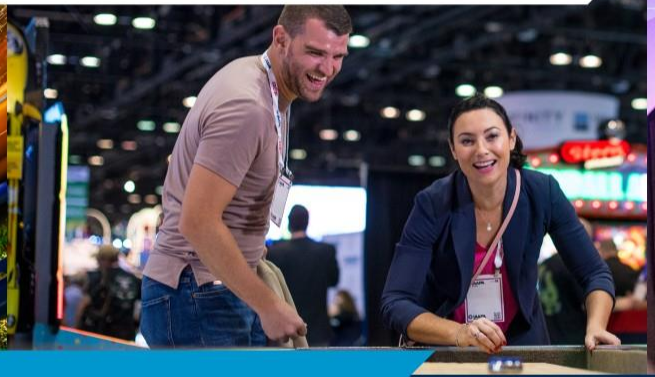
# IAAPA® EXPO



**CONFERENCE:** Nov. 16–19, 2020
**TRADE SHOW:** Nov. 17–20, 2020

IAAPA.org/IAAPAExpo

@IAAPAHQ | #IAAPAExpo

# AOP & UV: The Facts & Figures Behind Better Water Care

Tom Schaefer
Technical Sales Director
Clear Comfort

# Supplemental / Secondary

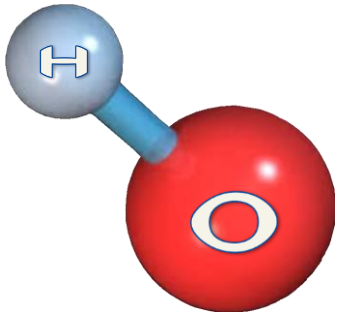
## AOP (Advanced Oxidation Process)

## Ultraviolet



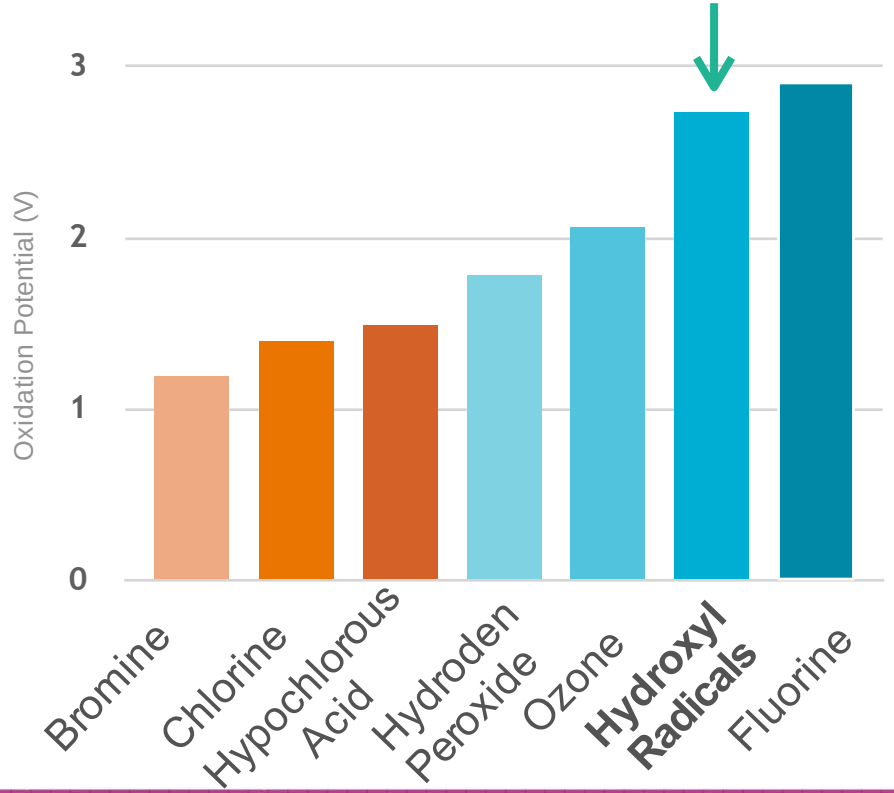
# Innovation


# AOP = Hydroxyl Radicals



POWERFUL HYDROXYL-BASED AOP

# Potency of Oxidizers




Inspired by nature, AOP creates hydroxyl radicals, which are the most **powerful oxidative compounds available for recreational water treatment**

# Speed: Reaction Rate Constants
## *Ozone vs Hydroxyl Radicals*

| Compound | Ozone k[O3] | Hydroxyl k[OH*] |
|---|---|---|
| Olefins | 1000 to $4.5 \times 10^5$ | $10^9$ to $10^{11}$ |
| S-Organics | 10 to $1.6 \times 10^3$ | $10^9$ to $10^{10}$ |
| Phenols | $10^3$ | $10^9$ |
| N-Organics | 10 to $10^2$ | $10^8$ to $10^{10}$ |
| Aromatics | 1 to $10^2$ | $10^8$ to $10^{10}$ |
| Acetylenes | 50 | $10^8$ to $10^9$ |
| Aldehydes | 10 | $10^8$ |
| Ketones | 1 | $10^8$ to $10^9$ |
| Alcohols | $10^{-2}$ to 1 | $10^9$ to $10^{10}$ |
| Alkanes | $10^{-2}$ | $10^6$ to $10^8$ |


NBA


NFL


NHL

# Decades of Science - Secondary

- 1995 Photocatalytic inactivation of coliform bacteria and viruses in secondary wastewater effluent
- 1998 Free Radicals in Viral Pathogenesis: Molecular Mechanisms Involving Superoxide and NO
- 2004 Microbicidal efficacy of an advanced oxidation process using ozone/hydrogen peroxide in water treatment
- 2007 The Return of Ozone and the Hydroxyl Radical to Wastewater Disinfection
- 2008 Photocatalytic inactivation of viruses using titanium dioxide nanoparticles and low-pressure UV light
- 2010 Investigating synergism during sequential inactivation of MS2 phage and Bacillus subtilus spores with UV/H2O2 followed by free chlorine
- 2012 Inactivation of adenovirus using low-dose UV/H2O2 advanced oxidation
- 2012 Role of Hydroxyl Radicals and Mechanism of *Escherichia coli* Inactivation on Ag/AgBr/$TiO_2$ Nanotube Array Electrode under Visible Light Irradiation
- 2016 Inactivation of Escherichia coli. Bacteriophage MS2 and Bacillus Spores under UV/H2O2 and UV/Peroxxdisulfate Advanced Disinfection Conditions.

## Measurement of Inactivation of *Cryptosporidium parvum* and *Bacillus subtilis* Spores using the Clear Comfort System

Karl Linden Research Group 6/15/201
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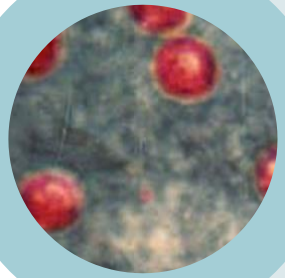
University of Colorado Bo



**Introduction:**
Cryptosporidiosis is a highly contagious gastrointestinal illness caused by the protozoa known as *Cryptosporidium*. Both the microbe and the disease are commonly known as "Crypto." *Cryptosporidium* is the cause of one of the most common recreational waterborne diseases in the United States, and the protozo characterized by an outer shell resistant to chlorine and many other disinfection chemicals.

Increased occurrences of this chlorine tolerant microorganism have directly resulted in higher downtimes with longer duration in public pools. A sing *Cryptosporidium* oocyst may be sufficient to cause symptoms in immunocompromised individuals and infants. The net result is low enues at higher operational costs while instilling fear into the patrons th on clean and safe pool environments. Next generation technologies and acti ie solutions for pools are in high demand to control such outbreak occurrences.

**Aim:**
Test the dose response of the Clear Comfort with *Cryptosporidium* oocysts and Bacillus spores over a 400-minute time period at a 2-Liter per minute air flow rate in a dechlorinated tap water matrix.

**Method Summary:**
*Cryptosporidium parvum* Iowa isolate (Harley Moon) was obtained from Waterborne Inc. passed through mice. $10^8$ oocysts of viable *C. parvum* were harvested and stored in 10 mM phosphate buffer and the oocysts were used within 30 days from shedding to experiments.

Exposed *Cryptosporidium* oocysts to a range of doses (0 min, 15 min, 60 min, 150 min, 300 min and 420 min) of Clear Comfort airflow in a 4-liter reactor, with sterile chlorine-free tap water. Chlorine free tap water was chosen to ensure disinfection efficacy from the Clear Comfort system was not compromised by water quality issues, so as to gain insights into the fundamental mechanisms of the disinfection process. A warm up period of 30 minutes where the disinfection system was run in the water was used before spiking the microbes into the disinfection chamber. pH,

# A chlorine tolerant parasite

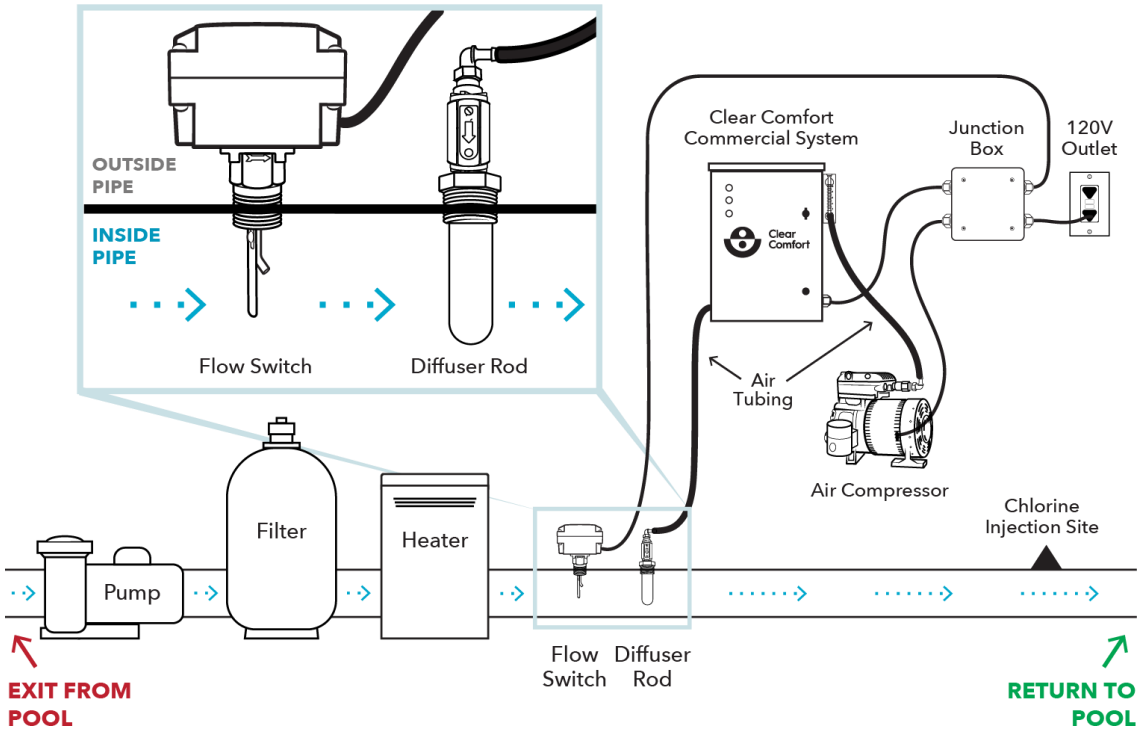
Third-Party Proven to
Reduce Up to **99.99% (4-log)**

University of Colorado Boulder

UNIVERSITY OF WASHINGTON

1 HOUR OR LESS

# Inline Diffuser Install Kit

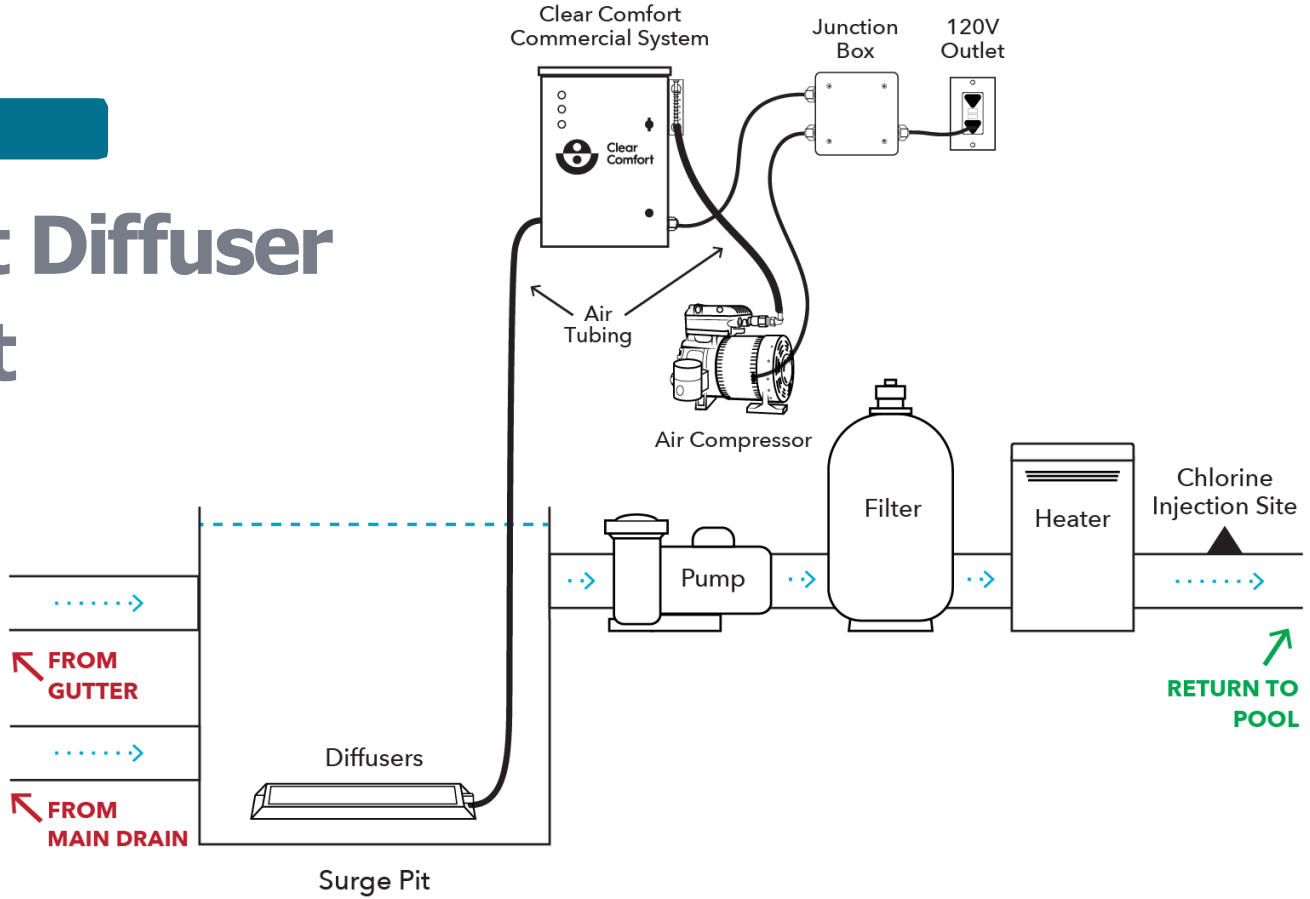





Clear Comfort

1 HOUR OR LESS

# Surge Pit Diffuser Install Kit






Clear Comfort

# EASY TO MAINTAIN

# Secondary Sanitizers - Multiple Benefits

**Disinfection By-Products** (DBP)


**Chlorine & Other Chemicals**

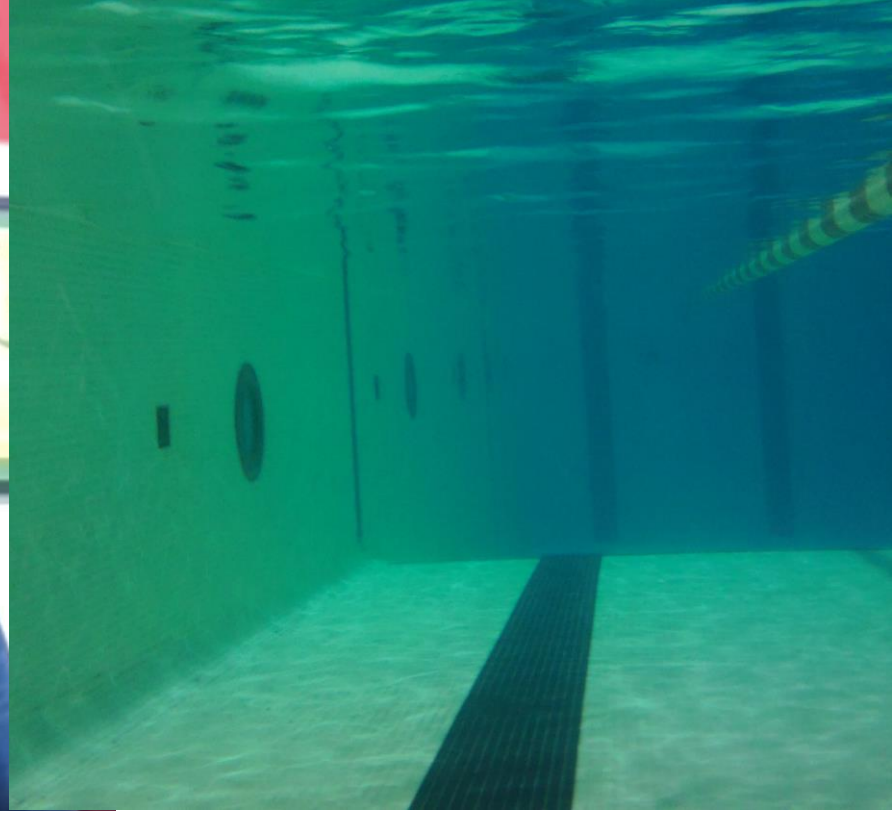

**Combined Chlorine** Compared to UV


Chlorine-Resistant **Cryptosporidium**

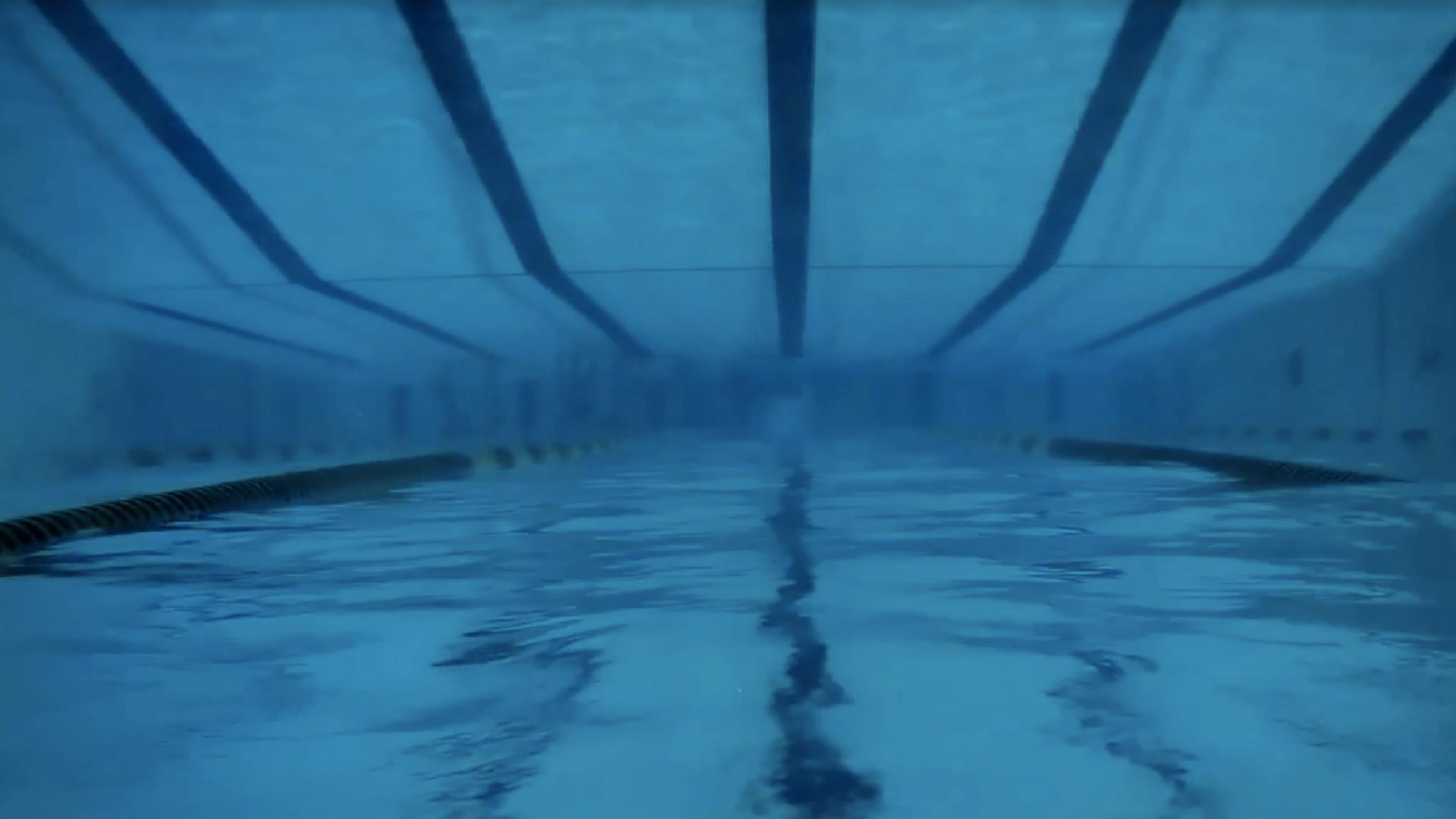



Clear Comfort


Competitive Swimming



Pre-AOP underwater camera



# Avery YMCA


Rob Castorri
General Manager
Tuckahoe Recreation Club

**Case Study:** 165,000 gallon pool

| | CLEAR COMFORT | TYPICAL UV | |
|---|---|---|---|
| Baseline chlorine only sanitizer | $8,400 | $8,400 | |
| Chlorine savings* | ($4,200) | $1,000 | |
| Energy to operate | $300 | $3,150 | |
| Annual maintenance | $2,995 | $4,800 | |
| Annual total expense | $7,495 | $17,350 | 60% Savings |
| Upfront deployment capital | $15,000 | $30,000 | |
| 5 year total cost of ownership | $49,480 | $111,950 | 58% Savings |


Owner & Coach
Aquatics Center in the Great Lakes

# Thank You

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