New low-P chemistry program improves corrosion rates in a mini mill and reduces scaling in critical systems

NALCO Water
An Ecolab Company

CASE STUDY – PRIMARY METALS
CH-2147

INTRODUCTION

The use of phosphorous bearing compounds has long been the industry standard for corrosion treatment after chromates were prohibited for use due to high levels of toxicity. Cooling tower treatment and management is impacted by scale, corrosion and microbiological stress. Effective corrosion control requires the phosphate concentration to be adjusted based on pH, chloride, sulfate, temperature and hardness ion concentration. Phosphorous is also a key nutrient for micro-organisms, such as algae. Phosphorous was recognized globally as the primary growth-limiting nutrient for algae in surface bodies. Challenges with excess phosphorous residual in the effluent and its impact on algae blooms have led to stricter regulations in many parts of North America. A mini mill customer was experiencing excessive scaling in their system due to the presence of both aluminum and calcium phosphate. Aluminum was added in the surface water by the city as part of their water treatment program, while the majority of the phosphate was due to the treatment of the system.

BACKGROUND

A mini mill customer was experiencing severe scaling of their cooling tower, which was critical for continuous casting contact cooling. The system uses city water as make-up source for the cooling tower. The city used aluminum sulfate (alum) to manage algae bloom growth. The treatment although effective in managing the algae was leading to high residual of aluminum in the incoming water for the mill. The mill experienced severe scaling and fouling in the cooling tower fill. Prior to the occurrence of this stress the mill historically had to replace the fill every 5- 7 years at the cost of $90,000. However, the new stress had led to a more frequent maintenance issue along with causing unexpected downtime due to loss

Phosphate-based deposit on the cooling tower fill which was removed from the tower.

Customer Impact	eROI℠	Outcome
70% improvement in corrosion rate	ASSETS	Higher asset reliability and longer asset life

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of cooling capacity, and distraction from other critical maintenance activities during their planned outages. Deposit analysis of a sample of the cooing tower fill indicated presence of both calcium phosphate and aluminum phosphate which is extremely insoluble.

The Nalco Water team also met with the city water team in the past years and discovered dosages of 2x-3x of alum than traditional treatment to mitigate high levels of algae.

The current water treatment program included a polymer for dispersion and scale control, an inorganic phosphate for corrosion control, a polymer for cathodic corrosion and calcium carbonate scale control, a calcium fluoride inhibitor required from mold powder effects and a coagulant to limit any solids carry over from the scale pit. The presence of additional aluminum not only compromised the current treatment program, but also led to additional chemical usage to continue to operate the cooling tower system as reliably as possible given the stress.

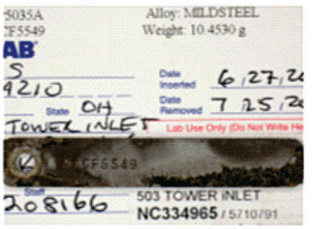
SOLUTION

A unique new non-phosphorous containing chemistry in combination with a polymer solution was deployed to mitigate the co-precipitation of both aluminum and calcium phosphate deposition. This new phosphorous-free corrosion control program leverages the synergistic effect of two products to deliver excellent results even with varying and highly corrosive water characteristics. The extended application window created by the new program treats soft water and high conductivity water with high chloride, along with high tolerance to pH upsets.

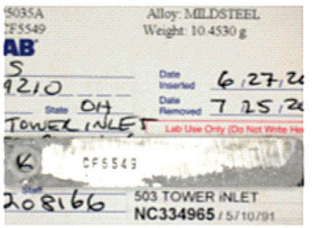
RESULTS

Nalco Water program was able to achieve an 84% reduction in inorganic phosphate relative to the traditional baseline. The small contribution of phosphate in the system was primarily due to the make up water source and treatment needed to manage fluoride deposition from the mold powder used during the casting process. An incoming aluminum concentration greater than 2 ppm presented a severe system stress, as the dispersant chemistry used to prevent the scaling phenomena was getting consumed leading to formation of both aluminum and calcium phosphate. The removal of orthophosphate from the treatment program eliminated phosphate scaling stress. Additional benefit of this treatment was the 70% reduction of the mild steel corrosion which was the best result achieved relative to historical performance in this challenging system.

Average mild steel corrosion rate (before):	3.1 mpy
Average mild steel corrosion rate (after):	1.0 mpy



Before Cleaning



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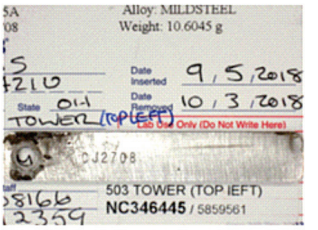

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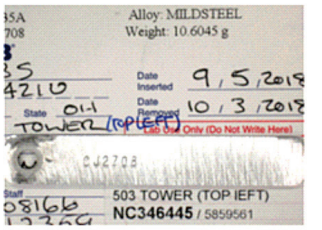

After Cleaning

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