A south Texas combined cycle power plant improves performance and reduces bleach use by 75%

OMNI™ Condenser Performance

NALCO Water
An Ecolab Company

CASE STUDY – POWER
CH-1054

BACKGROUND

Power plants do everything possible to maintain clean condenser surfaces. A clean condenser maintains high efficiencies, generating capacity and minimizes operating costs.

Of all the foulants to which power plant condensers are exposed, microbial slime has the greatest impact on performance. Microbiological deposits impede heat transfer even more than mineral scales and they create the conditions necessary for under-deposit corrosion. Anaerobic bacteria, which exist in the oxygen-free environment below a bio-mass, excrete corrosive hydrogen sulfide as a product of their metabolism. Without a microbial slime layer, these bacteria cannot survive.

Keeping a condenser free of microbial fouling delivers an economic advantage to the power plant. Condenser efficiency has an inverse effect on heat rate. A clean condenser minimizes the temperature of heat rejection and maximizes the efficiency of the entire steam cycle.[1]

The simplest measure of condenser cleanliness or efficiency is steam turbine back pressure, the pressure at which the steam exhausts to the condenser. Although not the most precise measurement, it easily and effectively aggregates the effects of steam mass flow, velocity and the loss of kinetic energy through the turbine stages.

SITUATION

At the 250 MW Sam Rayburn power plant in Nursery, TX – part of South Texas Electricity Cooperative (STEC) – adoption of a new microbial control program, part of the OMNI Condenser Performance program, kept their condenser clean and allowed them to reduce their bleach use by 75%.

Power plants commonly use sodium hypochlorite – bleach – to control microbial populations. Bleach is relatively inexpensive, easy to apply and effective. The downside: effectively treating a condenser with bleach requires a lot of it and it can be corrosive to copper and copper alloys.

[1] *"Heat Rate" is a measure of the amount of input energy needed to produce a unit of electricity output. It is commonly expressed as BTU/kWh.*

ENVIRONMENTAL RESULTS	eROI℠	ECONOMIC RESULTS
Decreased bleach use by 474 gallons/month	EARTH	$13,000 per year

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

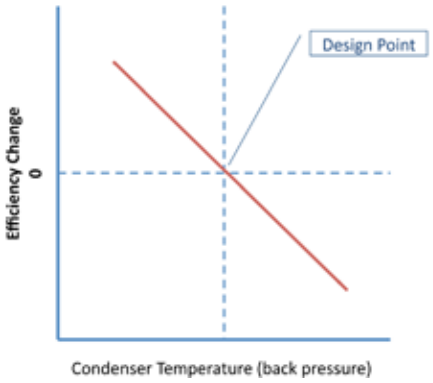

Figure 1 – *a wavelength measurable by one channel*

SOLUTION

STEC plant management encourages projects that reduce operating costs and increase plant efficiency. Implementation of Nalco Water's 3D TRASAR® Bio-Control, part of the OMNI Condenser Performance program, was one of those projects. The goals: reduce oxidant use, control copper corrosion and maintain a clean condenser.

3D TRASAR Bio-Control uses fluorescence to measure microbial activity, detect changes and take appropriate, automatic corrective action. A reagent – called a bio-reporter – is added to the recirculating cooling water. It fluoresces at a wavelength measurable by one channel of the six-channel modular fluorometer installed in a 3D TRASAR controller.

Every respiring organism produces, as a product of its metabolism, an enzyme, dehydrogenase, which reacts chemically with the bio-reporter. The reacted form fluoresces at a new wavelength. A second fluorometer channel measures the reacted form of the bio-reporter and the rate at which it changes.

By comparing the concentrations and rate changes of the two fluorescent species, 3D TRASAR Bio-Control applies oxidant to control microbial populations. By responding to changes in microbial activity as they happen, 3D TRASAR Bio-Control delivers better control performance than conventional control techniques.

RESULTS

Baseline data collection took place from the latter half of 2006 through the first half of 2007. Bleach consumption averaged 635 gallons per month (2,404 liters per month). Its application was managed based on manual pump adjustments based on wet chemistry tests.

3D TRASAR Bio-Control was first implemented in August 2007. Bleach use dropped to 95 gallons per month. Fearing the technology was not performing as promised, control was shifted back to manual while equipment and operational data were inspected. No variation from prior performance was noted and no microbial fouling was observed in September. In October 2007, control was switched back to 3D TRASAR Bio-Control. Over the next nine months, bleach usage averaged 161 gallons per month, a 75% reduction over prior usage.

Condenser back pressure served as the key performance metric during this period. As shown in Figure 3, condenser performance remained steady, even with the significant reduction in bleach usage.

CONCLUSION

Reducing bleach consumption, from 635 gallons/month to 161 gallons per month, at a cost of $2.30/gallon, represents a savings of $13,000 per year. The cost of 3D TRASAR Bio-Control is about $1,000/year.

$$\text{ROI} = \frac{\text{Incremental Savings} - \text{Incremental Investment}}{\text{Incremental Investment}} \times 100$$

$$\text{ROI} = \frac{\$13{,}000 - \$1{,}000}{\$1{,}000} \times 100$$

$$\text{ROI} = 1200\%$$

[2]*STEC uses chillers to reduce the CT compressor inlet air temperature. The chillers have copper-tubed refrigerant condensers that are on the same cooling circuit as the surface condenser.*

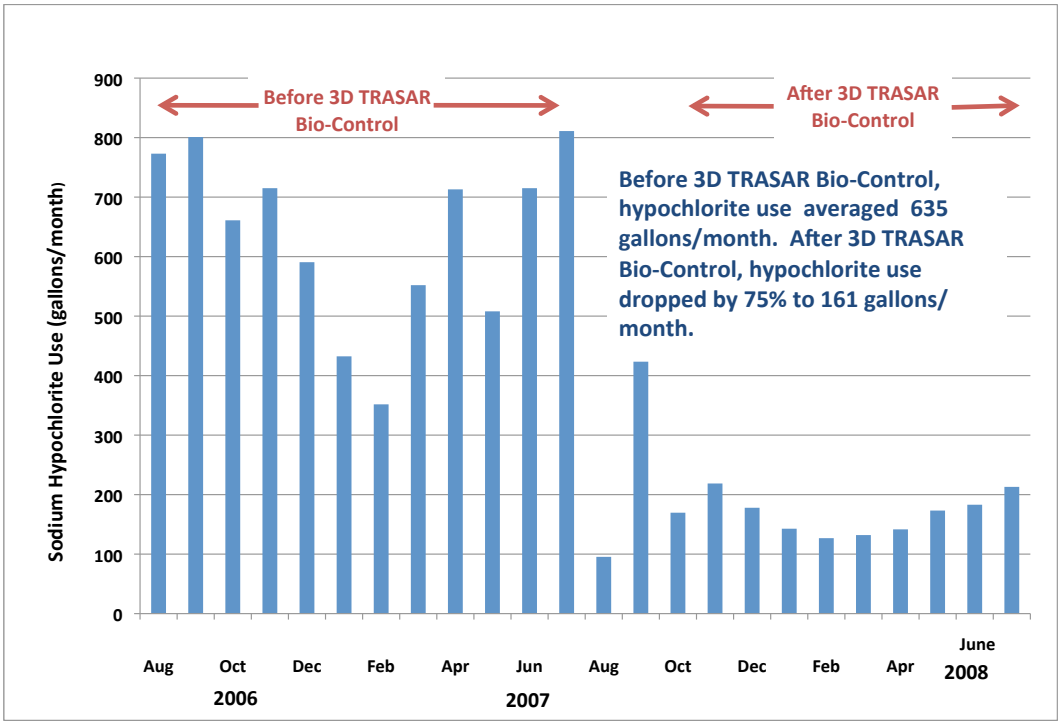

Figure 2 – *3D TRASAR Bio-Control delivered equivalent microbial control, but required 75% less oxidant.*

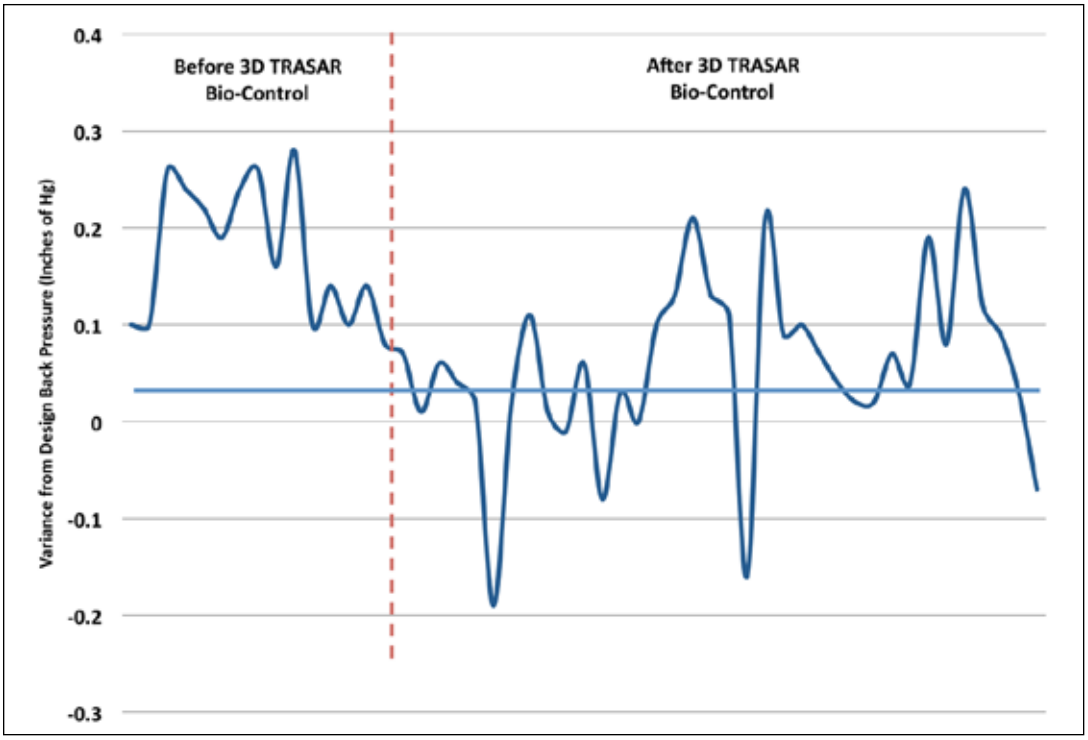

Figure 3 – *Variance from Design Back Pressure is the difference between the measured back pressure and the design back pressure. There was no measurable change in performance after implementation of 3D TRASAR Bio-Control, indicating that better control of the oxidant delivered equivalent results at a lower oxidant concentration.*

Nalco Water reports Environmental Return on Investment (eROI) values to customers to account for contributions in delivering both environmental performance and financial payback.

Nalco Water, an Ecolab Company

North America: 1601 West Diehl Road • Naperville, Illinois 60563 • USA
Europe: Richtistrasse 7 • 8304 Wallisellen • Switzerland
Asia Pacific: 2 International Business Park • #02-20 The Strategy Tower 2 • Singapore 609930
Greater China: 18G • Lane 168 • Da Du He Road • Shanghai China • 200062
Latin America: Av. Francisco Matarazzo • nº 1350 • Sao Paulo – SP Brazil • CEP: 05001-100

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