



*The SAFEST WATER In The World*

Module: Cooling Towers

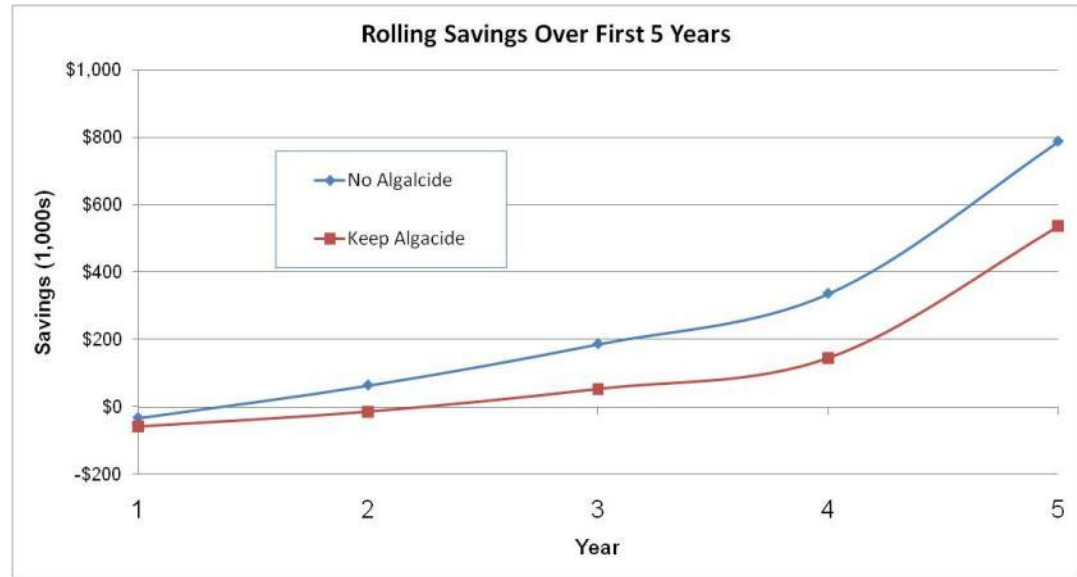
# Benefits in Cooling Tower Applications Include:

- ▶ Improved safety
- ▶ Cost effective
- ▶ Reduced environmental impact
- ▶ And...improved performance!



# Mixed Oxidant Solution Can Save Money By...

- ▶ Replacing multiple chemicals:
  - Hypochlorite
  - Bromine
  - And possibly others: algaecides, proprietary biocides
- ▶ Low cost of generation



# IMPROVED PERFORMANCE



# Cooling Towers May See Numerous Performance Improvements.

- ▶ Removal of biofilm
- ▶ Better residuals
- ▶ Reduced algae loading

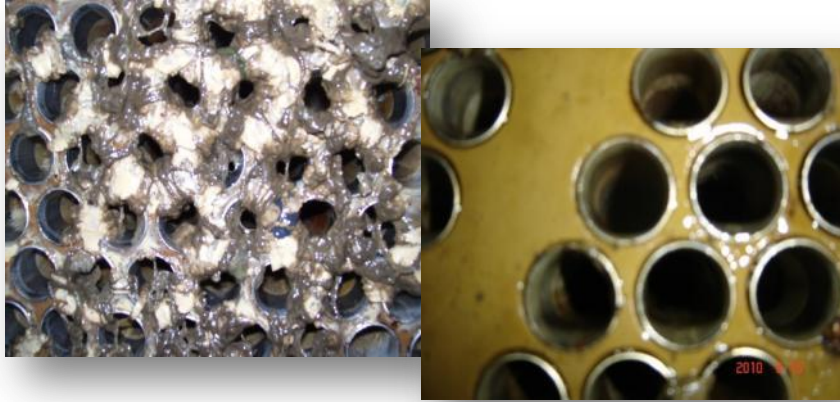


Filter recirculation pipe  
with sodium hypo



Filter recirculation pipe  
22 days after mixed oxidant solution

# Mixed Oxidant Solution Reduces Biofilm and Algae Fouling.



## **BEFORE MIOX**

Condenser Tube Sheet (Midwest Power Generation Site)

## **AFTER MIOX**

Condenser Tube Sheet after 2.5 months of using MIOX.



## **BEFORE MIOX**

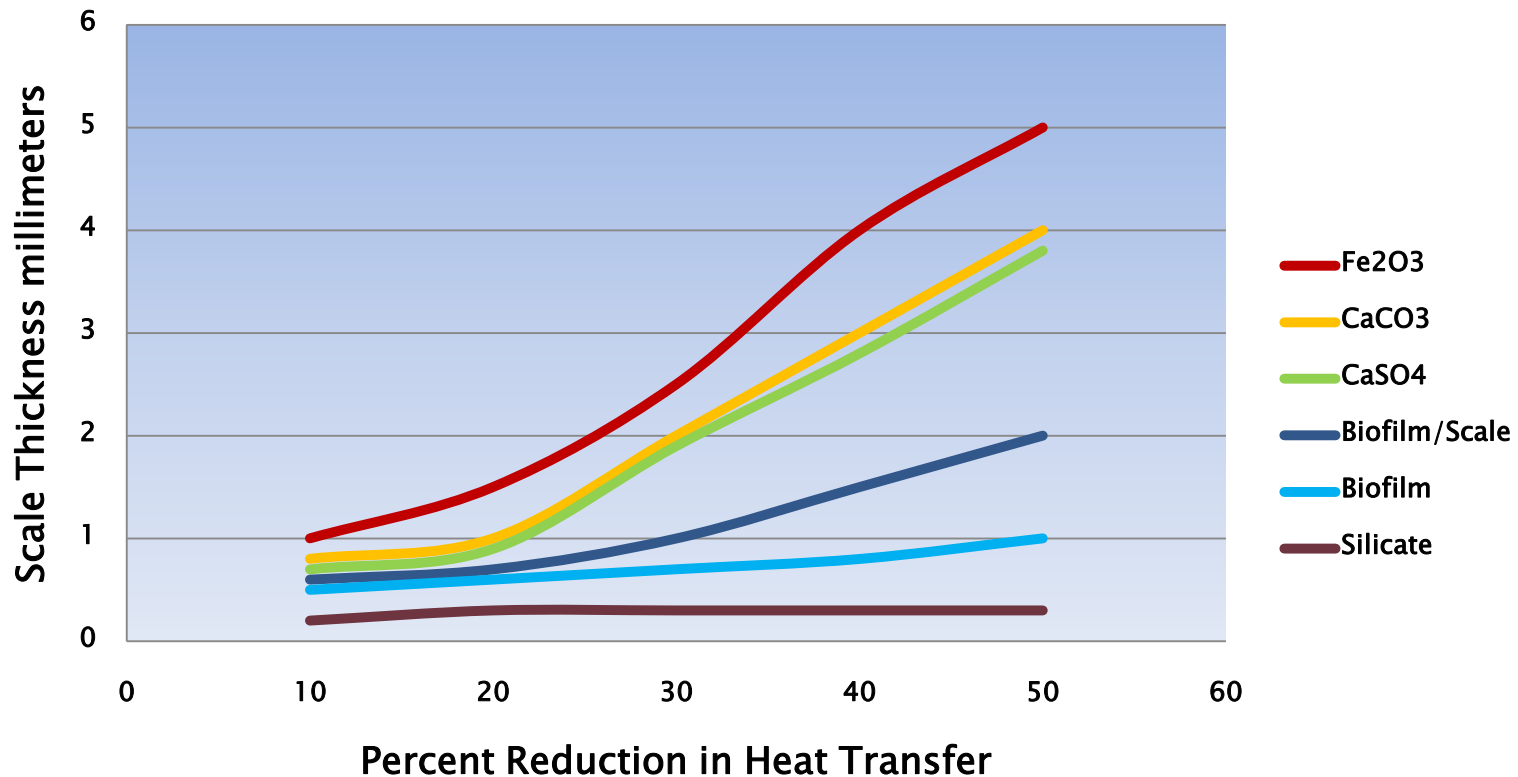
Biofilm is rampant with conventional biocide program for cooling tower application

## **AFTER MIOX**

Biofilm eliminated with mixed oxidant solution.

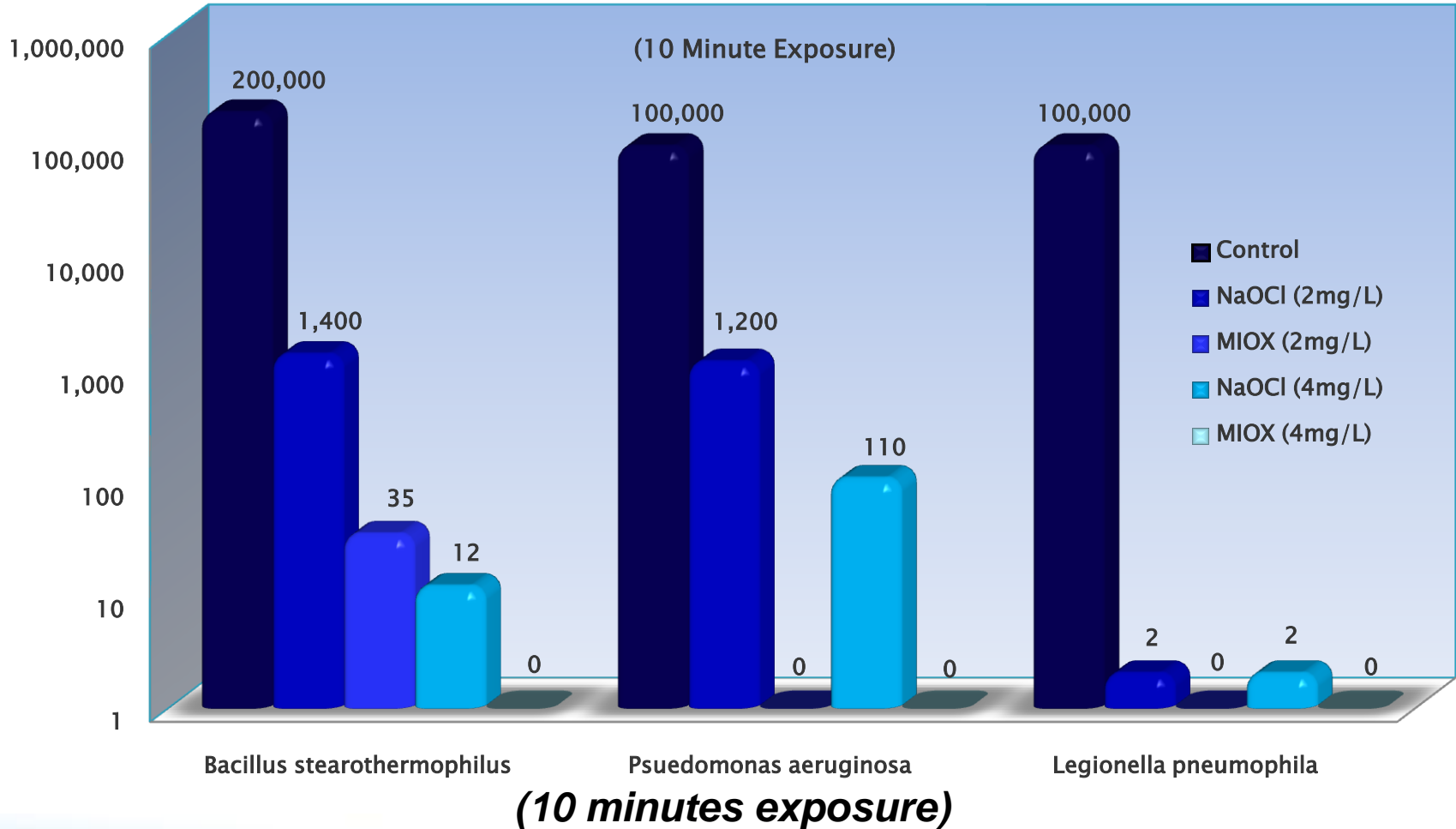


# Presence of Biofilm Reduces Thermal Efficiency.



- *Biofilm (1mm thick) Reduces Heat Transfer by 50%*
- *In a 200 ton chiller, energy costs can increase by 35%*

# Microorganism Kill in Simulated Cooling Tower Waters was Superior Using Mixed Oxidant Solution.



Larry Barton, PhD, University of New Mexico  
"Disinfection of Simulated Cooling Tower Water" - March 4, 1996



# Best Practice to Minimize Risk

- ▶ OSHA, Cooling Technology Institute, ASHRAE and others recommend maintaining a continual free halogen residual within the cooling tower system as a Best Practice to minimize the risks associated with *Legionella*.
- ▶ The mixed-oxidant solution has been shown to be very effective against *Legionella*.



*Legionella* Bacterium  
leaving host biofilm

# Mixed Oxidant Solution Offers Significant Benefits Over Standard Sodium Hypochlorite.

<b>Solution</b>	<b>Category</b>	<b>Cost Benefit</b>
Biofilm Removal	Operations	Longer Media Life
	Operations	Increased Plant Efficiencies
	Operations	Reduction of Chemicals
Safer Chemicals	Safety	Reduced handling & storage hazards
	Health	Reduction of Airborne Pathogens
Increased Efficiencies	Maintenance	Reduced Facility Maintenance
Reduced Logistics	Operations	Reduced Transportation
Reduced Costs	Operations	Industry Leading Operating Efficiencies



# Mixed Oxidant Solution is Less Corrosive than a Sodium Hypochlorite Solution.

0.2 mg/L DOSE			
Mixed Oxidant		Sodium Hypo	
Total Pb	Total Cu	Total Pb	Total Cu
Pb	.16	-	.20
Cu	-	.20	.47
Pb/Cu	.17	.10	.51

1.2 mg/L DOSE			
Mixed Oxidant		Sodium Hypo	
Total Pb	Total Cu	Total Pb	Total Cu
Pb	.14	-	.31
Cu	-	.17	.45
Pb/Cu	.14	.04	.48

## 4 WEEK AVERAGE CORROSION RATES, mg/L

\*\*Corrosion Study done by C&E Engineering Partners Inc. at Westerly, RI installation



# PROJECT PROFILES



# NIPSCO – Northern Indiana Power Plant

Saving over \$150,000/year in chemical costs for one tower



**Condenser Tube Sheet  
BEFORE MOS**



**Condenser Tube Sheet  
AFTER MOS**

- ▶ MIOX<sup>®</sup> 300 ppd Mixed Oxidant RIO<sup>™</sup>
- ▶ Replaced both chlorine and bromine for cooling tower water disinfection
- ▶ Partial retrofit using existing tanks
- ▶ Reduced price of disinfectant/oxidant by generating it on-site
- ▶ Generating a safer chemical below the 1% threshold for consideration as a hazardous material
- ▶ Improved chemical efficacy
- ▶ Reduced maintenance

***“Reducing our treatment regimen ...down to a single mixed oxidant product generated on site has resulted in substantial treatment chemical and labor cost savings.” -- Paul Schrock, NIPSCO Senior Chemist***



# Precious Metals Refinery, Ontario, Canada

## MIOX disinfects two cooling towers



- ▶ MIOX<sup>®</sup> SAL-40 Mixed Oxidant
- ▶ Installed April 2010
- ▶ Process cooling water, two towers
- ▶ Mixed oxidant solution chosen for advanced benefits including *Legionella* control

# Power Generation Station, Puerto Rico

## Biofilm removal in power plant & cooling tower



**MIOX on-site generator in portable building**



**Biofilm with conventional biocide program**



**Biofilm eliminated with mixed oxidant solution**



# Thermal Chicago Cooling Tower

## Algae and Biofilm Issues Solved



- ▶ Cooling basin cleared of algae in 2 weeks; biofilm cleared in 4 weeks
- ▶ No degradation of scale and corrosion inhibitors (phosphonates, polymer or azole)
- ▶ Low corrosion – mild steel corrosion rates at 0.9 to 1.4 mpy, yellow metal corrosion at <0.1 mpy
- ▶ Excellent microbial control even at elevated pH
- ▶ Easy to operate and maintain
- ▶ Eliminated 28,500 lbs of sodium hypo and isothiazolin and subsequent disposal of 51 chemical drums

# Case History:

## Thermal Chicago Cooling Tower

	<b>Before</b> <i>(Dual Biocide Program)</i>	<b>After</b> <i>(Mixed Oxidant Solution)</i>
<b>Aerobic Bacteria Count†</b>	<p>Consistent problems with biofilm in the basin of the cooling towers</p> <ul style="list-style-type: none"> <li>Bacterial counts in the bulk water averaged 10,000 CFU/ml</li> <li>Surface bacterial (sessile) counts averaged 100,000 - 500,000 CFU/ml.</li> </ul>	<b>Complete sterility</b> (< 100 CFU/mL) consistently
<b>Biofouling</b>	Accumulation of biofilms on cooling surfaces	<b>Removed existing biofilm</b> when and where the film was in contact with water
<b>Algae Growth</b>	Algae growth in the cooling water basin	<b>Algae removed and controlled</b> , no terbutylazine shocking was needed
<b>Residual</b>	low	0.6-0.7 FAC
<b>Scaling</b>	Managed using phosphonate/polymer program	<b>No adverse effect on scale formation</b>
<b>Water Clarity</b>	Somewhat cloudy water due to surfactant nature of biocides	Crystal clear water in the basin
<b>Corrosion*</b>	<p>Corrosion levels within industry norms (&lt;2 mils/yr. on steel surfaces; &lt;0.1 mil/yr. on copper surfaces)</p> <p>Copper heat exchange surfaces in good condition – azole program</p>	<p><b>Corrosion rates maintained within industry norms</b></p> <p>No effect on azoles used for copper; no effect on copper heat exchange surfaces</p>



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