

Technology Application Bulletin

Corrosive Makeup Water

3/04

Background

While the levels of corrosive anions, chloride and sulfate, present must also be considered, any water with a saturation index of less than -0.5 is generally considered to be corrosive. Such waters occur naturally in many areas of the country and are also produced by the processes of air washing, softening, reverse osmosis, deionization, and wastewater treatment. Disposal problems created by environmental restrictions, coupled with severe water shortages in some areas, have created a need to utilize corrosive waters as makeup to cooling systems. Of course, while rare, some areas have always had only corrosive water available, while air washers generate corrosive water during humid weather.



Corrosive water use results in rapid corrosion damage to equipment due to metal loss and plugging problems from deposition of corrosion products. Standard industrial water treatment technology is geared towards prevention of scale using phosphonates and polymers, with corrosion control based upon operating with a positive saturation index. Unfortunately, this technology **will not work** with many corrosive waters, as verified by our examination of many severely corroded cooling systems and air washers since 1973.

Technology Application

The ProChemTech technical center is located in an area of the country which has naturally corrosive waters, saturation index values of the local water supplies range from as low as -4.5 to a high of -2.0. In addition, ProChemTech personnel originated the use of corrosive softened makeup water for industrial cooling systems in 1984 as a positive means for elimination of scale in high temperature glass furnace cooling jackets. Due to these circumstances, the firm has developed a unique group of proven chemical products, the PCT 6400 series, which control corrosion in corrosive makeup water cooling systems and air washers. The chemistry utilized is based on **environmentally acceptable** combinations of polysilicates, molybdate, polyphosphates, phosphonates, azoles, **ZincGard™**, zinc, and polydiols; with appropriate polymers for deposition control. All of the products are liquid blends designed for direct product feed from the shipping container into the water to be treated.

ProChemTech corrosion control technology has been successfully utilized in systems using deionized water makeup to systems operating with saturated salt brine as the working fluid.

Acceptable Corrosion Control

It is a fact that corrosion cannot be eliminated, only controlled, in which case what is an acceptable corrosion rate in a cooling system? The USEPA has discussed this issue in a background document on cooling water treatment and defined corrosion rates in mil/yr as follows:

Term	Mild Steel	Copper and Alloys
Negligible	< 2.0	< 0.15
Mild	2.0 to 5.0	0.15 to 0.20
Moderate	5.0 to 10.0	0.20 to 0.35
Severe	> 10.0	> 0.35

Based on our many years of success, ProChemTech has set higher standards, our objective is to provide a maximum mild steel corrosion rate of 2.0 mil/yr, with copper and its alloys at a maximum of 0.1 mil/yr. In addition, with our proprietary **ZincGard**™ chemistry for control of white rust corrosion of galvanize, we believe that a maximum zinc corrosion rate of 3 mil/yr is reasonable.

Case History #1 - Natural Soft, Corrosive Water

A major sintered metal part manufacturer had operated a 1200 ton cooling system with a standard, phosphonate/polymer, water treatment program from a major supplier for approximately ten years using makeup with a saturation index of -2.2 to -3.6.

Corrosion rates were reported to be between 7 and 12 mils/yr using standard C1010 mild steel test coupons, with severe system corrosion damage and deposition of corrosion products observed.

Use of PCT 6421 was initiated in 1989 along with installation of a PCT manufactured makeup proportional blowdown and chemical feed system. Corrosion rates on mild steel coupons have been reduced to a long term average of 0.77 mil/yr, with copper at 0.05 mil/yr and brass at 0.10 mil/yr. The plant reports that corrosion and corrosion related deposition problems have totally disappeared. Typical water analysis results for this facility are as follows:

Parameter	Makeup	Cooling Tower
pH su	6.30	7.23
total alkalinity mg/l	3	88
conductivity mmhos	72	691
calcium mg/l	6.0	24.0
magnesium mg/l	1.4	6.4
iron mg/l	0.16	1.50
copper mg/l	0.02	0.03
chloride mg/l	4	94
sulfate mg/l	1	15.2
cycles		9.5
saturation index 100 F	-3.55	-0.64

Case History #2 - Softened Alkaline Hard Water

A major university installed a small cooling tower to service an experimental high temperature metal/ceramic sintering furnace. As the entire cooling tower system was supplied by our firm, we were given the water treatment business in order to maintain the exclusive ProChemTech five (5) year warranty against corrosion damage.



Given the potential for major damage with any scale formation, the makeup water was cation softened. As the water was very alkaline when cycled up, we selected PCT 6422, a **ZincGard**™ containing product, as the inhibitor with PCT 3014, a non-oxidizing product, as the biocide. A PCT manufactured makeup proportional blowdown and chemical feed system was used for system chemistry control. A recent set of corrosion coupons from this cooling tower showed the following corrosion rates:

Coupon Type	Corrosion Rate
C 1010 mild steel	0.3 mil/yr
CDA 110 copper	0.2 mil/yr
CDA 260 brass	0.3 mil/yr
zinc	2.1 mil/yr

Relevant analytical data for this facility are as follows:

Parameter	Makeup	Cooling Tower
pH su	7.49	8.69
total alkalinity mg/l	171	870
conductivity mmhos	458	2350
cycles		5.1

Since this water is high pH and very alkaline when cycled, typically we would expect zinc corrosion rates of 10 to 15 mil/yr due to white rust. However, the **ZincGard**™ in the specified product has held the zinc corrosion rate down to an acceptable 2.1 mil/yr.

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