CASE STUDY

Innovation Synergies Enable Reliable Wastewater Re-Use In Cooling Towers At $4 Million Lower TCO

eROI℠ by Ecolab

INTRODUCTION

A Latin American oil and petrochemical corporation is aggressively targeting Total Cost of Operation (TCO) reduction in response to a global industry downturn and is also seeking to reduce their water footprint in a water scare region. The company has identified cooling systems using treated sewage effluent as the key to achieve these goals. Water quality fluctuations, high organic content, and bacterial counts have resulted in significantly increased cooling operational stress. Failures and leaks related to these issues compromise the company's primary objectives of reducing unplanned shutdowns and efficiency losses.

BACKGROUND

Three refineries have relied on treated sewage effluent as cooling tower makeup water. Municipal wastewater was not polished and (biodegradable) organic levels were quite high, with ammonium and phosphate impurities resulting in ideal microbial growth conditions. Fluctuations in the makeup water quality caused high chemical use rates and inflated costs.

Historically, chlorine gas was used for microbial control. Lack of dosing automation resulted in periods of overfeeding, contributing to corrosion, particularly in admiralty exchangers and underfeeding where biological fouling can proliferate. Cooling water systems suffered from hydrocarbon contamination with frequent leaks, undermining the effectiveness of chlorine gas as a biocide and increasing demand. The pH control was managed via a manual addition of sulfuric acid, making scaling control challenging at high pH events. Refineries were struggling to meet cooling system KPI's consistently and were forced to run at low cycles of concentration, causing high water usage and supplementing river water to the make-up.

SOLUTION

Nalco Water enlisted a team of R&D, technical experts and local sales to survey all three systems and develop a multi-faceted solution to address major challenges through innovative automation, chemistry and digital solutions. The proposed program consisted of:

ANNUAL SAVINGS

WATER

Water reduction savings of 9 million m3 equivalent to

$3.85 MILLION

HUMAN HEALTH & SAFETY

Eliminated two acid cleanings saving

$100,000

and limiting employee exposure risk

PRODUCTIVITY

Reduced down time with

$10 MILLION

in production losses prevented

VALUE DELIVERED

Annual savings of over

$13.95 MILLION

NALCO Water
An Ecolab Company

- Purate Technology, the Nalco Water patented platform with on-site chlorine dioxide generation to improve safety and control, as well as providing robust biofouling inhibition. Chlorine dioxide is a fast-acting broad-spectrum biocide against bacteria, spores, viruses, fungi and algae over a wide pH range (~2-10). Unlike traditional chlorine gas or bleach, it does not react with hydrocarbons, making PURATE the ideal choice for these cooling systems.
- The Nalco Water High Charge Polymer dispersant to control deposition and scaling in cooling systems. It was developed for challenging waters found in high-cycle towers or reclaimed water sources. The polymer is controlled based on real-time requirements through its fluorescent tag. This high efficiency treatment contributes to the overall goal of TCO reduction while delivering a step change in performance.
- The NexGen 3D TRASAR controller constantly tracks all relevant aspects of supply, return and makeup water, and controls the feed of chemistry to optimize both system performance and chemical feed rates. This data is sent securely and wirelessly to the Refined Knowledge digital platform with 24/7 monitoring and alarming for peace of mind and reliable operation.
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RESULTS

After starting up the PURATE generators, refineries saw a long-term improvement in biological activity (Figure 1). Target biological levels of <50,000 CFU/mL were achieved despite existing cooling system contamination.

With biofouling under control following low chloride via PURATE technology, corrosion stress was also sufficiently lowered, resulting in cycle increases from an average of 2.0 to 3.5 and reducing water use of almost 9 million m /year for all three refineries combined. With the dissolved species concentration up in water, the demand on scaling control increased. High Charge Polymer (HCP) was introduced to control deposition, despite the pH fluctuating between 7 and 8. Carbon steel corrosion rates were further improved, as the polymer kept the corrosion inhibitor chemistry available in the solution.

Due to historic corrosion effects, occasional leaks still occurred. The delta-ORP detection and alarm functionality of the NexGen controller addressed this challenge by quickly alerting operations to hydrocarbon intrusion. These real-time alerts allowed the refinery to avoid discharge, health and safety violations, while safeguarding production. Improved corrosion rates resulted in a reduction in maintenance costs and helped asset production.

CONCLUSION

By implementing synergistic cooling water treatment innovations, the company was able to achieve both their utility TCO reduction and water savings goals. The challenging water quality at the refineries required robust 3D TRASAR real-time monitoring and an enhanced control strategy to oversee operations. PURATE chlorine dioxide resulted in a step-change in biocontrol, which was supported by superior scale dispersion. These improvements created significant water savings, by running at higher cycles of concentration. By implementing the innovative Nalco Water treatment, all three refineries reported water savings of 19% and estimated cost savings of $14 million annually, without increasing treatment spend.

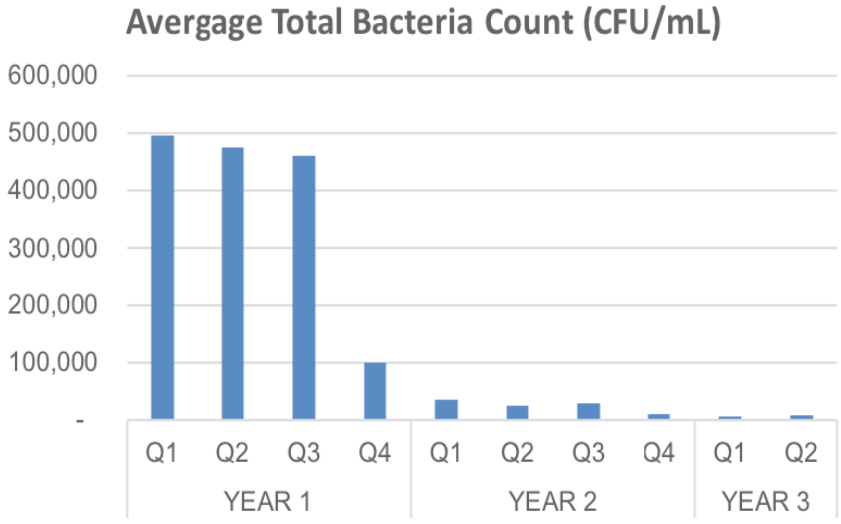

FIGURE 1: BACTERIAL COUNTS BEFORE & AFTER THE PURATE PROGRAM

KEY PARAMETER	BEFORE NALCO WATER	TARGET	AFTER NALCO WATER
pH Range	4-9	7-8	7-8
Average Cycles	2.0	> 3.0	3.5
Water Use	48 MM^3/Y	15% REDUCTION	39 MM /Y; 19%
Total Bacterial Count	$5*10^5$ CFU/ML	$<5*10^4$ CFU/ML	10^3 CFU/ML
MS Corrosion Count	> 2 MPY	< 2 MPY	< 1 MPY
MS After HCP	-	-	< 0.4 MPY

TABLE 1: TYPICAL BEFORE & AFTER PARAMETERS

CASE STUDY

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