



**CREATIVE
WATER
SOLUTIONS**

Industrial Water Division

Case Study

3M Corporate Headquarters 2014

**CREATIVE
WATER
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Introduction

Creative Water Solutions LLC and 3M conducted a 2 year trial of ProMoss™ treatment at their corporate campus cooling towers. The purpose of the study was to determine the effect of ProMoss™ on water chemistry, bacterial load, organic contamination, water use, scaling, corrosion, turbidity and conductivity.

The 2 towers selected for the trial were 7000 ton structures made from wood and galvanized steel. The ProMoss™ treated tower was 3, 3A and 4 – the control tower was 5, 6 and 6E. Due to the cool summer, the control tower was not running approximately 80% of the trial, while the ProMoss™ tower was running all summer.

The ProMoss™ tower required 93 ProMoss™3 bags per month delivered in 13 submersible contact chambers.





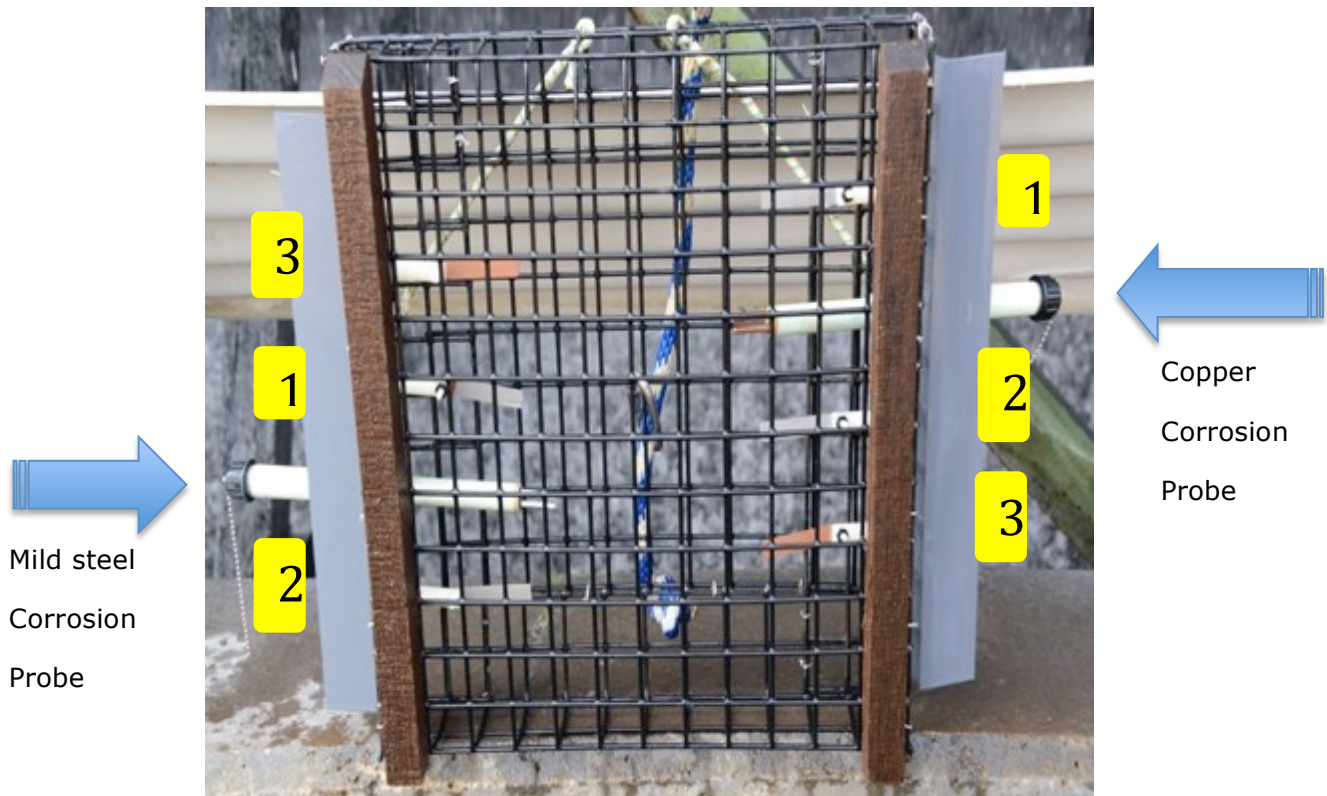


Trial Protocol 2014

- Month 1 – baseline data collection ProMoss™ and control towers
- Months 2-4 – ProMoss™ added to tower 3, 3A and 4
- Cycles of concentration increased by 100% after two months of ProMoss™ treatment
- Water treatment by Nalco
- No biocide added to ProMoss™ tower, control tower received biocide
- Weekly measurements in both towers
 - Corrosion
 - Linear polarization probes for copper and mild steel
 - Coupons for copper and mild steel
 - Water chemistry
 - pH
 - Total dissolved solids (TDS)
 - Alkalinity
 - Calcium hardness
 - Iron
 - LSI
 - Microbiology
 - Quantitative bacterial serial dilution
 - Organic contamination coupons
 - Nalco reports

Test cage for each tower

1. Organic contamination coupon
2. Mild steel corrosion coupon
3. Copper corrosion coupon



Results

- Photos of the coupons
- Photos of the towers
- Bacteriologic data
- Water data
- Chiller photos

Coupon Pictures

**Tower 3
Treated with ProMoss™**



Aug 1, 2014



**Tower 5
Control Tower**



Aug 1, 2014



The difference between the two towers is visibly evident for the mild steel coupons on the top and the organic contamination coupons on the bottom.

Photos from the towers

Results from the ProMoss™ Treated Tower



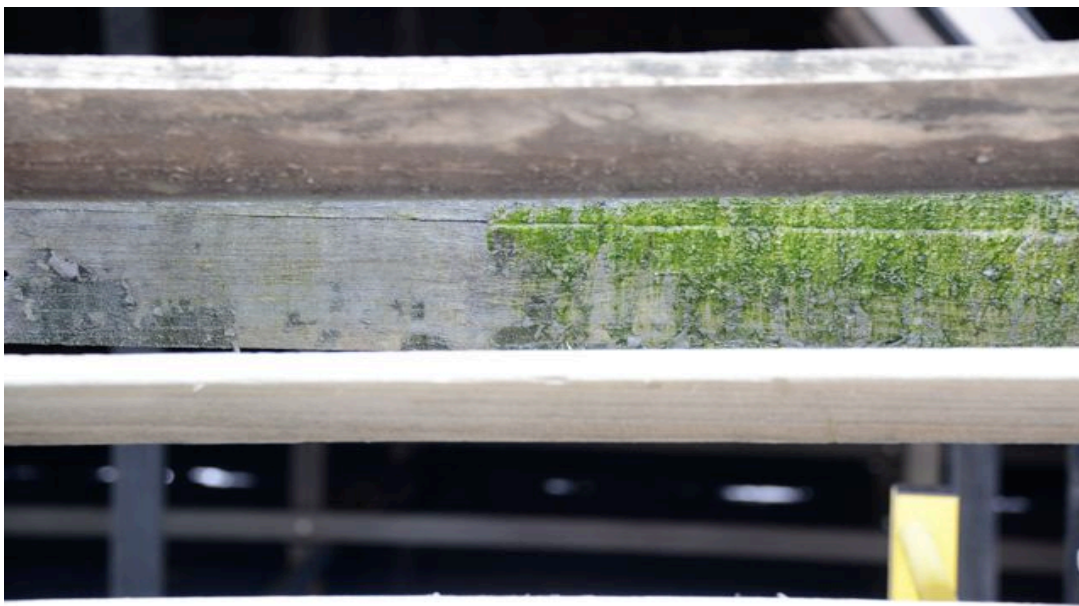
Tower 3 - Aug 8, 2015



Tower 3 - Sept 12, 2014

Midway through the summer the thick layers of organic contamination and algae started to peel off the cedar wood structure of the tower with ProMoss™. The wood was totally intact.

Results from the ProMoss™ Treated Tower



Tower 3 - Oct 17, 2014

By the end of the trial, almost all the organic contamination and algae had peeled off the tower structure. You can see the normal appearing wood on the left of the picture.

Results from the ProMoss™ Treated Tower



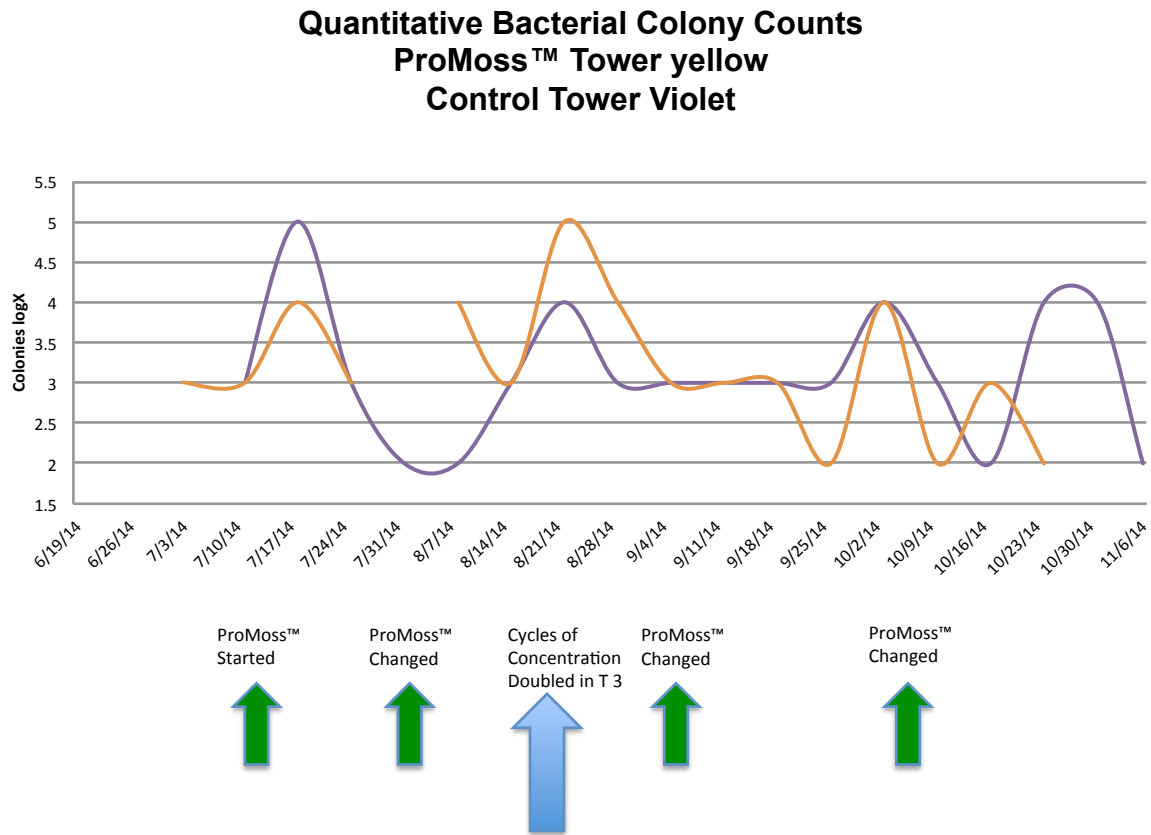
ProMoss™
Treated



Control

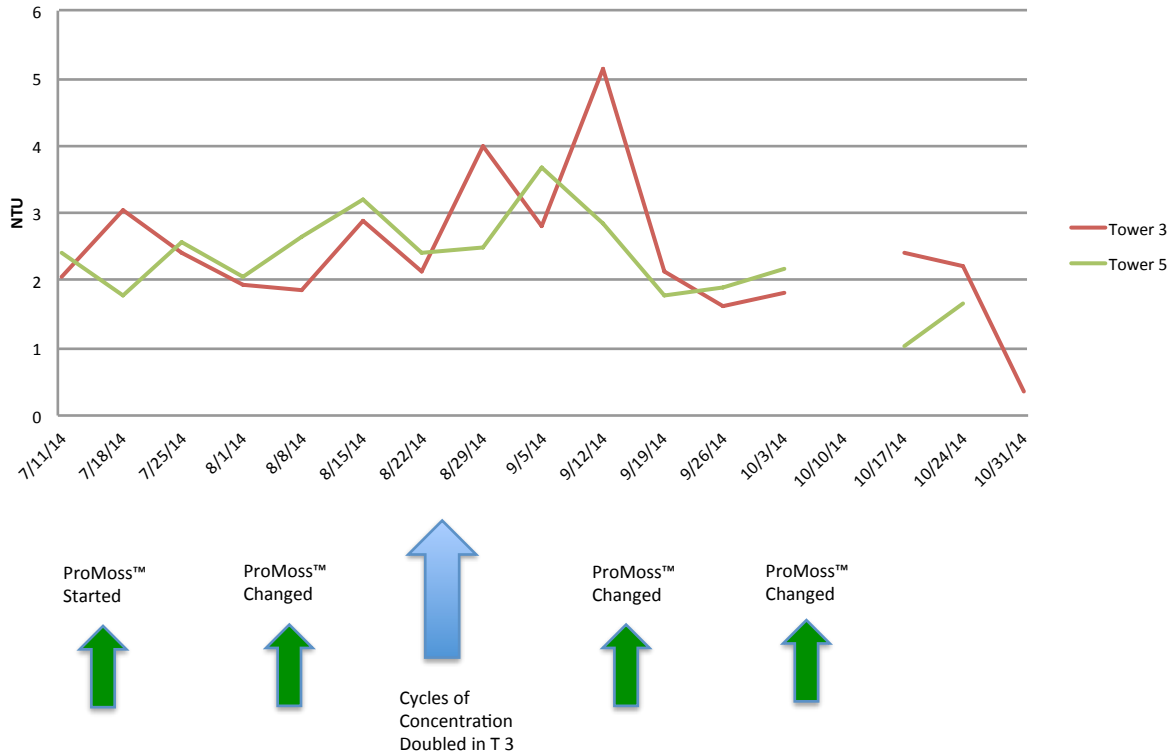
The photo on the left shows organic contamination and algae coming off an upright in the ProMoss™ treated tower while the control tower continued to accumulate more material. After the trial both towers were drained and power-washed. All the timbers in the treated tower were clear of contamination, while the control tower continued to have significant contamination.

Bacteriologic data



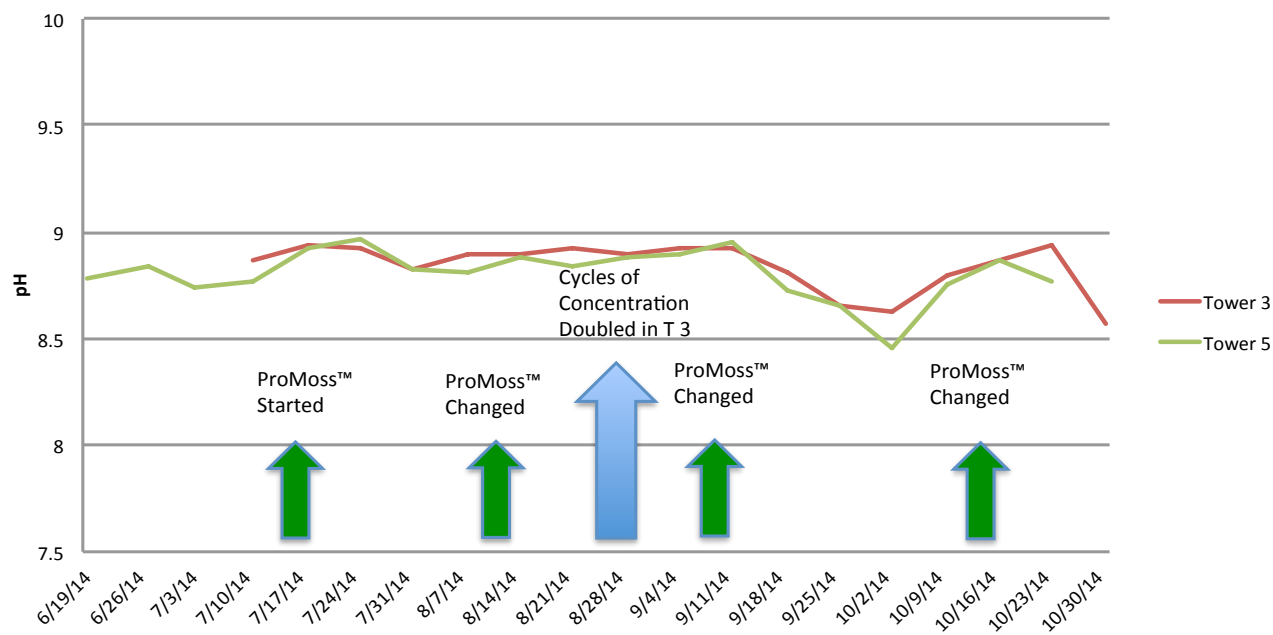
The ProMoss™ treated tower did not have biocide and the control tower did receive biocide. The quantitative bacterial counts from both towers were similar even after the ProMoss™ tower had the cycles of concentration doubled and the control tower remained at the previous years settings.

Cooling Tower Turbidity ProMoss™ Tower Red Control Tower Green



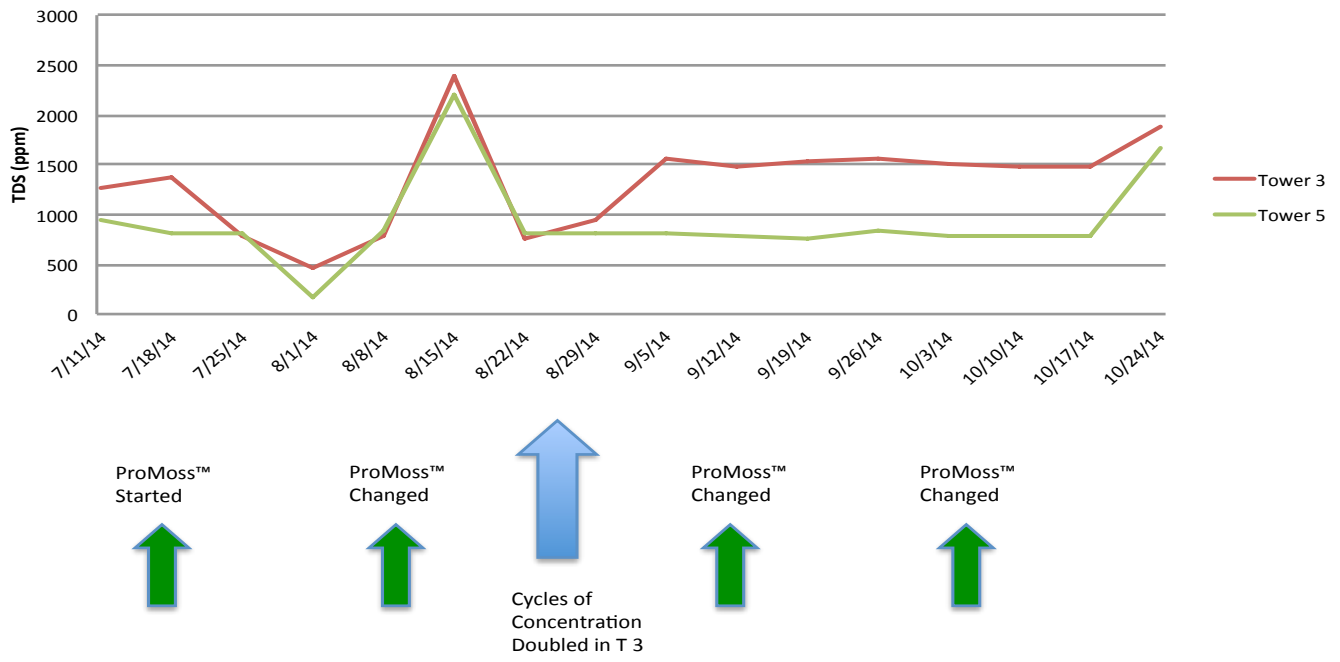
Turbidity was similar in the two towers until the cycles of concentration were increased in the ProMoss™ tower. It then increased for four weeks and then returned to levels similar to the control tower.

Cooling Tower pH ProMoss™ Tower Red Control Tower Green



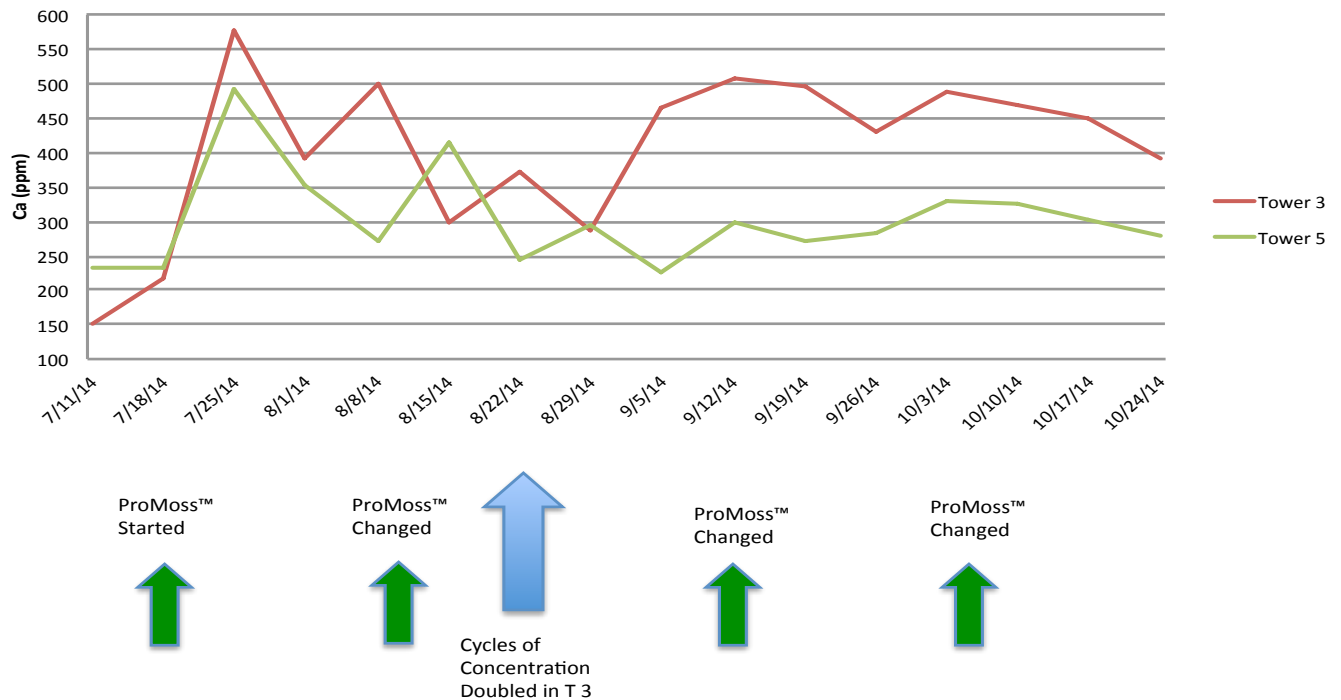
pH measurements were similar in both towers even with the increase in cycles of concentration in the ProMoss™ treated tower.

Cooling Towers – TDS ProMoss™ Red Control Green

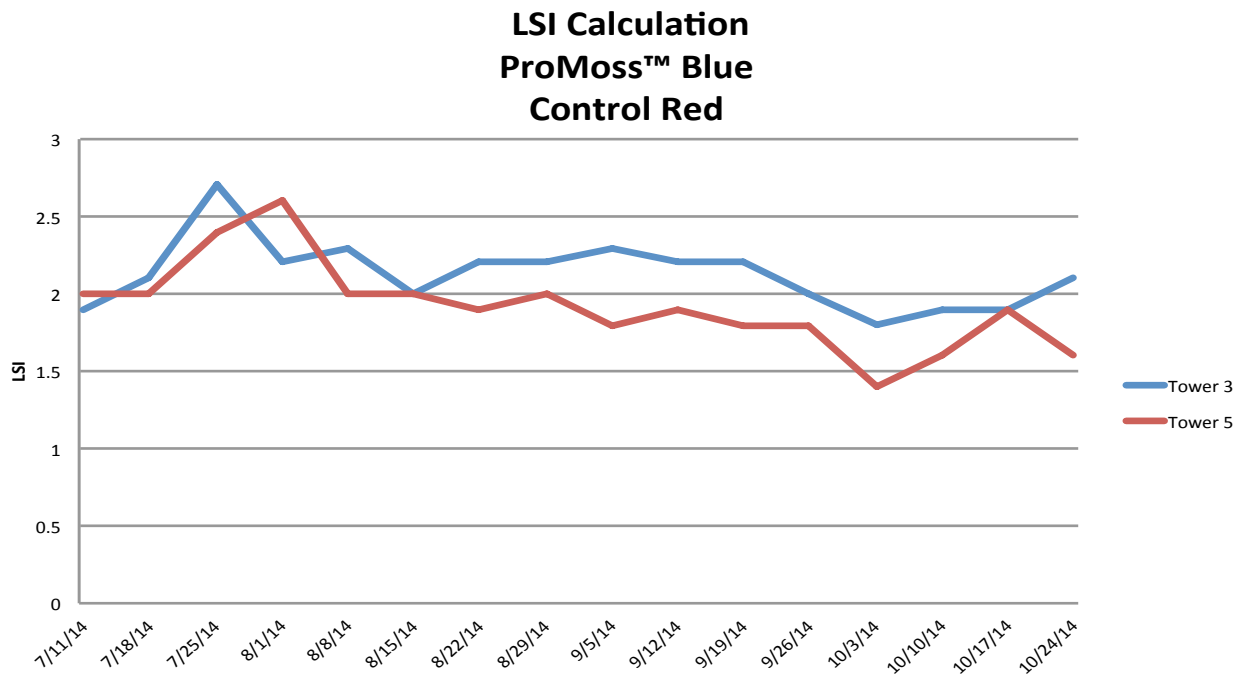


Total dissolved solids (TDS) were similar until the cycles of concentration were doubled in the ProMoss™ treated tower. It then increased in the ProMoss™ treated tower.

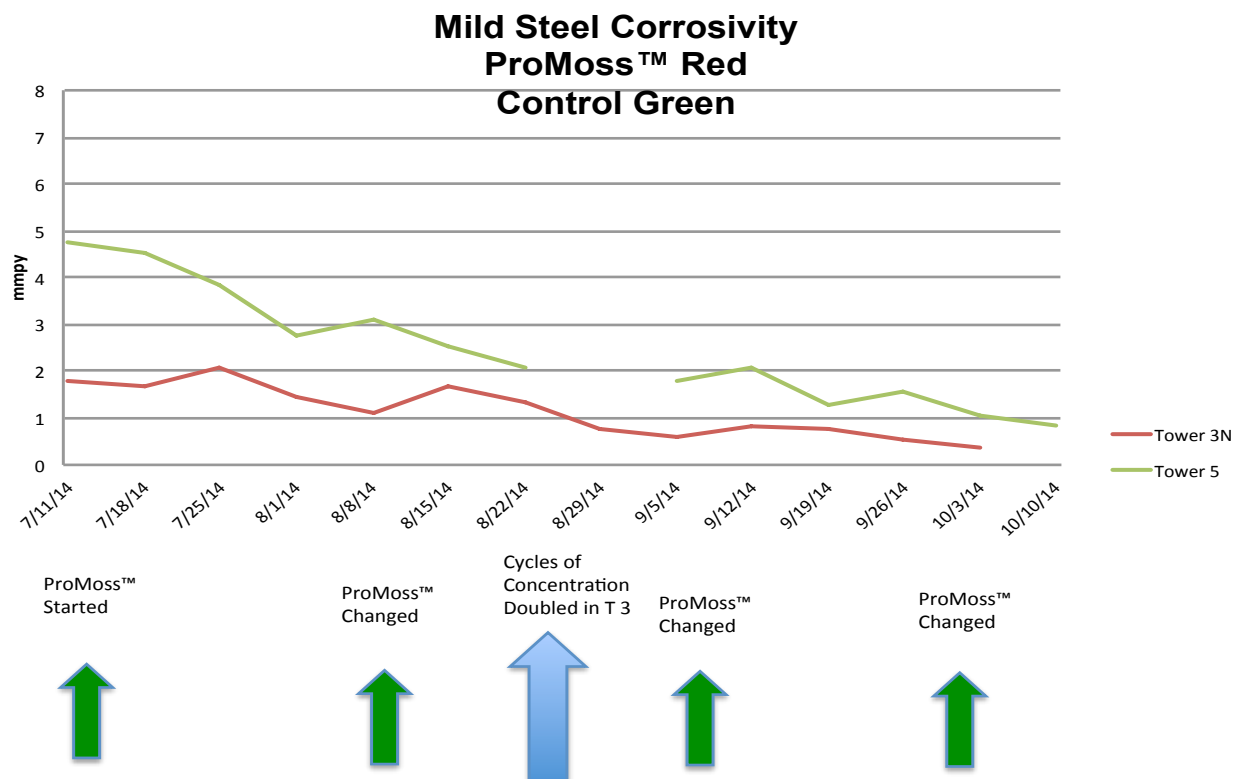
Cooling Towers – Calcium ProMoss™ Red Control Green



Calcium hardness measurements were similar in both towers until the cycles of concentration were increased. This resulted in an increase in the ProMoss™ treated tower compared to the control tower.

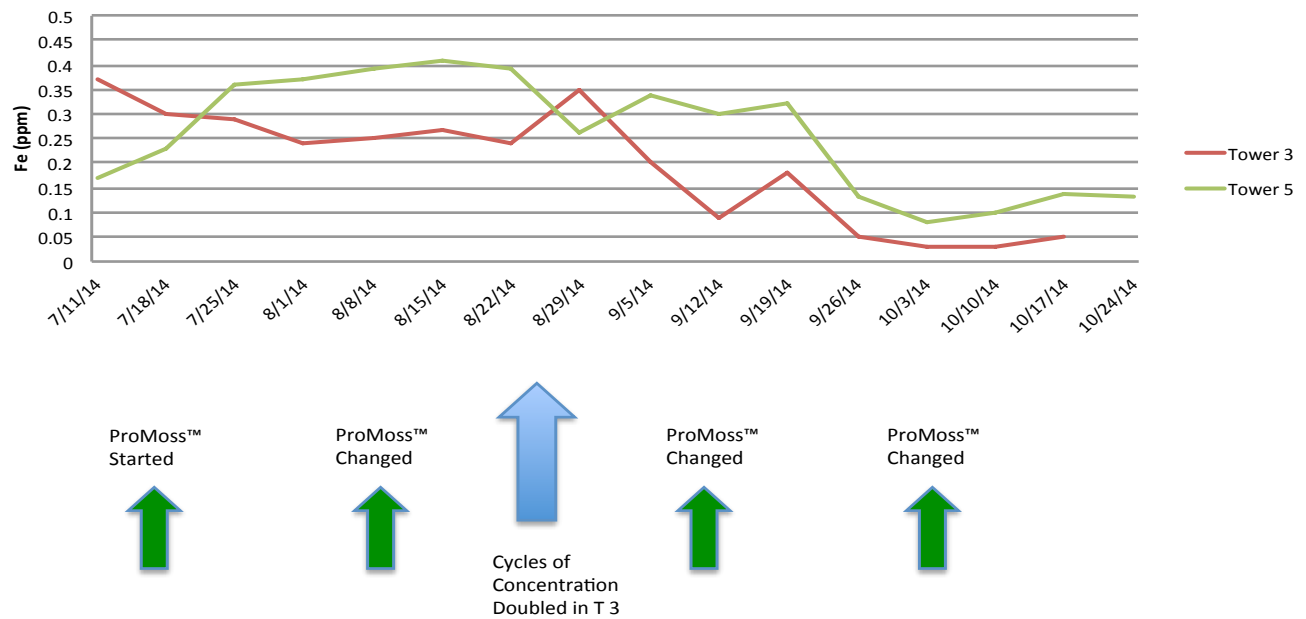


The Langlier Saturation Index (LSI) was calculated for both towers. Nalco was concerned with the +2 level in the ProMoss™ treated tower and predicted that the chiller would be significantly scaled. After the cooling season was over, the chiller was opened for cleaning and the only scaling was on the zinc anodes.



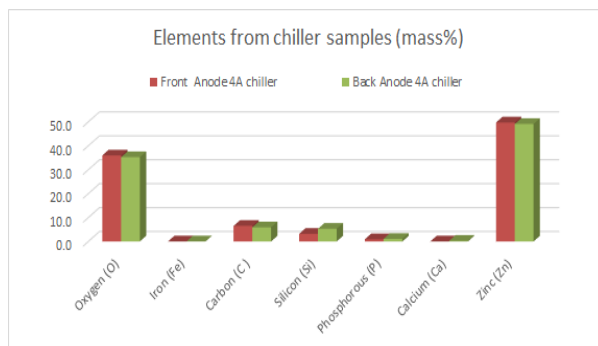
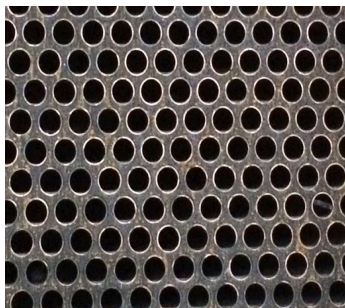
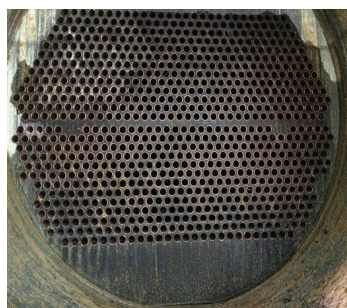
Corrosivity for mild steel measured with the linear polarization probe was significantly lower in the ProMoss™ treated tower compared with the control tower even after the cycles of concentration was doubled.

Cooling Towers – Fe ProMoss™ Red Control Green

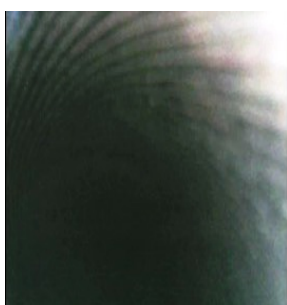


Iron levels in the water were significantly lower in the ProMoss™ treated tower and continued to decrease throughout the cooling season reflecting the ability of Sphagnum moss to absorb iron ions.

Chiller from Treated Tower



Zinc
Anodes



Inside Chiller
tubes

Mass percent [%]		
Element	Front Anode 4A chiller	Back Anode 4A chiller
Oxygen (O)	36.0	35.3
Iron (Fe)	0.047	0.079
Carbon (C)	6.55	5.91
Silicon (Si)	3.20	5.34
Phosphorous (P)	0.946	1.09
Calcium (Ca)	0.046	0.287
Zinc (Zn)	49.8	49.1

After the cooling season in 2014 was completed the chiller for the ProMoss™ tower was opened for cleaning. There was no corrosion in the tower and the only scale formation was on the zinc anodes. That scale was analyzed and found to be zinc and oxygen. The +2 LSI predicted that the chiller would be scaled, but no calcium scale was found. The calcium was being absorbed into the Sphagnum moss leaves and removed from the circulating water. Using a scope to inspect the chiller tubes, there was no visible corrosion or scale formation.

Conclusions for 2014 trial

- ProMoss™ treatment resulted in
 - Removal of years accumulated organic contamination and algae growth from the structure of the tower
 - Clarified the tower water
 - Controlled levels of Ca and Fe
 - Resulted in an increase in LSI with no evidence of scale formation
 - Maintained pH, TDS, Ca, Fe, corrosion for mild steel and copper after doubling the cycles of concentration during the peak of the cooling season.
 - Chiller had no corrosion or scale formation on the surface or down the tubes.
 - Resulted in a second year of use to test ProMoss™ with an onsite chlorine generation system for water treatment without delivered chemicals.

Creative Water Solutions

Contact Information

13809 Industrial Park Blvd.

Plymouth, MN 55441

Phone (763) 398-0141

Fax (763) 551-2572

info@cwsnaturally.com

www.cwsnaturally.com

