



## MIOX Improves *Legionella* Control: Legionnaire’s Disease, a Result of Inadequate Water Disinfection, is Preventable

### The Problem:

Legionnaires’ disease (LD), the more severe form of legionellosis, is characterized as a type of pneumonia. Legionellosis is caused when *Legionella pneumophila* or other *Legionella* species are introduced to a host as an aerosol. The infection can be fatal.

*L. pneumophila* is a ubiquitous aquatic organism that thrives in warm environments (32°- 45°C) and causes over 90% of LD in the U.S. Cooling towers, showers, spa pools, faucets, and potable water systems that circulate contaminated water are capable of producing a potentially lethal aerosol.

### The Solution:

On-site generated mixed oxidants using salt, water, and electricity provide one of the best options available for control of *Legionella*, ultimately resulting in improved energy efficiency and elimination of biological hazards. Destruction of biofilm removes the sessile bacteria, eliminating the possibility of Legionnaires’ disease.

Most LD cases are associated with nosocomial (hospital) infections or with outbreaks. In the U.S., 23% of reported LD cases are nosocomial and 10%-20% can be linked to outbreaks. Of these cases 10-15% cause death with a substantially higher proportion of fatal cases occurring during nosocomial infection. Outbreaks tend to occur in healthy people staying in hotels or other buildings in which the cooling systems or showers have become contaminated by *Legionella* germs.<sup>1</sup>



*Legionella* Bacterium Leaving a Biofilm

### **Increased Risk of Disease**

*Legionella* outbreaks are a real threat to human health with a recent example in Toronto, Canada causing 21 deaths at a nursing home, and ultimately resulting in a \$600-million class action lawsuit. In 2002, a *Legionella* outbreak caused seven deaths in the UK and a manslaughter charge to one local official. Other recent examples include a Florida hotel, a Pennsylvania nursing home, a N.Y. correctional facility, and a South Dakota restaurant. In Murcia, Spain, 449 cases of LD were confirmed and 6 of those people died when a cooling tower released *L. pneumophila* into the environment.<sup>2</sup> The Centers for Disease Control and Prevention (CDC) estimates 10,000 to 15,000 persons are reported infected annually in the United States, and others estimate 100,000 or more annual cases due to poor reporting and misdiagnosis.<sup>1</sup>

### **Mixed-Oxidant Proven (MOS) More Effective Against *Legionella***

Studies conducted at the University of New Mexico comparing equivalent chlorine concentrations of hypochlorite to MOS showed that after 10 minutes of exposure at a pH of 8.0, MOS achieved total kill against *L. pneumophila* and *P. pseudomonas* while chlorine alone did not.

Microorganism	Initial Microorganism Concentration	Mixed Oxidants (2 mg/L)	NaOCl (2 mg/L)
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<sup>1</sup> [http://www.hcinfo.com/legionnaires\\_disease.htm](http://www.hcinfo.com/legionnaires_disease.htm), Accessed August 28, 2007

<i>Legionella pneumophila</i>	1 x 10 <sup>5</sup>	0 CFU/mL	> 2 CFU/mL
<i>Pseudomonas aeruginosa</i>	1 x 10 <sup>5</sup>	0 CFU/mL	1,200 CFU/mL

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

## Legionella and Biofilm

*Legionella* associates with biofilm, a gelatinous layer consisting of microbial cells, the polysaccharide biopolymer they produce, and debris extracted from the recirculating water. The films continuously erode and disperse through the water system during normal operation, increasing the risk of inhaling a sufficient number of the airborne bacteria to cause LD. Studies show that chlorine-based mixed-oxidant solution (MOS) is more effective at removing biofilm from the water system hardware than hypochlorite (chlorine) alone.<sup>3</sup> MOS strips the biofilm and its polysaccharide substrate while chlorine only affects the bacterium on the surface of the film. Complete removal of the film eliminates one of the breeding grounds of *Legionella* bacteria.



a biofilm slime is visible.

**Right:** Pipe treated with MOS.

## MIOX Meets or Exceeds Professional Trade Organization Recommendations

Several international trade associations including JCAHO and AWT have recommended that health care facilities conduct a risk assessment of their potential sources of *Legionella* and develop a management plan for maintenance and operation of their water systems.<sup>4</sup> MIOX MOS can be a solution provider for these applications. *L. pneumophila* survives typical chlorine disinfection. The Cooling Tower Institute recommends hyperhalogenation at 5 mg/L for at least 6 hours if the bacterial condition of the cooling tower system is unmanageable. If biofilm exists, the reports recommend eliminating biofilm as well as amoeba and other protozoa that serve as hosts for *Legionella*. Not only does MIOX MOS inactivate these microorganisms at practical water treatment doses as Free Available Chlorine (FAC), it also eliminates biofilm and prevents scale formation. The CTI report recommends dipslide counts of <10,000/mL. Systems using MIOX MOS for routine disinfection maintenance report dip slide counts of <1,000/mL<sup>5</sup>. Finally MOS may be run continuously through the system or a residual may be held at 0.2-0.3 mg/L for one hour each day. This is in contrast to "halogen residuals" which according to these reports must be held at 1.0mg/L for at least one hour each day.

<sup>1</sup> [www.cdc.gov](http://www.cdc.gov) Accessed on Aug 30, 2006.

<sup>2</sup> Garcia-Fulgueiras, A., et al., "Legionnaires' Disease Outbreak in Murcia, Spain" *Emerg. Infect.* 9, 915-921, 2003.

<sup>3</sup> a) Phipps, Don Jr. and Grisel Rodriguez, Water Resources and Technology Department, Orange County Water District, California. Comparison of the Efficiency of Bacterial Removal and Reduction of Bacterial Viability by Mixed-Oxidant Solution (MOS) and Chlorine (as NaOCl) on a Reverse Osmosis Membrane. June 2001.; b) Crayton, Cyndi, et al. Montana Water Resources Center, Montana State University. Final Report on the Validation of Mixed Oxidants for the Disinfection and Removal of Biofilms from Distribution Systems. October 1997.

<sup>4</sup> LEGIONELLA 2003: An Update and Statement by the Association of Water Technologies. Downloaded Aug. 30, 2006 from <http://www.awt.org/>; The Joint Commission for the Accreditation of Healthcare Organization (JCAHO) and Joint Commission International (JCI) standard (EC 1.7).

<http://www.jointcommission.org/> Accessed July 23, 2006. Cooling Technology Institute. Legionellosis Guideline: Best Practices for Control of Legionella, July, 2006.

<sup>5</sup> Bradford, W., "A Comparison of Comments and Recommendations of the Cooling Technology Institute Report entitled "Legionellosis – Guideline: Best Management Practices for control of Legionella", CTI, 2000, and Observed Performance of MIOX Systems in Cooling Tower Maintenance." July, 2000.