

# Case History Report – Extended Operation of a Cooling Tower System with Softened Makeup Water

CHR 1209

## **Problem**

A large plastic injection moulding plant was experiencing severe scale formation in critical heat exchangers of their moulding presses leading to costly downtime and expensive acid cleaning for scale removal. While a well known large water management firm was handling the water management program and had made several chemistry program changes to remediate the problem, the scale problem had continued to upset plant operations in spite of the changes.

## **Solution**

ProChemTech was requested to investigate the problem on a competitive basis. Following an evaluation of the makeup water quality and plant cooling water system; a new water management program based on use of softened makeup water with appropriate water treatment chemistry was proposed. As softening the makeup water removed all scale forming minerals from the cooling water, the major problem that the new program had to address was the increased corrosivity resulting from cycling of soft water in the cooling tower system. ProChemTech SofTek<sup>™</sup> water treatment chemistry was specified to control the known corrosivity problems resultant from use of softened makeup water as it is designed to provide corrosion free operation of cooling towers at high dissolved solids levels with completely soft makeup water.

Following acceptance of the proposal, ProChemTech supplied water softener equipment was installed in early 2002 for 100% softening of cooling tower makeup water. The ProChemTech SofTek water management program was implemented following equipment installation and startup.

## **System Information**

The cooling tower system consisted of five galvanized steel, plastic fill cross flow units of 400 tons capacity each banked as one system with a typical load of 1200 tons. The water management program when reviewed consisted of pH control using sulfuric acid with a control point of 7.0, a molybdate traced phosphonate-phosphate based corrosion and scale inhibitor with hydantoin bromine tablets and glutaraldehyde used as alternating biocides, each slug dosed once a week. Cycles of concentration (COC) were maintained at three (3) and analysis of water samples taken during the review indicated that steel and copper corrosion rates were excessive given the levels found in the cooling water. A bypass sand filter was installed with blowdown controlled by conductivity and chemical inhibitor was fed proportional to makeup.

The new ProChemTech water management program utilized a single SofTek inhibitor with a single oxidizing biocide, PCT 3026 - n,n,dibromosulfamate, with COC maintained at six (6). Two changes have been made in the program since start-up; elimination of molybdate from the inhibitor formulation due to cost and addition of BlueTrace<sup>™</sup> to the inhibitor as an easy to test for control tracer.

## **Results**

Following conversion to softened makeup water and a ProChemTech water management program, the plant cooling tower system has operated with no scale problems. The following table compares some makeup water, acid program cooling water, and soft cooling water program analytical results.

Parameter	makeup water	acid program	soft program
pH	7.7	6.9	8.7
total alkalinity mg/l	148	34	720
conductivity mmhos	300	810	1900
total hardness mg/l	155	491	2
molybdenum mg/l	-	4.8	0
iron mg/l	0.05	0.29	0.38
cycles – conductivity	-	2.7	6.3

As corrosion is the major concern when operating with cycled soft water, corrosion monitoring using NACE corrosion coupons has been continuous since start-up. The following table summarizes corrosion coupon results obtained during the past three + years of operation (7/04 to 3/08).

coupon material	number tested	average mil/yr	minimum mil/yr	maximum mil/yr
C1010 steel	27	0.75	0.2	2.4
CDA 110 copper	14	0.054	0.03	0.11
CDA 260 brass	14	0.077	0.02	0.23

The steel corrosion results are substantially better than the 2 mils/yr which is commonly accepted in the water management industry as excellent control. Both the copper and brass rates are also well below the 0.15 mil/yr which is considered excellent corrosion control for these metals.

In addition to completely resolving the previous scale problem while obtaining excellent control of corrosion, the SofTek water management program has also doubled the COC obtained in the cooling system from three (3) to six (6), cutting the system blowdown by 50%, reducing costs for both water and sewerage. Another side benefit obtained was elimination of hazardous acid use for pH control and acid cleaning.

The exclusive ProChemTech SofTek water chemistry had its beginnings in 1984, when softened makeup water was used to address severe scale problems on recirculating cooling tower systems providing cooling water to large, very high temperature glass melting furnaces. Application of softened makeup water eliminated the scale problem, but caused severe corrosion problems. Our continued R&D on use of softened cooling tower makeup water to reduce water use was awarded a US patent, #7,595,000, "Operation of Cooling Towers with Minimal or No Blowdown", in 2009, which incorporates SofTek chemistry.

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