Case History Report – HighCycle Product 6218 B
Cooling Tower System Water Use Reduction

CHR 0511

Traditional treatment for operation of a cooling tower with hard alkaline makeup water used acid to control scale via adjustment of the cooling water pH into a non-scaling range with phosphate used to control corrosion. While this chemistry has been successful in many applications, the use of phosphate in cooling waters has been restricted in many areas due to environmental considerations while the use of acid is not advised due to environmental restrictions (SARA Title III), pH control problems resulting in severe corrosion damage, and the substantial health and safety risk (OSHA) involved. The water management industry has responded to this challenge by developing phosphonate-polymer programs which give acceptable results without use of acid.

Corrosion proof Delta cooling tower

HighCycle Water Treatment

Our firm has invented patent pending* scale control products that allow cooling towers to be operated at least two (2) cycles of concentration (COC) higher than typical phosphonate-polymer water treatment programs. One of the best monitored HighCycle programs in the country is a semiconductor plant located in Mesa, Arizona. Prior to the HighCycle program, plant cooling towers were operated using a typical phosphonate-polymer treatment program and averaged 2.3 COC.

HighCycle differs from all other water treatment programs in that makeup water calcium hardness (CaH) and total alkalinity (TA) are used to calculate the desired COC on every service call. The cooling tower blowdown controller is then reset to this calculated COC to compensate for the varying water quality of many water supplies. The equation used is:

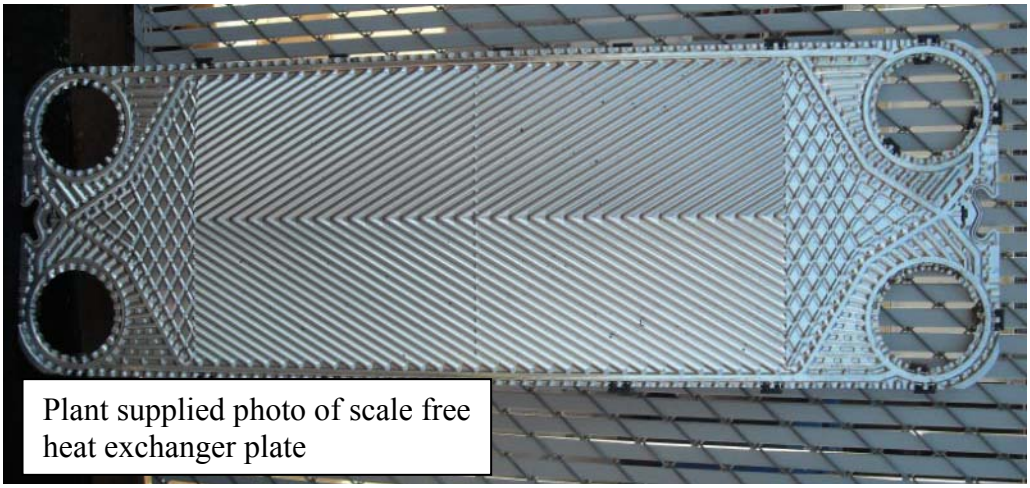
$$COC = 2 + \sqrt{\frac{110{,}000}{CaH \times TA}}$$

Applying this equation to the city water makeup at the Mesa plant over the ten (10) month period evaluated for this report, an average COC of 4.3 for a HighCycle program was obtained. From the service reports, the plant cooling towers were operated at an average of 4.2 since start-up of the HighCycle program, showing that the calculated COC can be obtained in operating systems. This is an average increase of 1.9 COC from the typical program in use prior to the HighCycle program

Cooling towers using the HighCycle program are evaluated on every service call where the conductivity, CaH, and TA results are determined on the makeup water and each cooling tower used to calculate COC values for these three parameters. A simple comparison of these calculated COC values, they should all be the same within test method error limits, shows if the cooling towers are forming scale or not. In the ten month HighCycle program period evaluated for this report, the cooling towers were determined to be non-scaling almost 100% of the time.

HighCycle Performance

The Mesa semiconductor plant, being a cooling dependent industrial operation, checks the condition of its cooling systems via routine maintenance procedures such as shutting down and inspecting the heat exchangers between the process cooling loops and cooling towers. In the past (with another program supplier), they have had extensive scale formation on the cooling water side of these units. During the last inspection, they were very pleased to find that several new plates, installed about the time that the HighCycle program was started, were completely scale free.



Plant supplied photo of scale free heat exchanger plate

HighCycle Water Savings

This plant operates with a 1,700 ton annual thermal load giving an evaporation rate of 16,474,275 gal/yr with blowdown to sewer of 12,672,519 gal/yr at the previous 2.3 COC. With conversion to a HighCycle program, the average COC increased to 4.2, reducing the blowdown to 5,148,211 gal/yr for a **7,524,308 gal/yr water use reduction.**

With a combined water/sewer rate of $5.772/1000 gallons, this water use reduction saved the plant approximately $43,430 per year in decreased water and sewer charges. This cost reduction was obtained at no additional cost to the plant as the cost of the HighCycle program is the same as that for a typical program.

Of equal importance, the HighCycle program kept the plant heat exchangers, plate and condenser, scale free while operating at the water saving increased COC, keeping energy costs at the lowest possible value.

HighCycle Corrosion Control
We routinely monitor the corrosion rates in the plant cooling towers by use of corrosion coupons. The corrosion rates operating a HighCycle program at this facility averages 1.18 mil/yr for steel and 0.12 mil/yr for copper. These are considered excellent results.

Makeup Water Analysis
The following is a typical analysis of the makeup water supplied to this plant.

Parameter	Result	Parameter	Result
pH	8.0	total alkalinity mg/l	125
conductivity mmhos	1,021	calcium mg/l	76.6
magnesium mg/l	26.0	iron mg/l	<0.03
copper mg/l	0.26	zinc mg/l	0.107
silicon mg/l	3.2	chloride mg/l	153
sulfate mg/l	219	total phosphate mg/l	0.31
total hardness mg/l	298.3	LSI @ 100 F	+0.7

Program Dosage Control
Typical phosphonate-polymer water treatment products present a challenge in that the active components are not readily analyzed in field testing with any real accuracy. All HighCycle products employ our patented* **BlueTrace tm** colorant tracer technology for cost effective, easy, and accurate field testing resulting in superior control of product dosage.

Environmental
The environmental, or **"green"** profile of HighCycle products shows that all the components are readily biodegradable with low toxicity values. Use of this product at recommended dosages thus presents no problems as to environmental degradation or pollution. A substantial **"green"** benefit was obtained by the plant via use of HighCycle operation of the cooling towers at higher COC resulting in a substantial reduction in water use and wastewater discharge.

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***US patent pending application 13/098,084 and BlueTrace US patent 7,932,091**