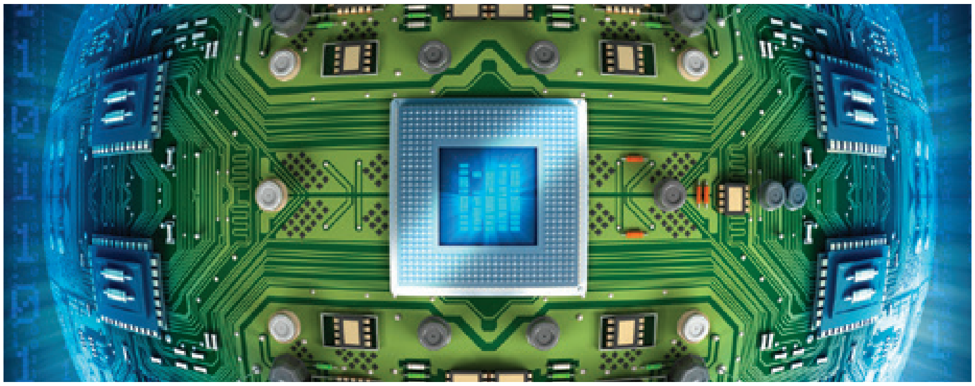
CASE STUDY

Microelectronics company saves more than just data with Nalco Water

eROI[SM] by Ecolab



BACKGROUND

The environment in which computer servers and other high tech equipment are assembled requires excellent air quality control (temperature, relative humidity and particle counts).

Two of the most important elements in a facility's environmental control complex are the chiller/cooling tower systems (which supply chilled water) and the air handlers (which are the interface between chilled water and facility air).

Good control of this environment benefits a facility in several ways:

- Water savings
- Energy savings
- Reduction of greenhouse gas generation
- Optimized labor use for controlling and maintaining the environmental control systems
- Extended equipment life
- Reduced risk of manufacturing climate upset resulting in out-of-spec product for the manufacturer

SITUATION

The customer is a leading manufacturer of data storage equipment. They have facilities throughout the eastern and northeastern US. Since 2005, the customer has worked with Nalco Water to continuously improve the operation of the climate control systems in their facilities.

The customer's climate management strategy included four goals:

- Reduce emissions from operations
- Reduce emissions in supply chain
- Reduce energy demand in customers' IT infrastructures
- Reduce global energy demand

There are three key areas around which the working relationship between Nalco Water and the customer is centered: water savings, energy savings and sustainability.

ANNUAL SAVINGS

WATER

Water savings of

7 million gallons

per year

ENERGY

5,170,979 kWh

per year in reduced energy costs from cleaner air coils

GREENHOUSE GASES

Reduced CO_2 emissions by

3,369 tons

per year

ASSETS

Avoided

$55,000

in equipment replacement costs

VALUE DELIVERED

$459,137

NALCO Water
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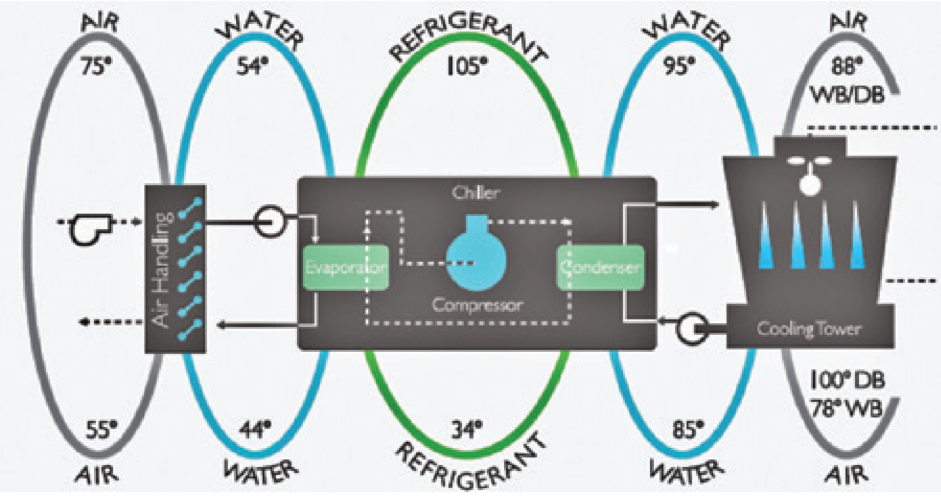

FIGURE 1: SHOWS HOW THE AIR/WATER INTERFACE OPERATES IN A TYPICAL MANUFACTURING HVAC SYSTEM

WATER SAVINGS

Other than sanitary and landscaping uses, cooling towers are often the largest water users for a large industrial complex such as this. The cooling towers remove heat from the chillers, which in turn remove heat from the air handlers, which control the heat load in the manufacturing and office spaces.

The investment in the HVAC system for a facility of this size is typically millions of dollars. Clearly, protecting that asset is important to the customer. At the same time, reducing water consumption, as long as risk is minimized, is also an important goal.

Facilities typically face four water-related challenges with their cooling towers:

Corrosion – The destructive process which returns refined metals used (from which heat exchangers, piping and chillers are made) to their natural oxidized state. This process damages equipment and shortens asset life.

Microbial fouling – The uncontrolled growth of undesirable microbes, some of which can excrete corrosive metabolic by-products, and insulating slime layers. These can corrode system metallurgy and cause system efficiency losses.

Scale – The exceeding of solubility limits of certain minerals. This forms mineral scale, which inhibits good heat transfer, and compromises system efficiency.

Fouling – Air-entrained materials building up on heat exchange surfaces.

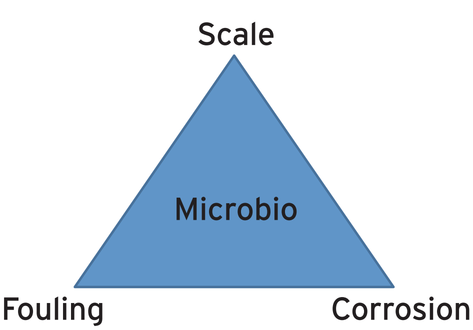

FIGURE 2: THE FOUR COMMON, INTERRELATED COOLING WATER CHALLENGES ARE CORROSION, MICROBIO, SCALE AND FOULING

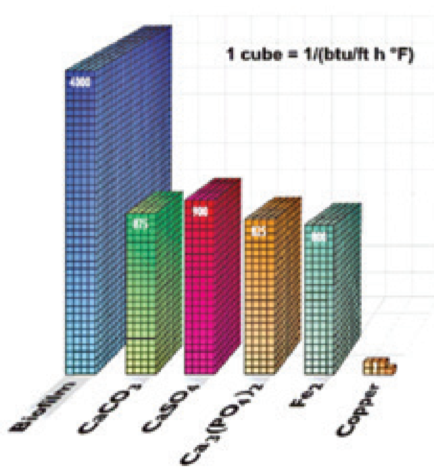

FIGURE 3: MICROBIAL BIOFILMS AND COMMON SCALE GREATLY REDUCE THE HEAT TRANSFER EFFICIENCY OF ANY HEAT EXCHANGE SURFACE

These stresses can be exacerbated by varying water quality, high temperatures and other factors.

A good water treatment program controls these challenges adaptively, minimizing risk and maximizing water conservation.

Here are two examples of the water savings achieved by the working relationship between the customer and Nalco Water:

Water savings through cycles optimization – The water at one of the customer's facilities is supplied by wells. Well water is often hard water (contains high levels of calcium and magnesium). Even with a good cooling water treatment program, hard water can limit the cycles of concentration (CoC) (a measure of how many times the water is used prior to leaving the cooling tower via blowdown). Exceeding the solubility of the calcium and magnesium in the water can lead to scale, which prevents efficient heat transfer and increases operating costs by requiring more electrical energy to produce the same amount of chilled water.

Over time, the level of hardness in the well water had increased. To help improve the water profile at the facility, Nalco Water recommended softening the water (using ion exchange to remove the majority of the calcium and magnesium).

Outcome

- Blowdown from the cooling towers will be reduced by 7,000,000 gallons annually
- Estimated sewer cost reduction $61,000 per year

There would also be a reduction in cooling tower chemistry usage, because the cooling towers will be operating at higher cycles of concentration. The first-year ROI is estimated to be $33,000. Second-year ROI is projected to be $72,000.

Water savings through prevention of out-of-control conditions in the cooling tower – One of the technologies used at the customer facility is Nalco Water 3D TRASAR™ automation. This is a collection of monitoring and control technologies as well as innovative cooling water chemistry and 24/7 expert remote monitoring. This program helps the customer avoid out-of-control scenarios on a continuous basis. This technology has enabled the customer to reduce water consumption and minimize the risk of poor performance. In the graph (Figure 4), one can see how the cycles of concentration have been increased over time. At the same time, as a result of the 24/7 monitoring and control capabilities of 3D TRASAR Technology for Cooling Water, corrosion control is still world-class. (Figure 5).

To translate this benefit: If a cooling tower had a 12,000 gpm recirculating rate, and ΔT of 10°F – at a CoC of 4, the tower would use approximately 87 million gallons of water annually, and blowdown (discharge) approximately 21.5 million gallons of water annually.

That same tower, operating at a CoC of 7, would use approximately 76 million gallons of water annually, and blowdown 10.5 million gallons of water per year – more than a 50% reduction in discharge. Furthermore, this reduction in water consumption and sewer volume was achieved with no increased risk to the chiller asset.

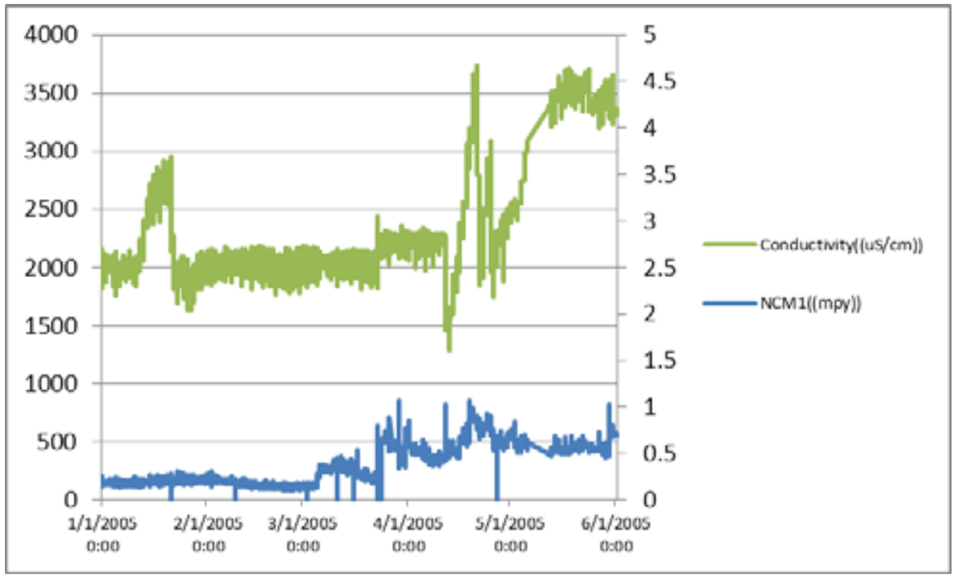

FIGURE 4: SHOWS HOW THE TECHNOLOGY ALLOWS HIGHER CYCLES OF CONCENTRATION, RESULTING IN REDUCED WATER USE

Corrosion Rate (mpy)		
Carbon Steel	Copper Base Alloys	Description
<1	< 0.1	Excellent
1 to 3	0.1 to 0.25	Very good
3 to 5	0.25 to 0.35	Good
5 to 8	0.35 to 0.5	Fair
8 to 10	0.5 to 1	Poor
>10	>1	Severe

FIGURE 5: QUANTITATIVE CLASSIFICATION OF CORROSION RATES

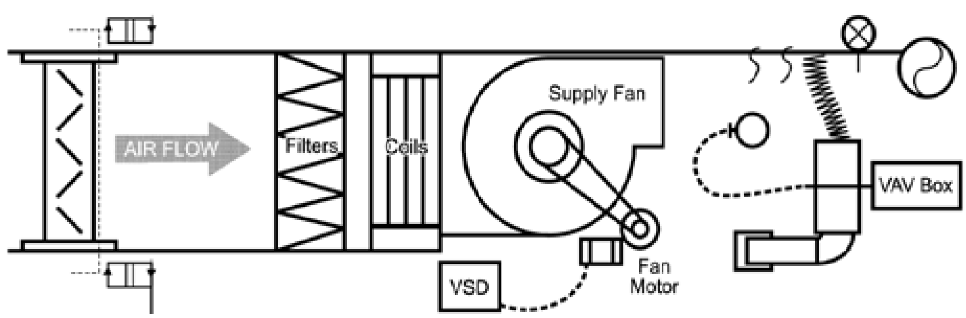

FIGURE 6: SHOWS A TYPICAL AIR HANDLER CONFIGURATION

ENERGY SAVINGS

Air handlers - The experienced facilities engineer is well aware that the chiller and air handler systems are large energy consumers. In addition to the energy-wasting, water-based challenges of scale and microbio fouling mentioned earlier, air handlers are also prone to efficiency-robbing fouling and dirt. Air handlers operate by moving air through filters and across heat-exchange coils to cool or warm the air; this adjusts the air's relative humidity and/or temperature.

As with any other heat exchange surface, the cleanliness of the coil has a direct impact on the efficiency of that heat-exchange process.

The filters used in these air handlers also provide an optimization opportunity, if the task is properly approached. Here's how Nalco Water and the customer have tackled these challenges:

There are more than 200 air handlers at the customer's facilities. Using Nalco Water's COIL-FLO™ cleaning process, the coils in the air handlers were cleaned. This method, which uses a patented low-water volume, medium-pressure cleaning solution, has distinct advantages over other commonly used techniques:

- It is more effective than high-pressure water in that it reduces the potential for tube fin damage, and avoids driving the dirt into the coil pack, resulting in incomplete cleaning
- It is better than using low-pressure water, which is usually ineffective for very dirty coils – this also often results in driving dirt into the pack
- Aggressive chemicals which can accelerate coil metal loss, and deceptively make the coils look shiny, but not actually cleaner

A fundamental aspect of the COIL-FLO process is that representative air coils at a facility are measured for efficiency prior to cleaning, and re-measured after the cleaning. These results are then used in a calculating spreadsheet to determine the energy savings achieved.

An example shown is from the customer's utilization of the COIL-FLO program at its 1,284,000 ft^2 campus.

Outcome

- Avg. 0.67 in. static pressure reduction (H_2O)
- 8,760 hours operation per year
- Avg. 36.67 kw/hr saved
- $122,197 per year minimum annual electrical savings
- CO_2 reduction: 1,682,474 lbs/year

Figure 7 shows an example cleaning in process, and Figure 8 shows an example of the before-and-after data comparison of energy consumption and reduced pressure loss through the filter bank.

FIGURE 7: IS A TYPICAL CLEANING IN PROCESS

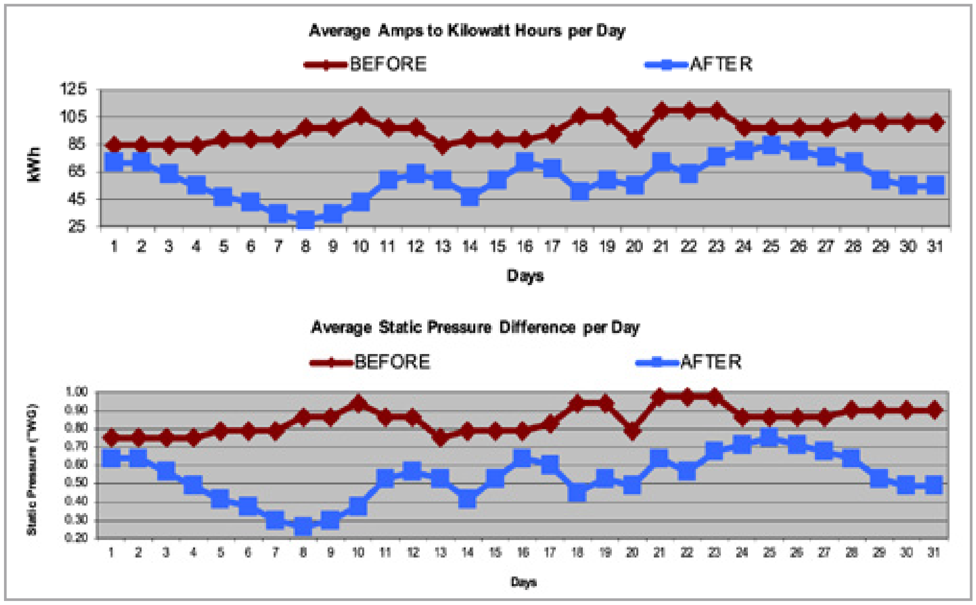

FIGURE 8: BEFORE-AND-AFTER DATA COMPARISON

Chiller efficiency improvement by scale removal and prevention – Another example of energy savings generated by this working partnership and innovative solutions is the silica removal process created by Nalco Water and used by the customer at two of its facilities.

Silica scale is a particularly tenacious scale – until recently, there were a limited number of ways it could be removed – hot hydrochloric acid, ammonium bifluoride or hydrofluoric acid. These approaches are very dangerous, and potentially corrosive to base metal.

Many local municipalities use silica corrosion inhibitors as an approved corrosion inhibitor in potable water systems. In some cases, poor control of inhibitor feed can result in silica scale. This was the case at two of the customer's facilities. The resulting silica scale was 3/16" thick in some locations (Figure 9). The resulting energy inefficiency impact was a temperature drop of only 3°F (design was 13°F). Conventional tube brushing and an acid cleaning had been attempted to no effect. The other alternative was to re-tube the heat exchanger, at an estimated cost of tens of thousands of dollars. Nalco Water developed another alternative, a process that is much less hazardous, and nearly non-corrosive.

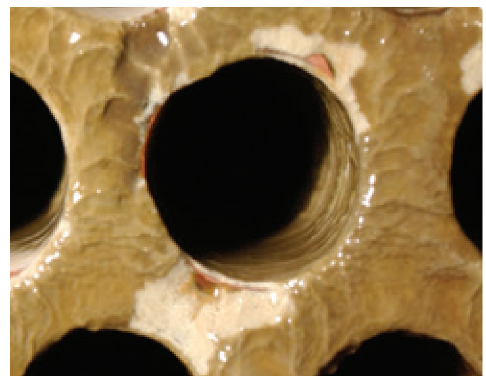

FIGURE 9: HEAVY SILICA DEPOSIT IMPEDED EFFICIENT HEAT TRANSFER IN THIS CHILLER

FIGURE 10: AFTER THE CLEANING, THE CHILLER'S HEAT EXCHANGE EFFICIENCY WAS COMPLETELY RESTORED

The technology entirely removed the deposit in some areas, or so substantially softened it that it could be removed from the chiller just by brushing. Corrosion during the cleaning was essentially zero on mild steel and copper. Figure 10 was the photo taken after the cleaning.

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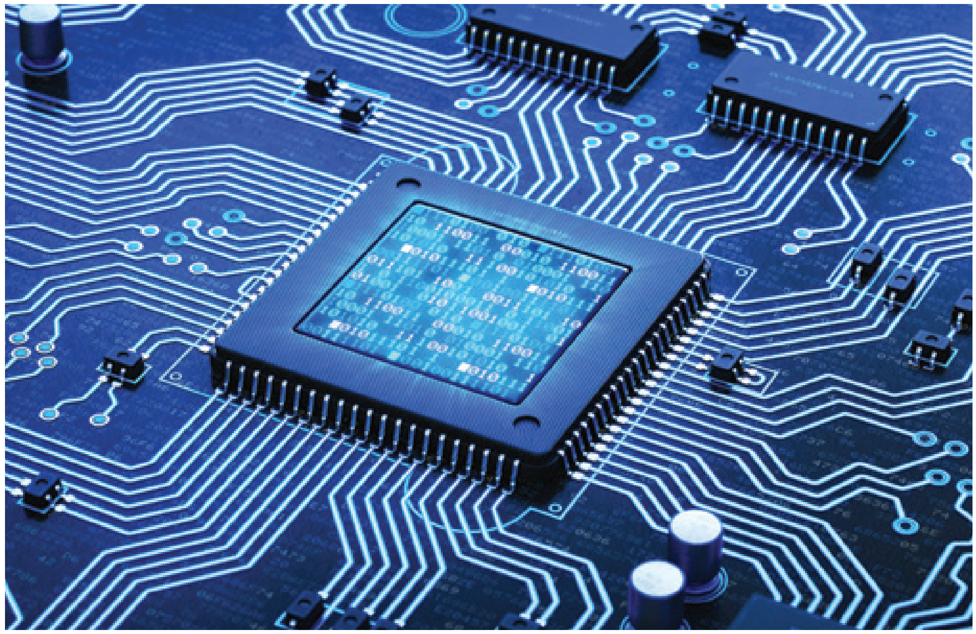
Outcome

Cost avoidance: The condenser bundle did not have to be replaced: $55,000.



SUSTAINABILITY

The combination of the water savings through the Nalco Water 3D TRASAR Cooling Water program, the energy savings on the air handlers via the HVAC performance and the optimized air filtration has resulted in the following positive environmental impacts:

Outcome

- Greenhouse gas generation reduction from this work has exceeded 3,369 tons to date
- Reduced energy consumption to date by 5,170,979 Kwh/year
- Water savings

SUMMARY

The concept of understanding the entire air / water / energy interface in a typical HVAC-air handler system, combined with solid measurement techniques, good baseline data capture and continuing advances in water treatment and air handler cleaning can generate tremendous savings in water, energy and greenhouse gas production. At the same time, through proper data management, risks can be minimized and performance assured.

Nalco Water, an Ecolab Company

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