

Case History Report

PCT 6231B - Operation of a Cooling Tower System with Hard Alkaline Corrosive Makeup Water

CHR 11/06

Traditional chemistry for operation of a cooling system with hard alkaline makeup water has been based on use of 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 very 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), control issues, and the substantial health and safety risk (OSHA) involved. The water management industry has responded to this challenge by developing phosphonate-polymer base programs, which generally give acceptable results without use of acid pH adjustment. However, some waters are both very scaling, high hardness and alkalinity, and have high levels of both chloride and sulfate, which substantially increase the corrosivity of the cycled water to the point where the phosphonate-polymer chemistry does not provide acceptable corrosion control.

ProChemTech was retained to provide a water management program for a new facility in the Phoenix, Arizona, area equipped with two stainless steel EVAPCO AT type counterflow cooling towers in HVAC chiller service. Due to the makeup water being very hard and alkaline with high levels of both chloride and sulfate; we found that the typical phosphonate-polymer chemistry used in non-acid treatment of hard alkaline waters did not produce acceptable results as to corrosion control, approximately 5 mil/yr on mild steel corrosion coupons. We then proceeded to develop a new complex phosphonate-polymer base product to address the corrosion problem while still providing excellent scale control under difficult conditions. The following picture is of the condenser tube bundle in one chiller after two months service with the new product, PCT 6231B.



Corrosion rates on mild steel have been reduced to below 2 mil/yr, while copper and brass are below 0.1 mil/yr. These corrosion rates are generally considered excellent in the water

management industry.

Analysis of the makeup and cycled cooling water provides further confirmation of the effectiveness of this new product with hard alkaline corrosive makeup water as to scale control.

Parameter	Makeup water	Cooling water
pH	8.0	8.8
total alkalinity mg/l as CaCO ₃	123	380
conductivity as mmhos	1102	2930
calcium mg/l as Ca	65.1	210
magnesium mg/l as Mg	27.1	87.7
Ca:Mg ratio	2.4	2.4
chloride mg/l as Cl	132	410
sulfate mg/l as SO ₄	256	468
total hardness mg/l as CaCO ₃	275	887
cycles on Mg		3.2
saturation index 100 F	+0.64	+2.4
Larson-Skold corrosion index	3.15	3.15

The new product is also economical to use, the above results were obtained operating at a dosage range of 150 to 200 mg/l as product, which is similar to that of most phosphonate-polymer cooling water inhibitors.

All phosphonate-polymer based water treatment products present a challenge in that the active components are not readily analyzed in field testing with any real accuracy. Typically molybdate has been added to such products to permit easy, accurate field testing. Molybdate, however, is being subjected to increased environmental restrictions and has recently increased in cost by a factor of four. In response to these problems, ProChemTech developed our patent pending **BlueTrace**™ colorant tracer technology for cost effective, easy, and accurate field testing. This technology has been incorporated into PCT 6231B to eliminate the environmental and cost problems with molybdate while providing for accurate product dosage control.

Looking at the environmental, or “green” profile of this new complex phosphonate-polymer product, we find 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. In addition, a substantial “green” benefit is obtained via use of this product in that cooling systems can be operated at high cycled saturation indexes, which allows higher cycles of concentration to be obtained. Operation at higher cycles substantially reduces both blowdown and makeup water requirements, and costs, and conserves fresh water.

ProChemTech International, Inc.
"The Water Management Company"
814-265-0959 www.prochemtech.com