks in a plant is another way to directly conserve water.

- **Eliminate Condensate Contamination:** Perhaps the reason condensate isn't being returned is condensate contamination. The more condensate that can be returned the better because of the value of the condensate and because boiler cycles can be increased with large amounts of returned condensate. Condensate contamination may also be the reason the boiler is run at a set conductivity. If it weren't for the contamination, the conductivity would be higher. Remember, the higher the conductivity or cycles in a boiler, the lower the makeup and blowdown rates and energy consumption.
- **Water Chemistry:** It is always a good practice to re-examine the boiler water chemistry. If the feed water quality has changed, this may directly impact the number of cycles the boiler can run. The impact may be positive or negative, but must be realized none-the-less. New chemistries may be available to allow boilers to run at higher cycles too.
- **Blowdown Controller:** Many boilers are manually blown down to control conductivity. With manual blowdown, there are times when the conductivity is below the control range and times when it is above the control range. The worse the control, the more the swings occur. Automatically controlling the blowdown on a boiler ensures the boiler runs within the set conductivity limits. This results in either water savings if the boiler was typically under cycled or improved steam quality if it was typically over cycled. Some boilers that have blowdown

controllers don't use them because they don't work properly. Crown has found that the key to a properly working blowdown controller is to have a cooled sample.

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 run 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 run 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 run 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. Running 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 running 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 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 sent down the drain. Reusing the concentrate could almost be considered "free 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 a 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

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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 running 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 losses 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 is 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 boilers and 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. Your local Water Management Consultant should be familiar with all these water-saving possibilities and can help you make the correct water saving decisions for your facility. ❖



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