Nalco Water's 3DT397 Technology Reduces Corrosion and Environmental Impact at Power Plant

NALCO Water
An Ecolab Company

CASE STUDY – POWER
CH-2103

INTRODUCTION

Every power plant wants to be a good corporate citizen of the community in which it resides. Every power plant wants to minimize its environmental impact. These desires must be balanced with the need to safely generate reliable, low-cost power. The need to balance these priorities – operational costs, regulatory compliance, industry best practices – led this Midwestern power plant to evaluate new technology to meet their changing needs.

BACKGROUND

Oxidizing biocide programs – bleach or bleach/bromine – are economical, well understood, relatively easy to apply and deliver good results in most industrial cooling water systems. Changing environmental rules and certain aspects of system design can render these programs more complex to apply and less effective.

Like many power stations, this plant applied an azole-based corrosion inhibitor to protect its Cu:Ni condenser.[1]

Good microbial control required a lot of bleach and bromine to overcome the recirculating water's chlorine demand, a result of the high concentrations of organic material in the make-up water. The typical Free Residual Chlorine (FRC) was about 0.2 ppm during their periodic slug dosages of biocide.

As is so often the case, gaining control of one chemical aspect of the recirculating water – microbial control– negatively impacted another. The FRC degraded the performance of the azole. The result: high copper corrosion rates and copper concentrations in the plant outfall.[2]

Corrosion threatened the integrity of the plant's condensers. In today's challenging power market, operators cannot afford unplanned outages, downtime or premature equipment failure.

ENVIRONMENTAL INDICATORS	eROI℠	OUTCOME
Reduced copper corrosion by 75%	ASSETS	Higher asset reliability, longer asset life
Reduced copper discharge by 60%	ASSETS, WASTE	Met or exceeded environmental goals

eROI is our exponential value: the combined outcomes of improved performance, operational efficiency and sustainable impact delivered through our services and programs.

1 The plant used benzotriazole (BZT) as its yellow metal corrosion inhibitor.

2 Variability in make-up water pH and turbidity also complicated water treatment at this station. Turbidity could reach 500 NTU in the unclarified river water used as cooling tower make-up. High suspended solids caused erosion corrosion in the copper condenser.

In addition, this plant has a dissolved copper discharge limit of 160 ppb. The cooling tower blowdown periodically exceeded this limit. The elevated copper concentrations in the discharge, if not addressed, would become an area of concern for environmental regulators.

Something needed to change and, working with the plant's management, Nalco Water developed a chemical solution.

SOLUTION

Nalco Water's 3DT397 chemistry is a more environmentally friendly, halogen stable yellow metal corrosion inhibitor designed for the kinds of conditions found at this power plant.[3]

3DT397 technology is manufactured by Nalco Water, making supply much more stable and reliable. This is important because the global azole supply is highly volatile, which has presented business challenges for manufacturers and users. During periods of tight supply, azole prices increase dramatically and there have been times when procuring these materials at any price has proven difficult.

3DT397 has other advantages over traditional azole chemistries:

- More stable than triazole chemistry in the presence of oxidizing biocides. Lower consumption means more product available to provide corrosion protection than traditional azoles under the same conditions.
- Forms a thicker, more protective film than triazole.
- Is nontoxic, while azoles are harmful to aquatic species. For details, see Table 1.
- Residuals are easily monitored using a simple test procedure.

	Acute toxicity to Fish	Acute toxicity to Invertebrates	Acute toxicity to Algae	GHS Toxicity Category
CI-TT	15.1	47.4	N/A	Harmful
TT	23.7	245.7	114	Harmful
BZT	75	277	N/A	Harmful
3DT397	480	367	147	Nontoxic

Table 1. LC50 (ppm) toxicity testing results of triazole products compared to Yukon.[4]

RESULTS

3DT397 chemistry delivered the results and performance the plant needed:

- Lower corrosion rates
- Low copper concentrations in the outfall, fully in compliance with their environmental requirements.
- 3DT397 has a lower toxicity than their current azole treatment, addressing a safety and best practices goal.
- 3DT397 is easily monitored using a simple analytical procedure, an improvement over their azole treatment.

Corrosion Rate (mpy)	BZT	3DT397
Admiralty Brass	0.4	0.1
Copper	1.7	0.1
Cu:Ni 70:30	0.1	0.02
Cu:Ni 90:10	0.2	0.02

Table 2. Corrosion rate before and during trial with Yukon

Water Chemistry	BZT	3DT397
Active Feed (ppm)	0.80	0.47
Active Residual (ppm)	0.12	0.37
Loss of Inhibitor (%)	85%	21%
Avg soluble copper (ppm)	0.15	0.06

Table 3. Water Chemistry before and during trial with Yukon (3DT397)

BEFORE DURING

Table 1: Corrosion Coupons. Baseline (left) and Yukon (right)

Achieving good microbial control in this variable, challenging water required a high FRC. 3DT397 gave the plant the freedom to apply those levels of oxidant without impacting asset integrity, as shown in Table 1. Corrosion coupon results using Yukon were significantly better.

Brass corrosion dropped by 75% to 0.1 mpy, while Cu:Ni alloy corrosion dropped 80-90%. Copper concentrations in the discharge dropped 60%.

[3] *The Nalco Water product number for this chemistry is 3DT397.*

[4] *Higher numbers indicate lower toxicity.*

High concentrations of free chlorine will degrade traditional azole treatments. 3DT397 is much more halogen stable than those older technologies. The amount of product consumed in this halogenated environment dropped by 64% using 3DT397. That means, at an equivalent dosage, three times more active 3DT397 material is available as a corrosion inhibitor than was available when azole was applied.

CONCLUSION

Every power plant wants to be a good corporate citizen of the community in which it resides. Every power plant wants to minimize its environmental impact. These desires must be balanced with the need to safely and reliably generate low cost power. 3DT397 helps Nalco Water customers strike this balance and achieve the results and performance they need to remain competitive in today's challenging marketplace.

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