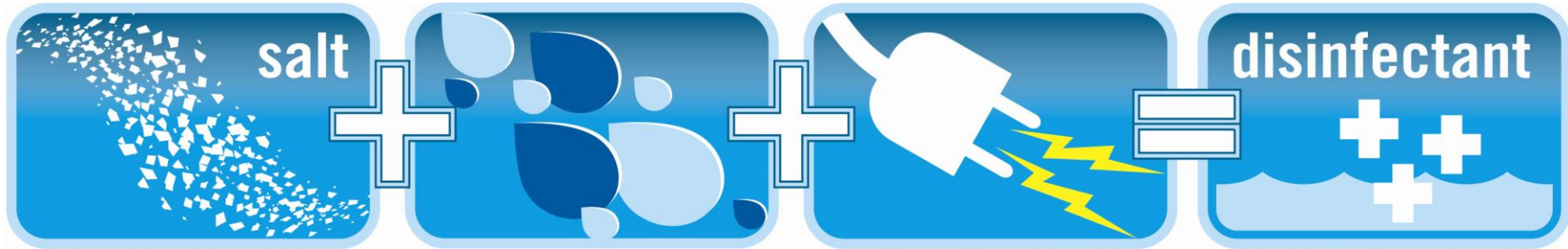




 *The **SAFEST WATER** In The World*

The Alternative for  
Greener Beverage Sanitization

# On-site Generation Gives Power to the User.

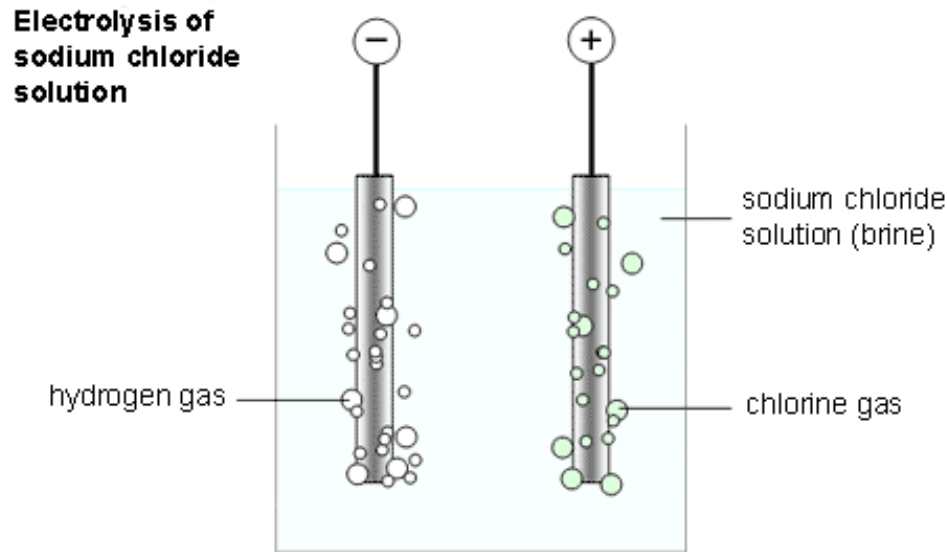


**The amount you need, when and where you need it (disinfectant for process water, sanitizer and cleaner for clean-in-place, etc).**

**Eliminates storage and handling of hazardous chemicals.**

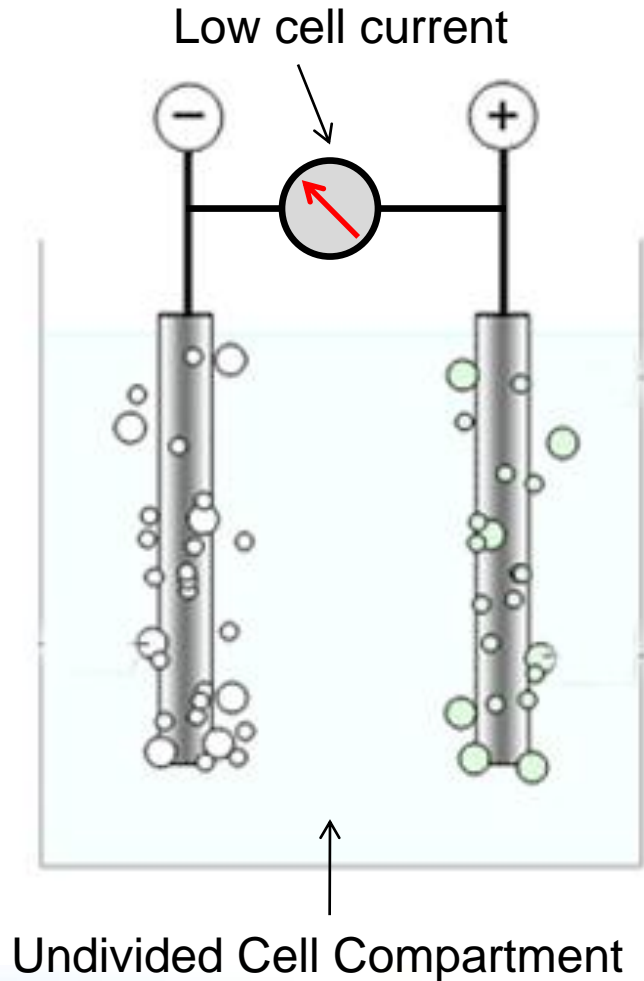
**On-site generation, electrochemically activated water (ECA) and electrolyzed oxidizing water (EOW) are all the same technology.**

# The Basics of On-Site Generation Chemistry:



- ▶ **Anode Reaction (+ Side)**  $2 \text{Cl}^- \rightarrow \text{Cl}_2 + 2 \text{e}^-$
- ▶ **Cathode Reaction (- Side)**  $2 \text{H}_2\text{O} + 2 \text{e}^- \rightarrow \text{H}_2 \uparrow + 2 \text{OH}^-$
- ▶ **Chlorine Hydrolysis Reaction**  $\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HOCl} + \text{Cl}^- + \text{H}^+$   
 $\text{HOCl} \rightleftharpoons \text{OCl}^- + \text{H}^+$

# Why Mixed Oxidant?

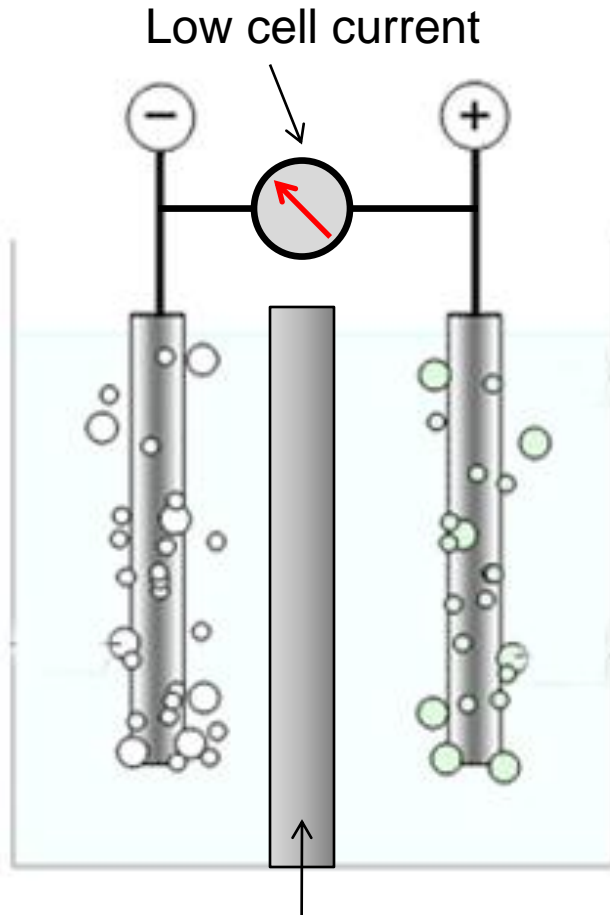


## #1 Hypochlorite On-Site Generator

- ▶ Produces single product: hypochlorite at pH 9
- ▶ High salt and energy conversion efficiencies
- ▶ Moderate capital equipment costs and low operating costs
- ▶ Easily scalable
- ▶ Good sanitization with low metal corrosivity

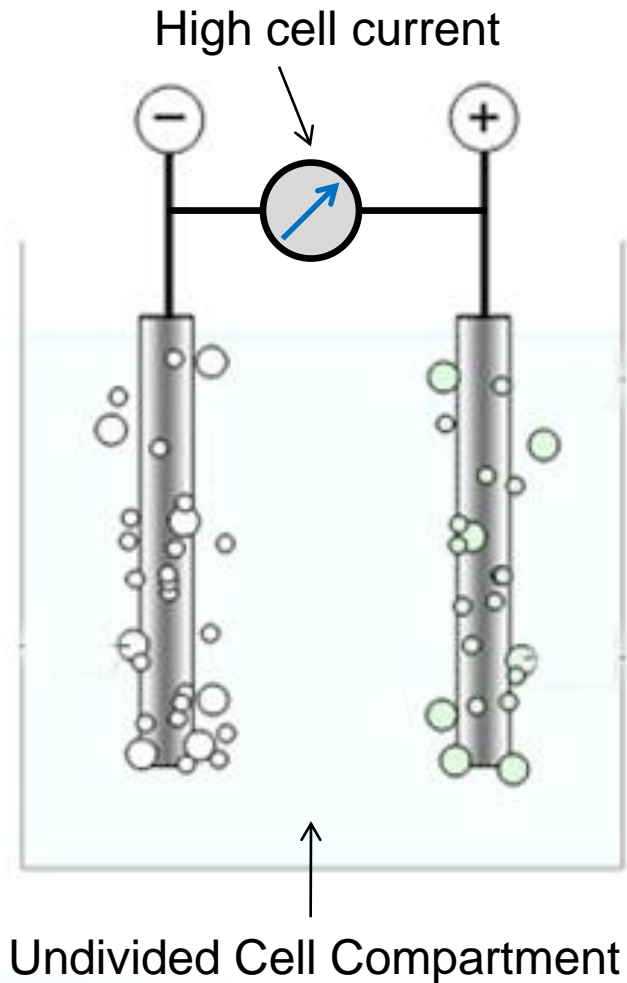
# Why Mixed Oxidant?

## #2 Dual Stream On-Site Generator



- ▶ Produces single dual products: hypochlorite at pH 2 (anolyte) and caustic at pH 11 (catholyte)
- ▶ Low salt and energy conversion efficiencies
- ▶ High capital equipment costs and moderate operating costs
- ▶ Difficult and costly to scale
- ▶ Good sanitization efficacy with high metal corrosivity

# Why Mixed Oxidant?

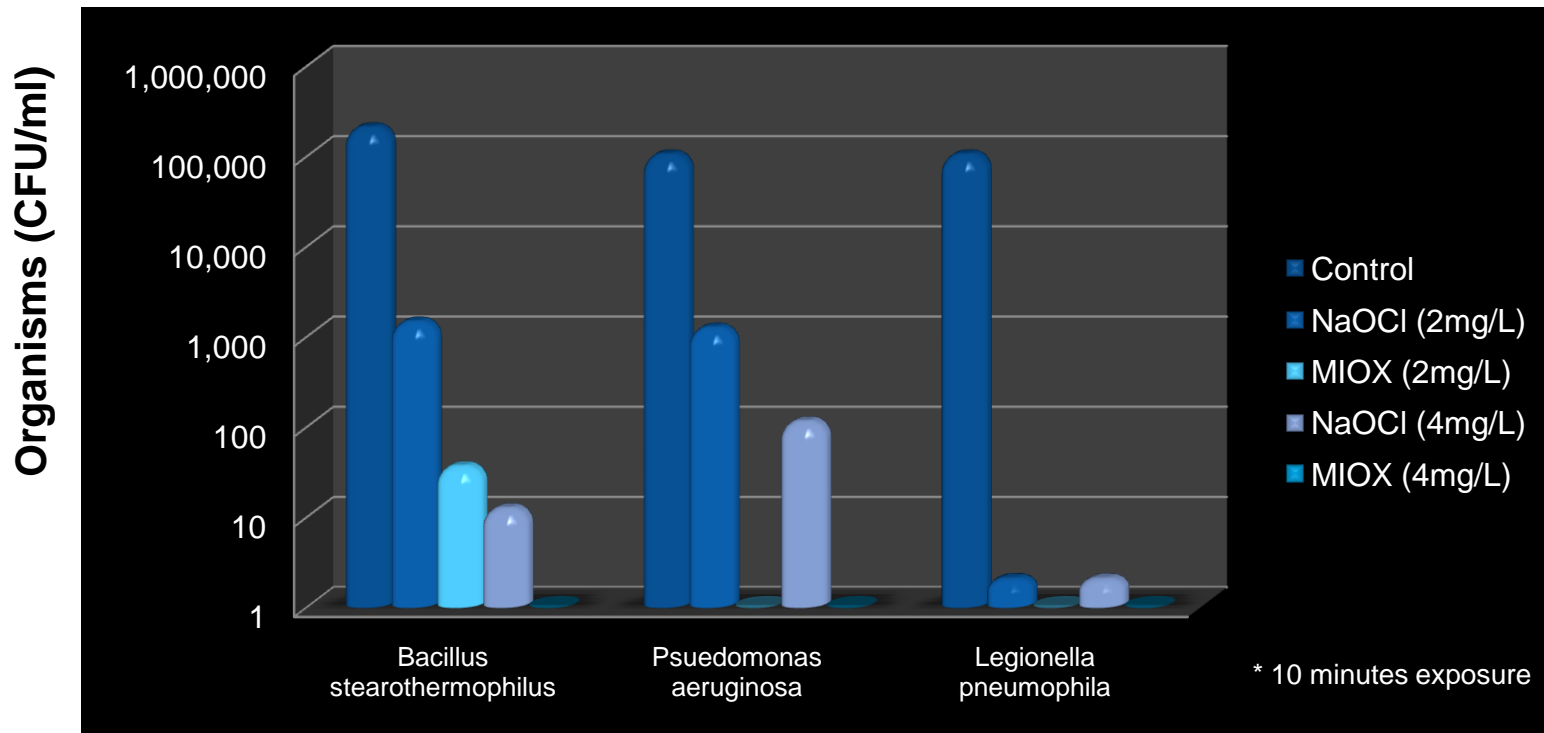


## #3 Mixed Oxidant On-Site Generator

- ▶ Produces single product: Mixed Oxidant at pH 9
- ▶ High salt and energy conversion efficiencies
- ▶ Moderate capital equipment costs and low operating costs
- ▶ Easily scalable
- ▶ Superior sanitization efficacy with low metal corrosivity

# Mixed Oxidants Effective against *Legionella*

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*.

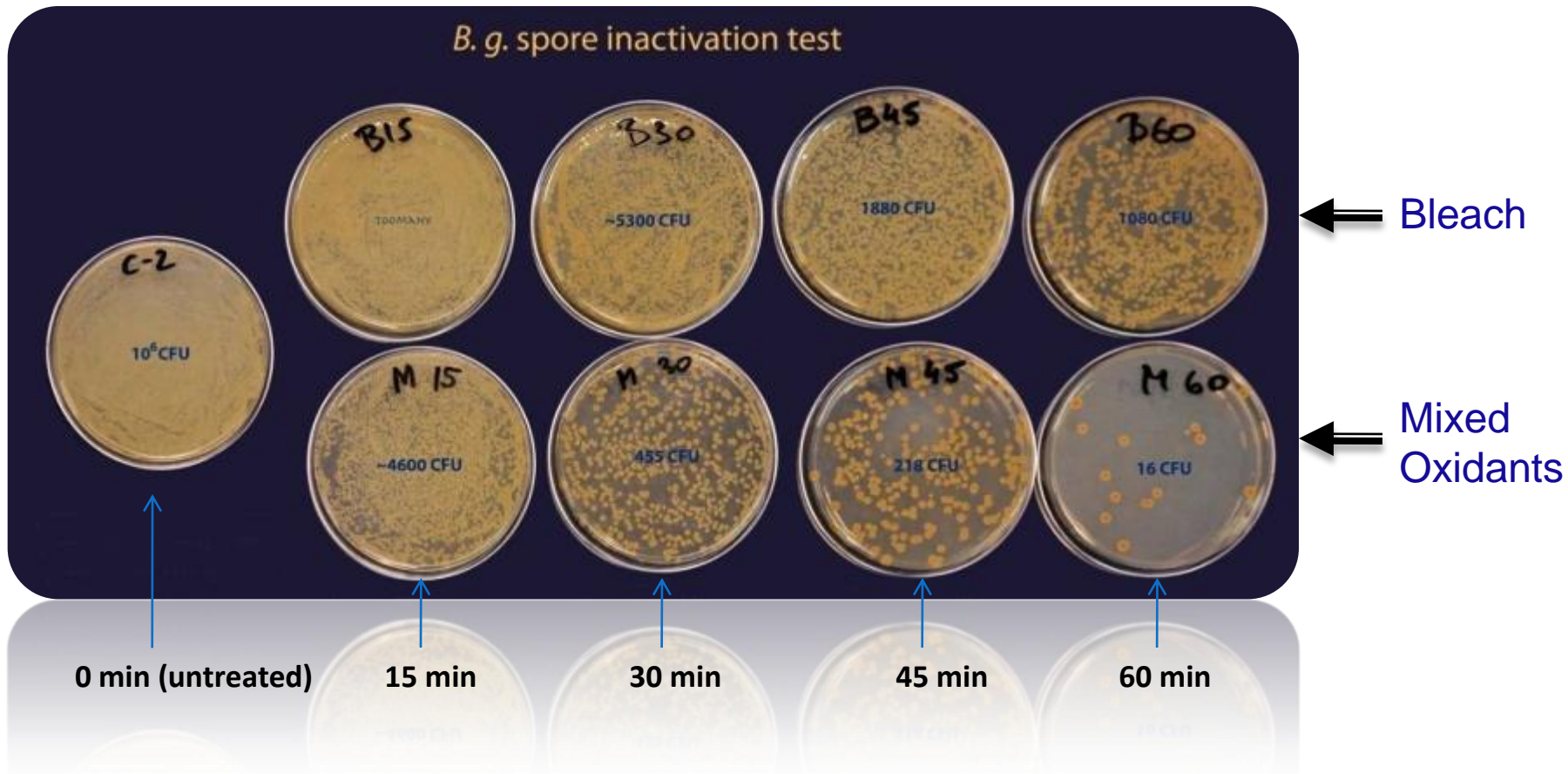


Larry Barton, PhD, University of New Mexico  
"Disinfection of Simulated Cooling Tower Water" - March 4, 1996



# Mixed Oxidants Studied by the CDC:

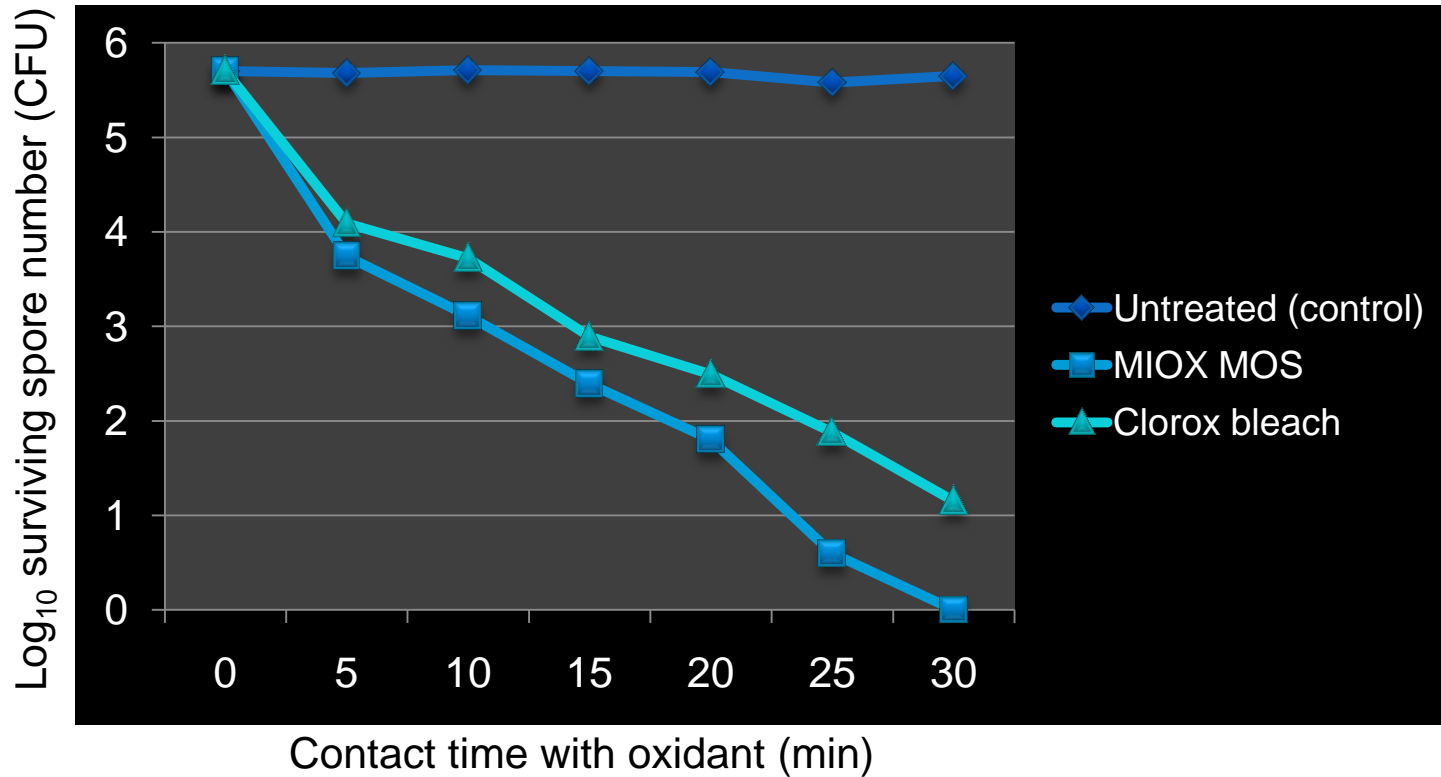
Bleach vs. Mixed Oxidants inactivating *Bacillus globigii* (*B.g.*)



Bajszar, 2009; Validated in 3<sup>rd</sup> party studies at the Centers for Disease Control and Prevention



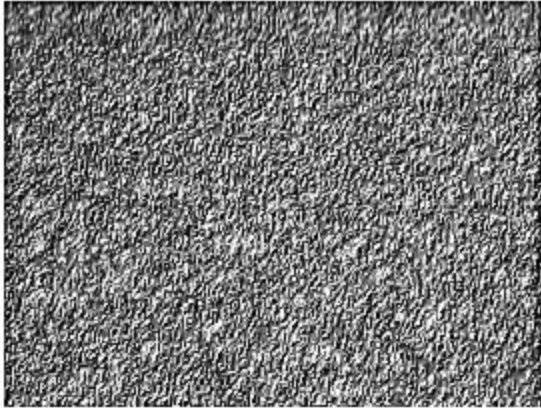
# Mixed Oxidant Inactivates *B.g.* Spores *Faster*.



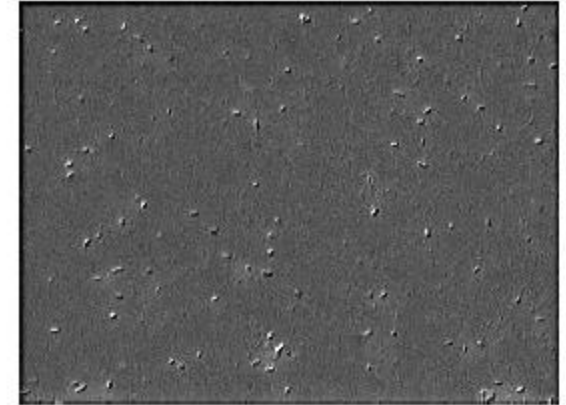
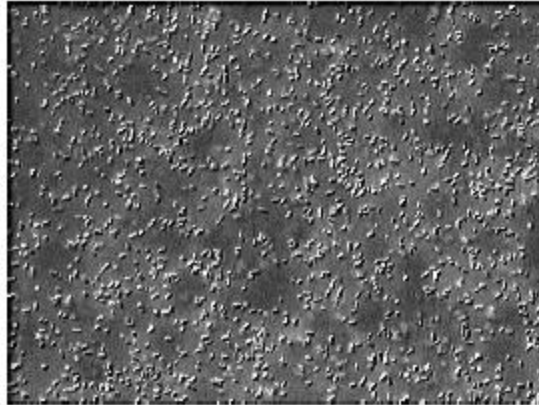
Bajszar, 2009; Validated in 3<sup>rd</sup> party studies at the Centers for Disease Control and Prevention



# Effects of MIOX Mixed Oxidant Solution (MOS) on *Pseudomonas putida* biofilm



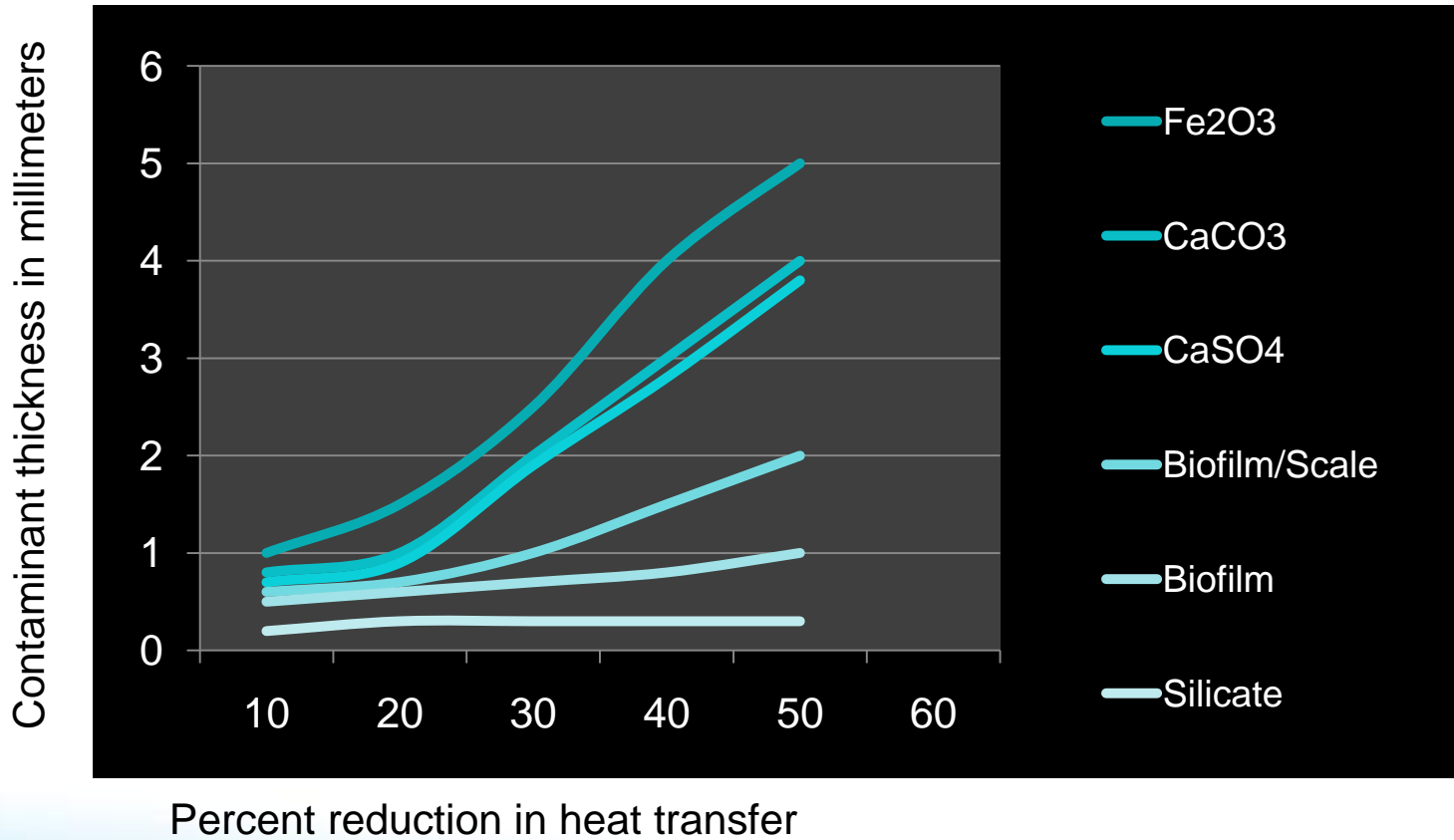
**At 35 minutes:**  
**Unchecked biofilm growth**



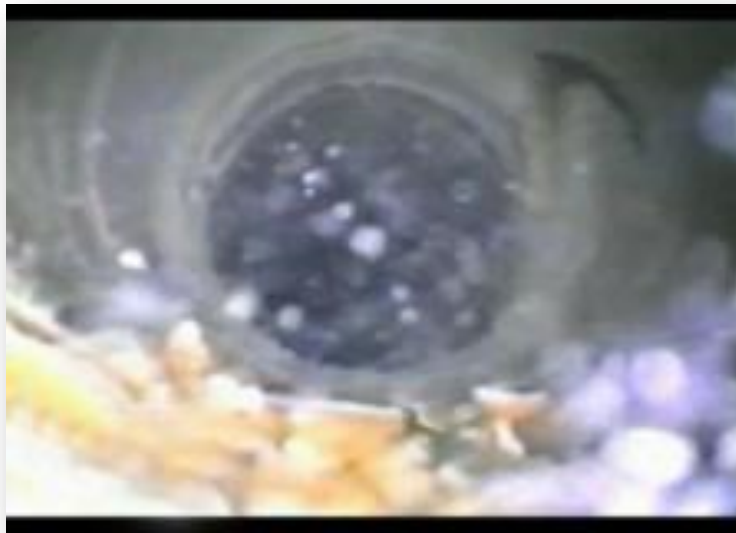
**At 5 hours + 40 minutes:**  
**Biofilm cells nearly undetectable**

# Mixed Oxidant Improves Cooling Tower Efficiency.

- ▶ By using mixed oxidant in cooling towers, biofilms are cleared out within weeks
- ▶ Removal of biofilm can lead to a greener, more energy efficient cooling
- ▶ Mixed oxidant can reduce the number of biocides added to a cooling tower



# Mixed Oxidant Effectively Removes Biofilm.



Filter recirculation pipe  
with sodium hypo



Filter recirculation pipe  
22 days after mixed oxidants

# Mixed Oxidants Reduce 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**

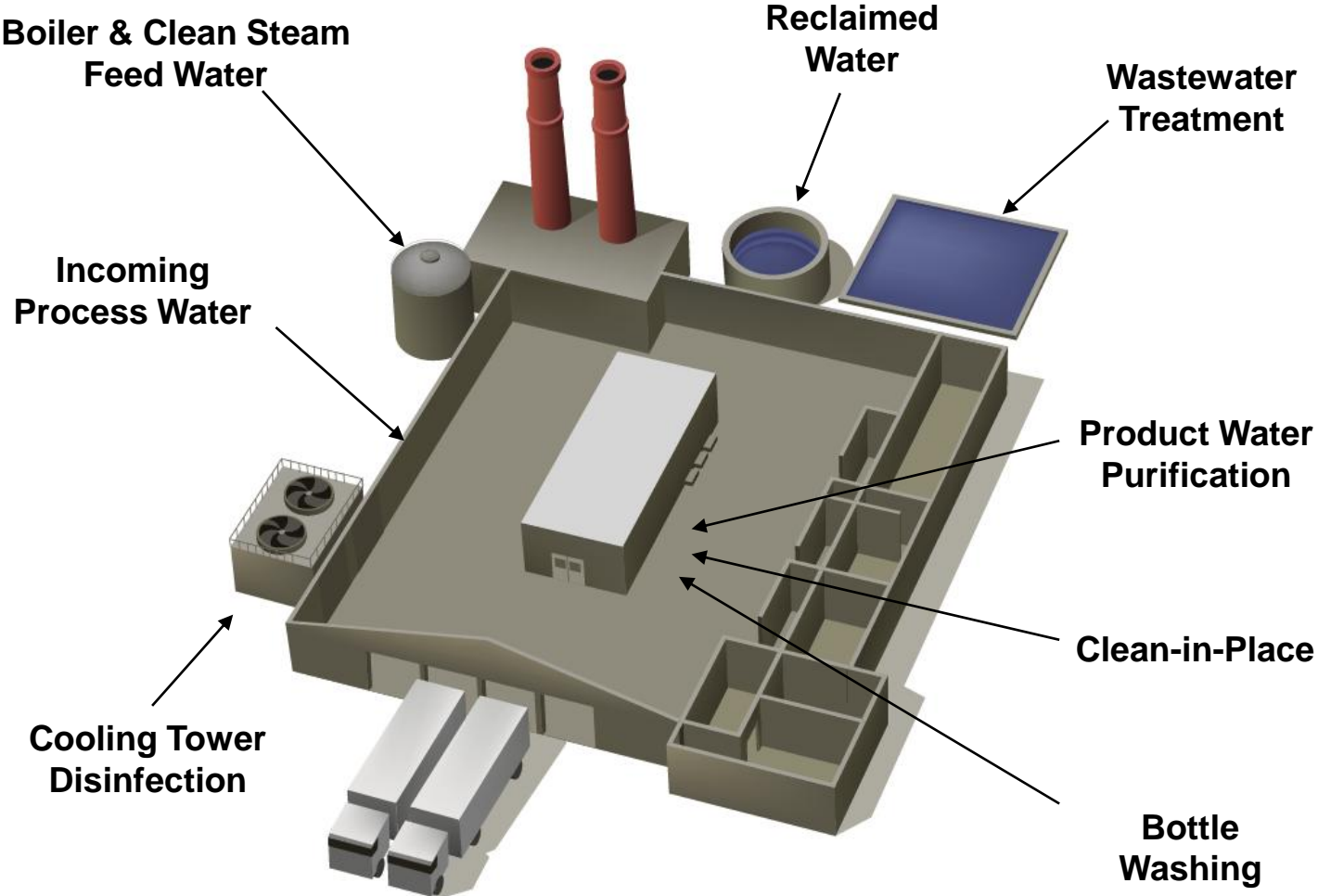
Algae is rampant with conventional biocide program for cooling tower application

## **AFTER MIOX**

Algae eliminated with mixed oxidants.



# Beverage Plant Typical Water Uses:



# MIOX Technology is Readily Scalable.

## **AE-4® Series**

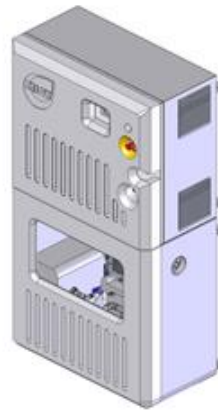
Mixed Oxidant: 4 PPD



## **VAULT™ Series**

Mixed Oxidant: 15-60 PPD

Hypochlorite: 20-100 PPD



## **RIO® Series**

Mixed Oxidant: 60-300 PPD

Hypochlorite: 100-500 PPD



# Reducing CIP Time Enhances Productivity.

Traditional Process: *Effective, but more steps wastes time and money.*



MIOX Process: *CIP using MIOX cuts the process by approximately **40%**, reducing downtime and saving money.*



# U.S. Bottling Plant Installation: Integration and Process Studies with MIOX

- ▶ Disinfection efficacy
- ▶ Cleaning capability
- ▶ Enhanced plant productivity:  
reduction in CIP cycle time
- ▶ Environmental impact: reduction in the  
use and storage of toxic chemicals and  
reduced energy consumption
- ▶ Integration with process control systems



# Bottling Plant (Carbonated Beverages) Mexico

Mixed oxidant for multi-point beverage application yields significant cost savings



- ▶ MIOX<sup>®</sup> RIO M2 Mixed Oxidant
- ▶ Installed June 2010
- ▶ Clean-in-Place
- ▶ Dosed in potable water treatment
- ▶ Wastewater
- ▶ Cooling towers
- ▶ External sanitation
- ▶ 45 CIP operations consecutive positive
- ▶ Cost savings expected: \$100,000/year over chemicals

# Bottling Plant (Carbonated Beverages) Mexico

MOS chosen for advanced benefits, biofilm removal



- ▶ MIOX<sup>®</sup> RIO M2 Mixed Oxidant
- ▶ Piloted May 2010
- ▶ Clean-in-Place
- ▶ Dosed in potable water treatment
- ▶ Wastewater
- ▶ External sanitation
- ▶ Iron content reduced from 5 ppm to 0.01ppm
- ▶ Positive flocculation results
- ▶ Cost savings expected: \$150,000/year over chemicals

# MIOX Bottling Plant Installations: Mexico



- ▶ **Three bottling facilities**
- ▶ **Mixed Oxidant applications include:**
  - Cold Clean-in-place
  - Intake Water
  - Cooling Towers
  - Wastewater Disinfection
- ▶ **Purchase Drivers include:**
  - Less than a year payback based on chemical usage
  - Reduced water and energy usage
  - Improved microbiological results
  - Reduced CIP time by approximately 40%
  - Meets environmental and sustainability goals

# MIOX Bottling Plant Installation: Colombia



Before MIOX



After MIOX



- ▶ Calcium hypochlorite replaced in 2007 with MIOX generated on site
- ▶ Water from the municipality and a well site is mixed
- ▶ Disinfectant must be added
- ▶ Disinfection for the following:
  - Beverages– Juice, Carbonated, Bottled water
  - Filter backwash
  - Cooling towers

# MIOX Mixed Oxidant: Lean & Green

- ▶ Reduced transportation footprint
- ▶ Reduced use of toxic chemicals
- ▶ Reduced energy and water use in CIP
- ▶ Improved cooling tower efficiency



# Minimizing Chemical Transportation Reduces Carbon Footprint.

- ▶ When cleaning and disinfecting chemicals are delivered to a bottling plant, the major components of these deliveries is water
- ▶ When using OSG, the only physical delivery is salt, which is delivered without additional water



**Delivery of disinfecting and cleaning chemicals**



**Delivering salt for the same sanitizing equivalent from an OSG**

# Minimizing Hot CIP Cycles Reduces Water & Energy Consumption.

Why use this...



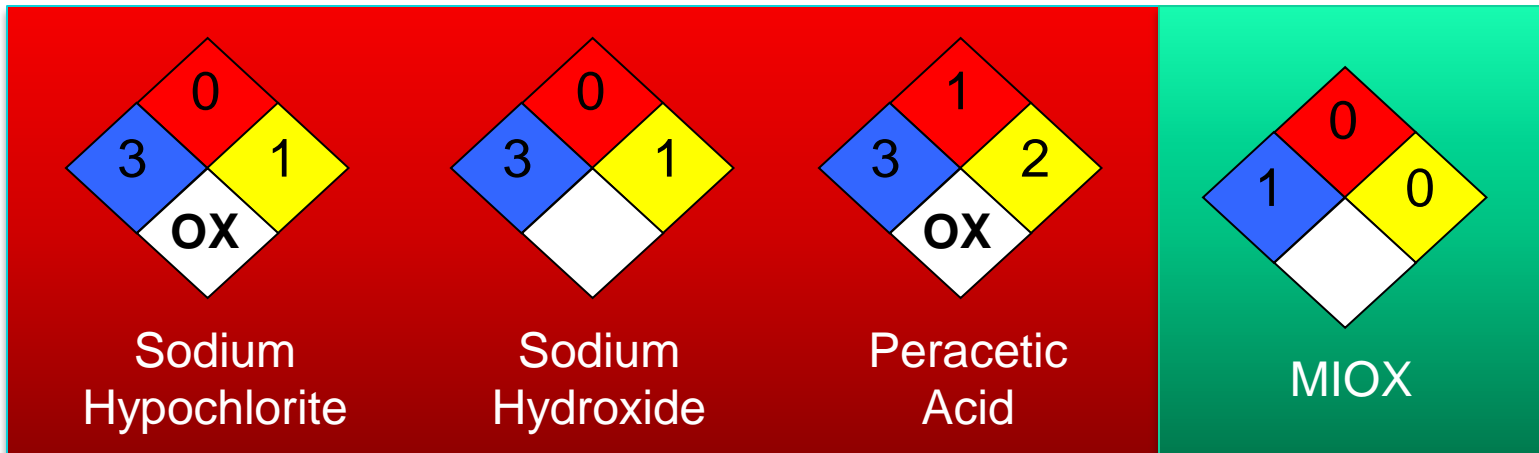
when you only need this?



- ▶ MIOX CIP requires less water to fully clean a bottling line
- ▶ Decreasing hot CIP cycles saves significant energy needed to heat cleaning and sanitizing solutions

# Mixed Oxidant Replaces Toxic Chemicals.

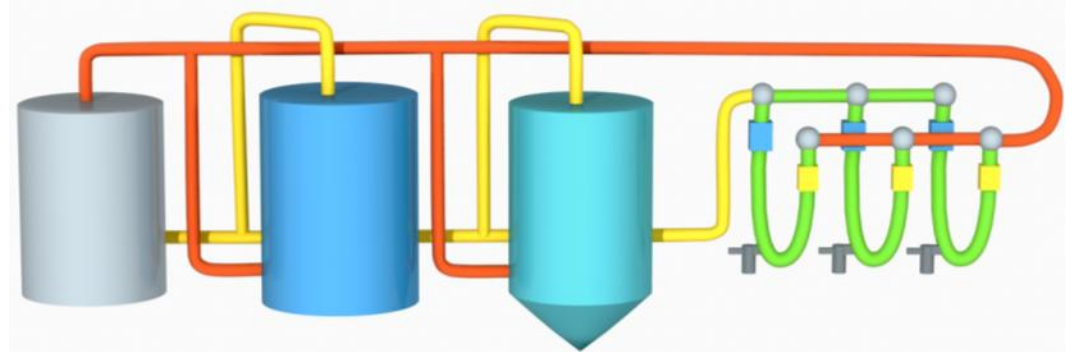
- ▶ Mixed Oxidant can replace or reduce consumption of toxic chemicals such as bulk sodium hypochlorite, peracetic acid, and sodium hydroxide
- ▶ Decreasing the amount of these chemicals stored on site results in lowered exposure to risks such as worker injury and accidental environmental discharge



# MIOX is Committed to Beverage Industry R&D.



Corrosion Studies



Laboratory Clean-in-Place

## Cleaner Water Research

- ▶ Advance Oxidation for removal of organics
- ▶ Technology for removal of oxyhalides



# MIOX: A Winning Team



- ▶ Top 10 Winner of **The Artemis Project's** Top 50 Water Companies
- ▶ Top 100 Winner of **AlwaysOn GreenTech** Award
- ▶ Nominated for **EPA's Green Chemistry** Award
- ▶ President's "**E**" **Award for Excellence** in Exporting
- ▶ Popular Science's **Grand Award Winner**
- ▶ Nominated for US Commercial Services **SBA Exporter of the Year**
- ▶ 1 of 17 participants in **Clean Energy Trade Mission**
- ▶ Department of the Navy **Top 50 SBIR/STTR Success Stories**



# Our expert technical staff is available to help with any application.



- ▶ **Susan Rivera, Ph.D.**, Manager – expert in OSG technology applications, experience with International Security, Science Policy, and Regulatory Affairs



- ▶ **Wes Bradford, Ph.D.**, Chief Chemist – expert in water chemistry applications for potable water, waste water, and cooling towers, with over 16 years experience with mixed oxidants.



- ▶ **Andrew Boal, Ph.D.**, Research Scientist. Expert in Chemistry with over 14 years of scientific research experience and over 50 publications in the scientific literature.





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1-888-MIOX H2O  
(1-888-646-9426)  
[www.miox.com](http://www.miox.com)

