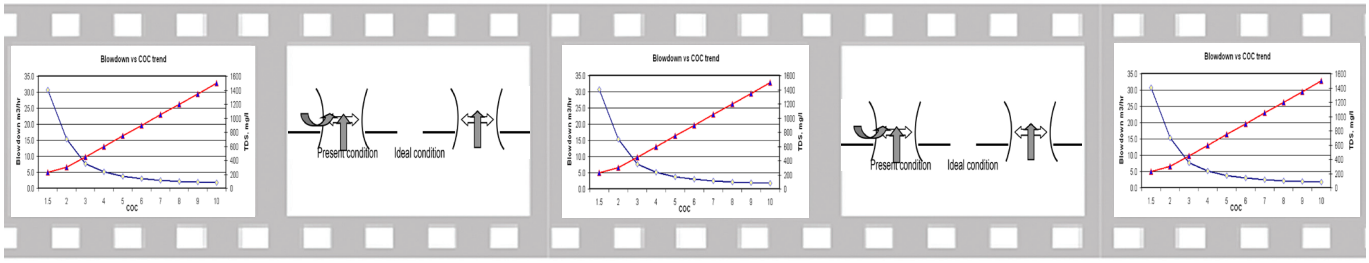
Improving Cooling And Boiler Water Systems



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By Navalkishore Kadwani

Availability of good-quality water is becoming increasingly scarce in the world, in this day and age of rapid industrialization. To add to our woes, fast and unplanned development of our metros due to the rapid growth of automotive and IT industries has increased the demand for drinking water in these areas. Available water sources like lakes and rivers are unable to keep up with this ever-growing demand, as a result of which water has become a scarce commodity in big cities, especially during summers.

To compound matters further, increased withdrawal from natural water bodies has resulted in reduction in the water levels of reservoirs which adversely affects the quality of water (increased TDS and salinity) that is supplied from them. But industries can help in dealing with the problem of water scarcity by using water efficiently in cooling towers and boilers.

When it comes to cooling towers, there are many areas where more efficient use of water can be implemented, such as:

- Maintaining optimum cycles of concentrations (COCs)
- Cooling water automation for better control and reduced water usage
- Proper maintenance of cooling towers
- Side-stream filter health checks

For boilers, water consumption can be reduced by:

- Recovering and recycling condensate
- Optimizing the cycles of operation

Let us consider cooling water systems and areas of potential improvement…

Maintaining Optimum COCs

Cycles of concentration in the cooling system give the measure of how much the makeup water is concentrated, which happens due to the evaporation process in the cooling tower. The dissolved and suspended solids in a cooling system remain behind when water evaporates while passing through the cooling tower, which reduces scaling tendencies associated with the salts present in the water. Nowadays, there are very effective polymers like High Stress Polymer (Nalco), which can reduce or eliminate the scaling potential of various scale-forming species in the cooling system at very high TDS levels. By resorting to such technology, water consumption can be reduced by operating at high COCs. Even acid consumption can be reduced by operating in the alkaline range of pH.

However, even though there are chemical solutions to reduce scale formation in cooling water, it may be prudent to operate

the systems at optimum COC levels to achieve the goal of saving water, while at the same time not stretching the system to extreme limits.

The graph in Figure 1 demonstrates the COC v/s blow-down trend for a typical cooling water system. It can be seen that at the COC levels of 6, the percentage of water saving reduces sharply. However, the TDS levels go on increasing in a proportionate manner. So, in many cases, it may not be beneficial to operate the systems at very high COCs.

Cooling Water Automation For Better Control & Reduced Water Usage

Considering the increasing cost of water and wastewater treatment, it is prudent to optimize water systems, and going for automation systems that can provide real-time monitoring and control. Nalco's 3D TRASAR technology is one such system providing state-of-the-art automation solutions for cooling-water systems designed to detect stress in the cooling system and take appropriate measures to mitigate the problem. 3D stands for Detect Determine and Diagnose, which means that online monitoring of the system on a real-time basis provides timely solutions, enabling one to take corrective actions at the earliest.

3D TRASAR technology has the capability of taking online samples and determining various important parameters such as pH, conductivity, turbidity, ORP and chemical activity levels. It also monitors other important parameters like corrosion rates on multiple metallurgies to give us an insight into the system's health.

The 3D TRASAR controller also has the ability to analyze this data, detect the system's stress levels and use the information to control the feed systems to accurately control chemical feeds. This means that the system's performance is maintained at optimum levels at all time. using 3D TRASAR technology the blow-down can be controlled by providing a control valve on the blow-down line, which means that the cooling system can be operated at the desired COC levels based on conductivity. Acid feed can also be controlled using the 3D TRASAR so that there are no pH upsets, and the cooling water system can be controlled within a narrow pH band.

Proper Maintenance

Regular maintenance of louvers and drift eliminators should also be taken in to account to reduce uncontrolled water losses from cooling towers. This not only reduces the makeup water requirement but also helps in better house-keeping of the cooling tower area.

Many a time we observe that the fan skirt provided in some of the cooling towers has a large panel missing (varying in size) at the location where the fan shaft is connected to the motor.

Whenever there is an open area available in the skirt provided around the induced draft fan, it draws air from the same, as

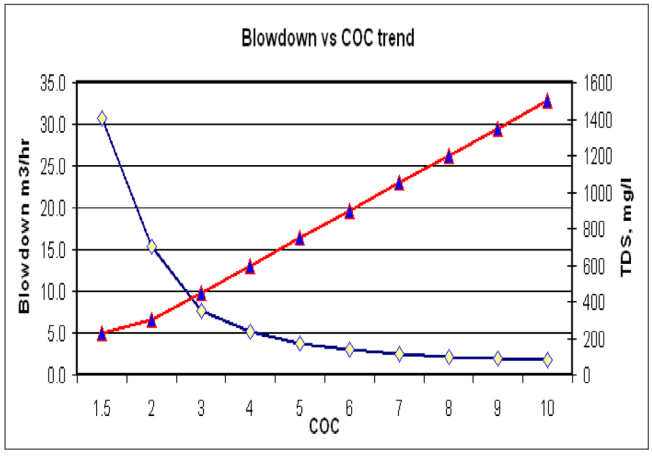


Figure 1: COC v/s Blow-Down Trend for a Typical Cooling Water System

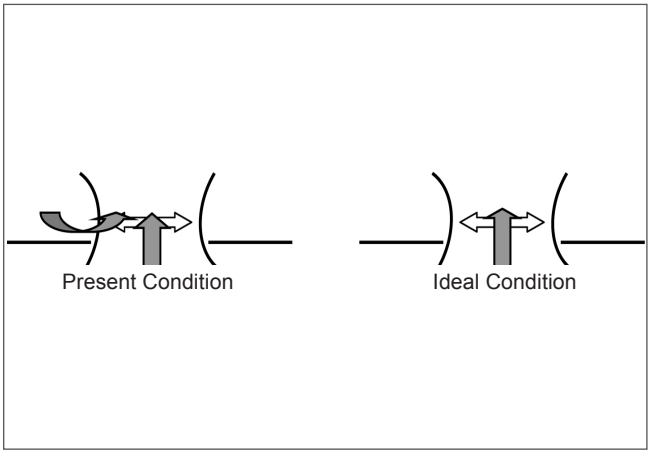


Figure 2: Fan Skirt

there is very little drop in pressure at that location, and the air flow rate from the area would be directly proportionate to the size of the opening. These open areas should be covered as it reduces the net amount of air being sucked through the side of the cooling towers, which means that it will directly impact the liquid to air ratio, thereby reducing the efficiency of the cooling tower. This can have following effects:

- Increase in water supply temperature
- Increase in energy consumption for the same heat duty

Algae grow in wet areas of the cooling tower where there is sunlight. Cooling tower decks are prone to algae growth due to the availability of sunlight, water and food (dissolved salts). If allowed to grow uncontrollably, algae can create the following problems for cooling water system:

- Formation of thick algae mat on distribution decks
- Increased oxidant (chlorine) demand
- Reduced biological control (by providing food for microorganisms)
- Plugging of heat exchanger tubes due to dead algae mass

Covering the distribution deck can help arrest the growth of algae to a large extent, which will offer benefits in terms of:

- Reduced deck cleaning
- Reduction in oxidant demand
- Improved biological control, and other benefits

Now, let us briefly look at the areas of water conservation in boilers. Boilers are one of the major consumers of water in industries as they form an important part of some processes like fertilizers and refineries. But, one can find various types and sizes of boilers in use in the manufacturing industry at present. The basic use of boilers is to produce steam, which is either to provide energy to run turbines in power plants or to supply the desired quality of steam that is required in some chemical processes.

In most applications steam is condensed in the process of heat utilization like condensing turbines, or is condensed after usage in the process. The condensate so formed in most cases is high-purity water, which can be reused in the boilers as feed. Condensate returns can help improve the operation of boilers in the following ways:

- Feed water temperature increase: By increasing the feed water temperature a plant can reduce the fuel required to convert one kilogram of water into steam.
- Cycles of concentration: Since the condensate is low in dissolved solids, the more returned, the lower the concentration of dissolved solids. This will help increase the boiler cycles of concentration thereby reducing the blow-down, which means a lower amount of heat lost through the blow-down.
- Reduced makeup water requirement: As more condensate is recycled, less makeup is required for the feed water, which means lower cost of pre-treatment (ion exchange, regeneration of chemicals, etc.).

Although there is economic benefit in recycling the condensate, there are problems associated with the same. Condensate may come back with impurities, which can create problems in the boiler system, like; corrosion products from the condensate lines or high TDS in case of condenser tube leakage. One needs to ensure that a capable condensate corrosion control program is in place to ensure that the corrosion products generated are minimized. A foolproof monitoring system, which will detect condenser tube leakage and warn the operator in case of any deviations, is also required.

The benefits of proper maintenance are quite clear, be they in recycling the condensate, in terms of improved energy efficiency and reduced water consumption.

Summary

To sum up, we can say that there are many areas of possible improvement in a typical industrial cooling and boiler water system, which if properly managed can help reduce water consumption and improve system performance. With advancement in technology of automation systems that can provide round-the-clock monitoring and control for cooling systems, which in turn helps to reduce industrial water usage.

With effective utilization of water, industry can support the government in meeting growth objectives while at the same time preserving the environment for future generations.

Case Study

16 Million Gallons Of Water Saved

3D TRASAR® Program Provides Over $110K Annual Savings for Luxury Hotel

A luxury hotel in Mumbai, India, was looking for a chemical treatment program that would reduce condenser tube fouling, reuse sewage treated water, and decrease energy consumption.

Background

The Renaissance Mumbai Convention Centre Hotel and Marriott Executive Apartments, a Marriott-owned property, was experiencing significant condenser tube fouling, which was resulting in increase in, both, the approach temperature and the energy requirements of its 1400-ton chiller system. In fact, the fouling was so bad that the approach temperature increased an average of 7.5 degrees Celsius. In addition, the kilowatt per ton had increased to an average of 0.74 due to the fouling.

Program

In an effort to help the hotel achieve its operating goals, Nalco used its Optimizer software to analyze the operating data for the hotel makeup water used in the cooling system. This data led Nalco to recommend a trial of its 3D TRASAR program. The program included: PSO chemistry, non oxidizing biocide, oxidizing biocide and an algaecide. The recommended Nalco 3D TRASAR program was run on a trial basis from April 2008 to March 2009.

The 3D TRASAR system incorporates chemistry, algorithms, hardware and software, which perform together to provide optimal control of a cooling water system. The system works proactively to prevent the formation of scale, corrosion, and equipment fouling or malfunction, before it occurs. A fluorescent particle on treatment chemicals allows the system to continuously monitor and adjust chemical consumption for optimal use. The 3D TRASAR program detects the upsets that precede scaling, corrosion and biofouling and then delivers the appropriate chemical response. The result is a balanced, efficient and safe cooling system. Less maintenance, no over or under-dosing of chemicals, lower operating costs and maximum asset protection are the key deliverables.

Economic Impact

During the 12-month trial, the Nalco program provided outstanding operating results for the hotel. The program addressed the customer's concerns with operating efficiency due to condenser tube fouling.
Specific program results of the trial program include:

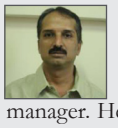
- The approach temperature was decreased from an average of 7.5°C. to 4.5°C.
- The kilowatt per ton decreased 12% from 0.74 to 0.65.
- STP water was used as the makeup water. This reduced consumption of fresh water by 15.85 million gallons (60,000 cubic meters) annually.
- Condenser tube fouling was nearly eliminated. In fact, no condenser cleaning had been required for the last 12 months. This represented an annual savings of $2,200.
- Increased ease of operation with continuous chemical feed and monitoring.

Environmental Impact

The Marriott Corporation has adopted a proactive approach for reducing environmental adversities through its operating initiatives. The Nalco program implemented at the Renaissance Hotel allowed the facility to conserve nearly 16 million gallons of water annually by reusing sewage treated water. This conservation effort represents annual savings of over $48,000. In addition, approximately 600,000 kWh were conserved annually, reducing electricity expenses by nearly $60,000.

The 3D TRASAR program provided a value-added solution with significant economic and environmental benefits for the Renaissance hotel.

About The Author



Mr. Navalkishore Kadwani, is the Industrial Technical Consultant at NLC Nalco. Mr. Kadwani joined NLC Nalco in 1994 as an Application manager. He did his BE Chemical from the Bombay University in 1989. http://www.nalco.com/