

Case Histories of Using Tin Technology to Control Corrosion in Water Systems

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Tin is emerging as a cost-effective and environmentally-friendly technology to control corrosion. These case histories demonstrate the power of AS Inc.'s patented technology to treat industrial cooling water as well as drinking water.

Case History I: Industrial Cooling Water

The Park Central Office Complex in downtown Denver is a 500,000 square foot building with 1750 HVAC towers. Following a laboratory evaluation by Puckorius & Associates that indicated a tin based water treatment program performed well for industrial cooling water, the Chief Engineer of the office complex agreed to participate in a field evaluation in their cooling water system.

At the start of the evaluation, AS-8310 (a Tin compound, Tolytriazole, HEDP, and Poly Carboxylate Polymer) was fed for the first two weeks at twice the maintenance level of 100 PPM. During this time, the HVAC system was operated at 4-5 cycles of concentration on Denver City Water.

Water Analyses HVAC at Park Central Office Complex

Parameter	Makeup	Recirc	COC
Conductivity	307	1306	4.25
pH	7.2	8.45	-----
Calcium Hardness	84	384	4.57
Chloride	5	24	4.8
M Alkalinity	56	236	4.21
Tolytriazole	0	1.9	-----
Silica	2.8	12.5	4.46

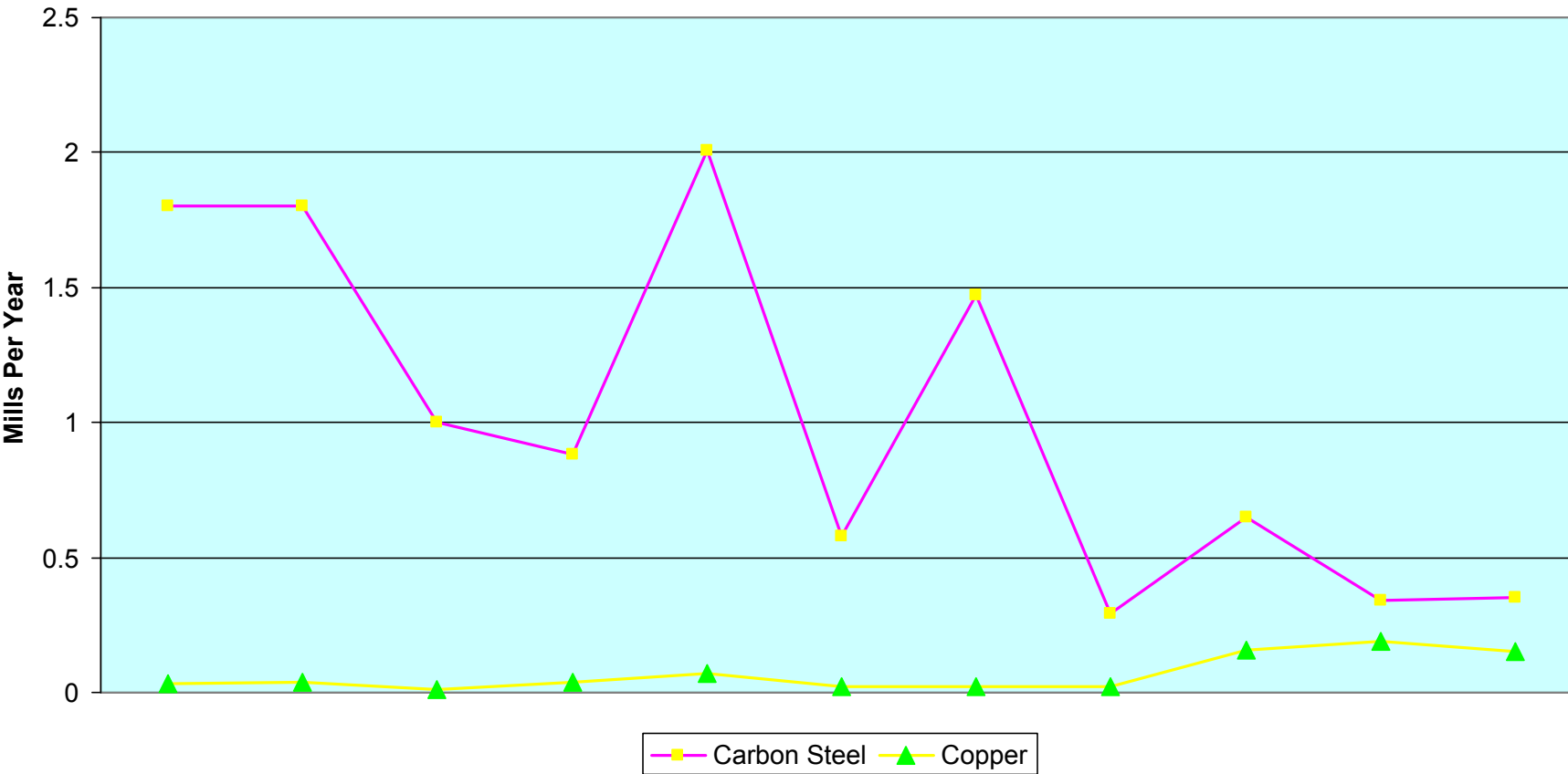
As the above data show, there was very good correlation in the cycles of concentration. This correlation indicates that no deposit formation is occurring.

Park Central Corrosion Coupon Data

Date In	Date Out	Exposed	C. Steel	Copper
06/02/04	09/24/04	114	0.88	0.04
09/24/04	11/03/04	40	2.01	0.07
01/05/05	05/04/05	119	0.58	0.02
08/03/05	01/04/06	154	1.47	0.02
02/15/07	03/29/07	42	0.29	0.02 AS
03/29/07	04/27/07	29	0.651	0.155
04/27/07	05/24/07	27	0.339	0.188
05/24/07	06/28/07	35	0.35	0.15

The corrosion coupon data, shown above and graphed below, clearly indicate that the tin technology treatment was very effective controlling carbon steel corrosion. Please note that the coupons exposed prior to 03/29/07 had been “pretreated” by the incumbent supplier. Therefore, the results aren’t like comparing apples vs. apples, but rather like comparing apples and oranges. Also please note that exposure time is a key element in determining the corrosion rate as corrosion is most aggressive when surfaces are fresh and tapers off as the exposure time increases.

Park Central Corrosion Coupon Results





As the above coupons show, the corrosion produces a minimal effect on the bulk of the surfaces, with corrosion being visible where the coupons attach to the corrosion coupon holder.

How Does Tin Work?

As Inc.'s research and discussions with our chemical engineering colleagues indicate that the tin atom can share electrons and form a barrier that greatly reduces corrosion. Tin also works as a reducing agent and converts ferric (+3) iron to ferrous (+2) iron which is useful to clean up systems and to form a protective iron oxide (gamma iron oxide).

Moreover, tin technology offers several advantages over other commonly used corrosion control water treatments, such as phosphates, molybdates, and nitrites.

Advantages of Tin Technology over Phosphate Based Treatments

Phosphates require calcium to form a protective layer, which, as iron and phosphate deposits, can become a barrier to heat transfer and reduce treatment efficiency. What's more, phosphate is a nutrient which leads to algae growth. Using tin instead of phosphates removes a nutrient from wastewater streams.

Advantages of Tin Technology over Molybdates

Molybdates are costly given that effective doses for corrosion inhibition are 40-50 PPM. Effective doses for tin are 2-3 PPM. Use of Molybdate has been banned in Denver because the wastewater treatment plant sludge there is used for land applications which include raising dairy cattle. Molybdate, which interferes with the absorption of copper in cows, was found in the milk supply. To prevent problems with child development, molybdate discharge was banned.

Advantages of Tin Technology over Nitrites

Unlike nitrites, tin is not a microbiological-nutrient, and so does not cause the maintenance cost and monitoring that a nutrient creates. Bacteria metabolize nitrites into nitrates which render it ineffective as a corrosion inhibitor. It also creates a need for biocide use, and recharging the system with additional nitrite to control corrosion. Thus the cycle begins again and without careful attention, corrosion control can be sacrificed.

Environmental Implications

Tin is an effective green technology – worth mentioning to today’s increasingly environmentally conscious consumers, public officials and representatives, and business partners. Tin is not a constituent listed on NPDES permits. At the levels used in AS Inc.’s applications, tin is environmentally safe for use not only in industrial cooling water treatment but in drinking water treatment programs as well. The tin levels that AS Inc.’s technology uses are vastly smaller than tin levels in canned food products consumed daily by millions around the globe. AS-8150 and AS-8105 are NSF 60 certified, approved for application at levels up to 1PPM and 10 PPM of product, respectively.

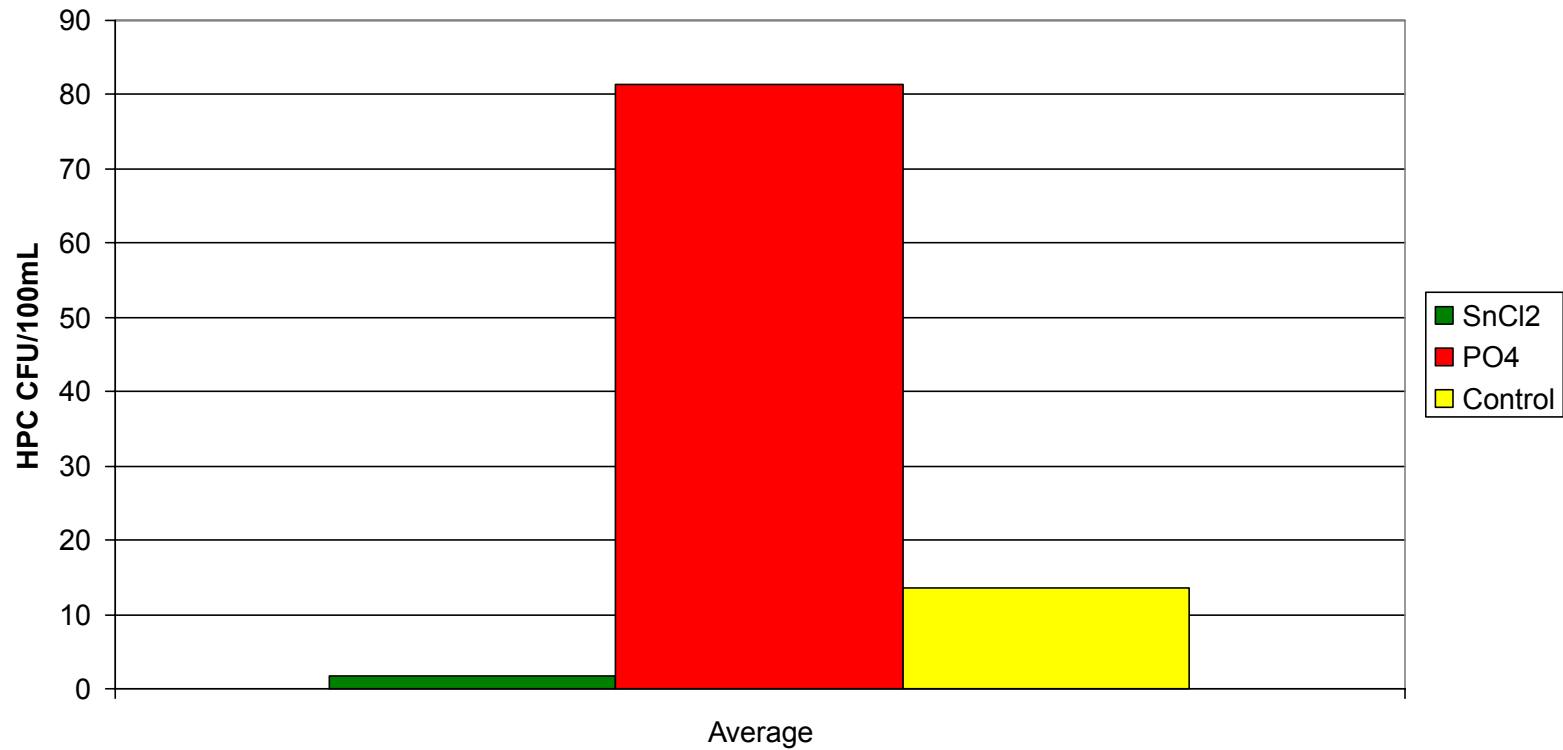
Case History II: Drinking Water

St. Paul, Minnesota has been treating its potable water with AS-8150 for seven years to successfully reduce lead release. Prior to using AS-8150, St. Paul was under a Minnesota State Health Department mandatory lead service line replacement order (LSLR). Since introducing AS-8150, St. Paul has passed every round of Lead and Copper sampling and the mandatory LSLR order has been rescinded. Since late 2005, St. Paul has been placed on reduced monitoring status.

The below graph is from a pipeloop study done by Elizabeth Esbri Amador, a graduate student at the University of Minnesota. The study focused on lead release as well as on the propensity to grow bacteria. The lead release aspect showed PO4 to be slightly more effective; however, bacterial growth was significantly greater with PO4.

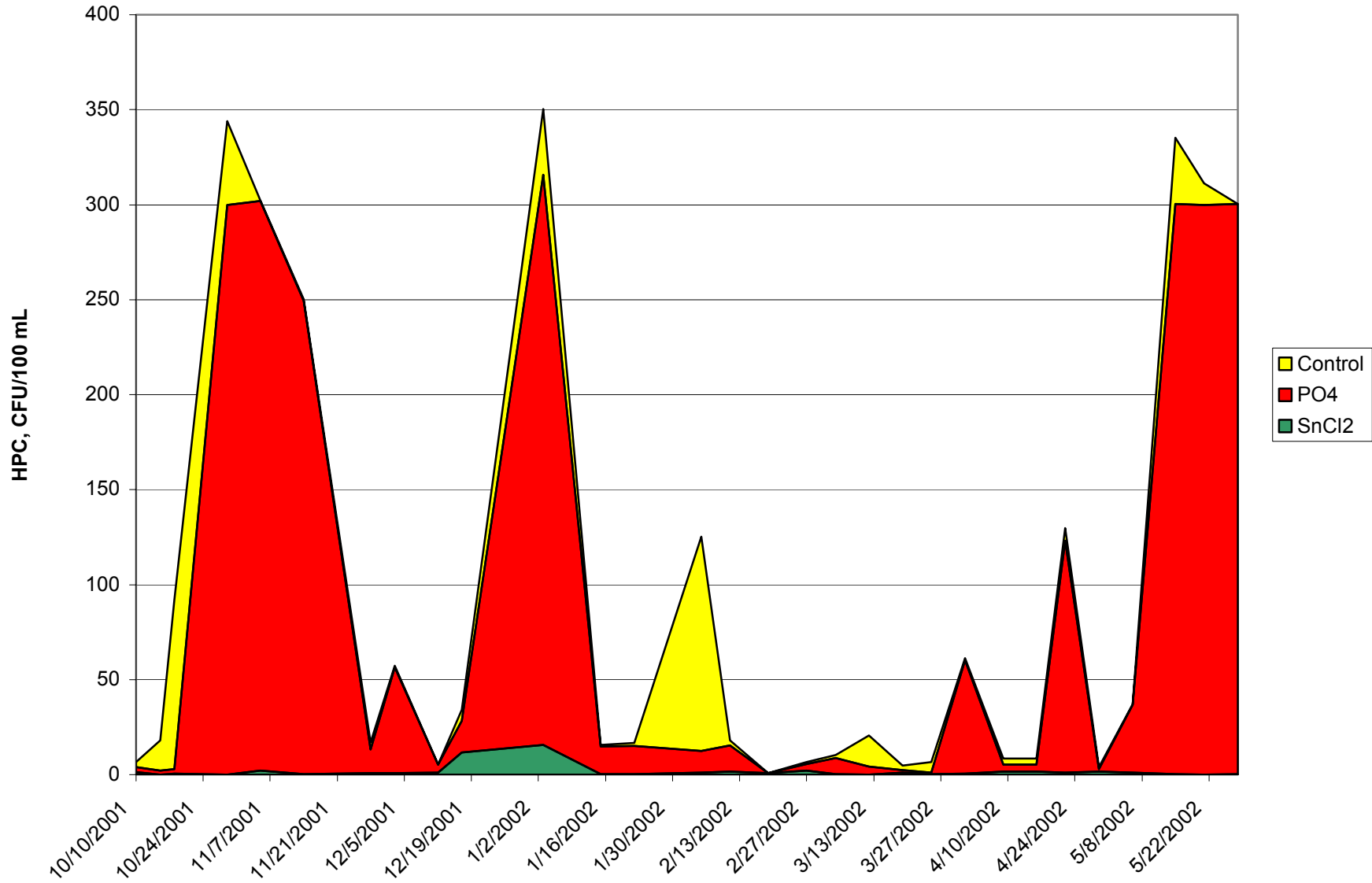
Microbiological Growth in Pipeloop Study

Average Heterotrophic Plate Count Values



As shown in the above bar chart, orthophosphate increased the CFU count over the control value, while the stannous chloride treated loop had the lowest CFU value.

HPC Counts



As shown in the above graph, orthophosphate is the most predominant color (red) on the graph, and stannous chloride (green) has the least amount of area on the graph.

Conclusion

As the above case histories demonstrate, AS Inc.'s tin technology, AS-8310, provides excellent mild steel corrosion control. Besides being effective, tin based treatment programs can be formulated to be highly competitive with non tin based programs that are less environmentally sensitive.

Tin based treatment offers additional advantages as well: Tin technology can improve heat transfer, due to cleaner surfaces creating lower scaling potential, and tin based treatment can significantly reduce Microbiologically Induced Corrosion (MIC).

Tin based treatments are applicable in open recirculating systems such as cooling towers as well as potable water systems, especially ones where lead pipes may require treatment or replacement so that drinking water may remain safe.

Acknowledgements

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