



# Application of ultraviolet-LED systems for microbial control in air and water loops

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aquisense  
technologies

BIOWYSE



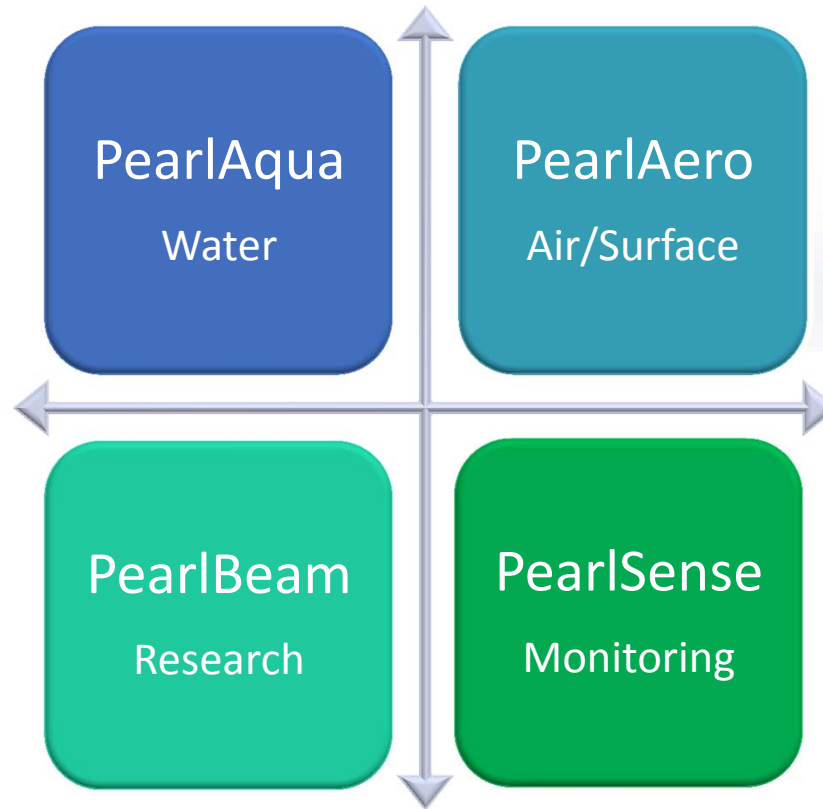
Consortium member



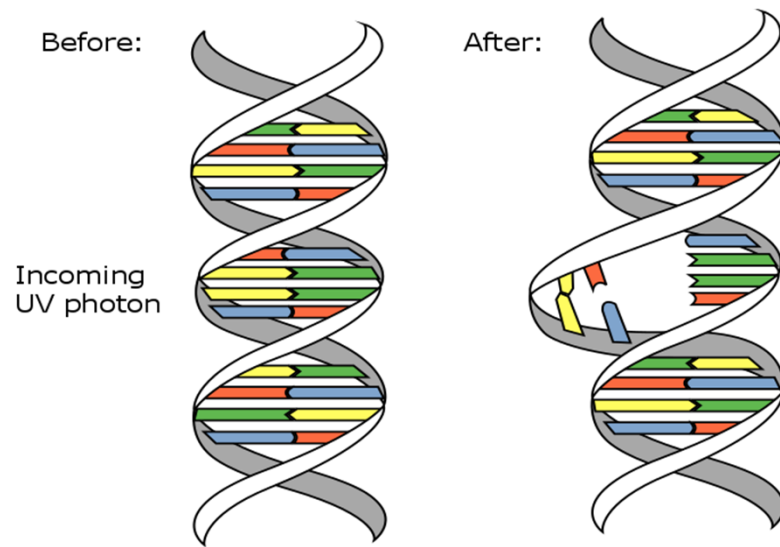
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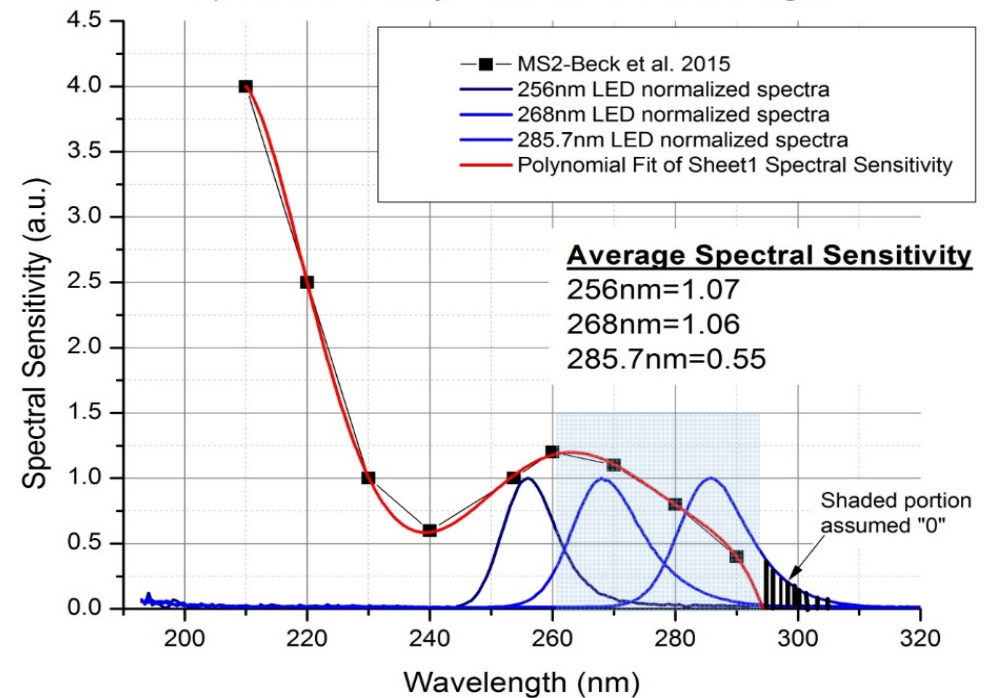
Integrate the best available UV-LED sources  
into products that solve real world problems



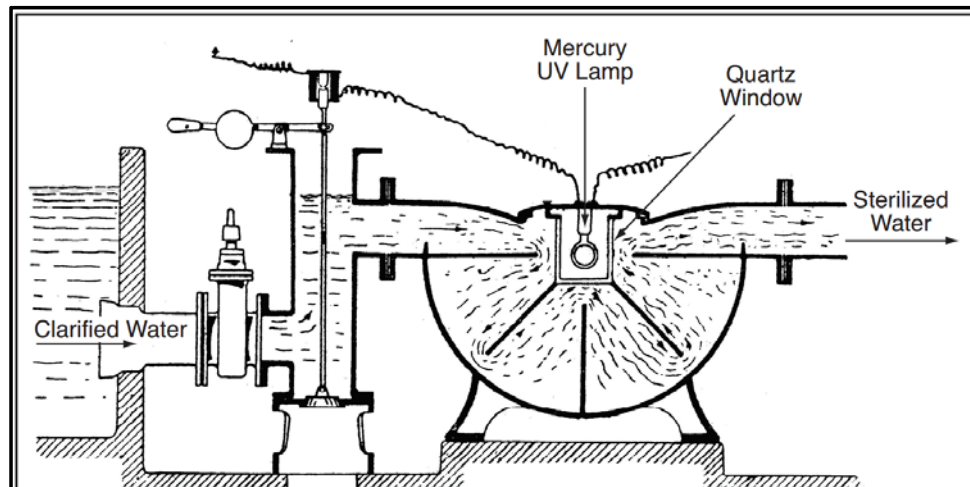
# Fundamentals of UVC disinfection



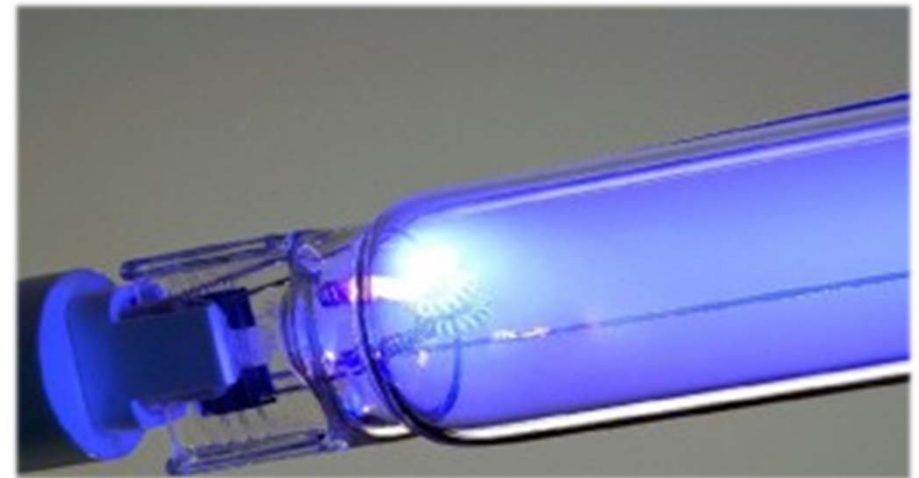
Spectral Sensitivity of MS2 applied to LED spectra to determine average spectral sensitivity of MS2 to LED wavelengths



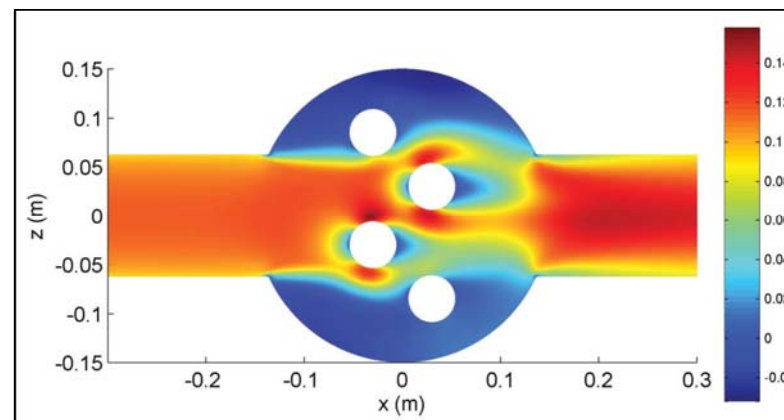
# UV disinfection: a century of fine tuning



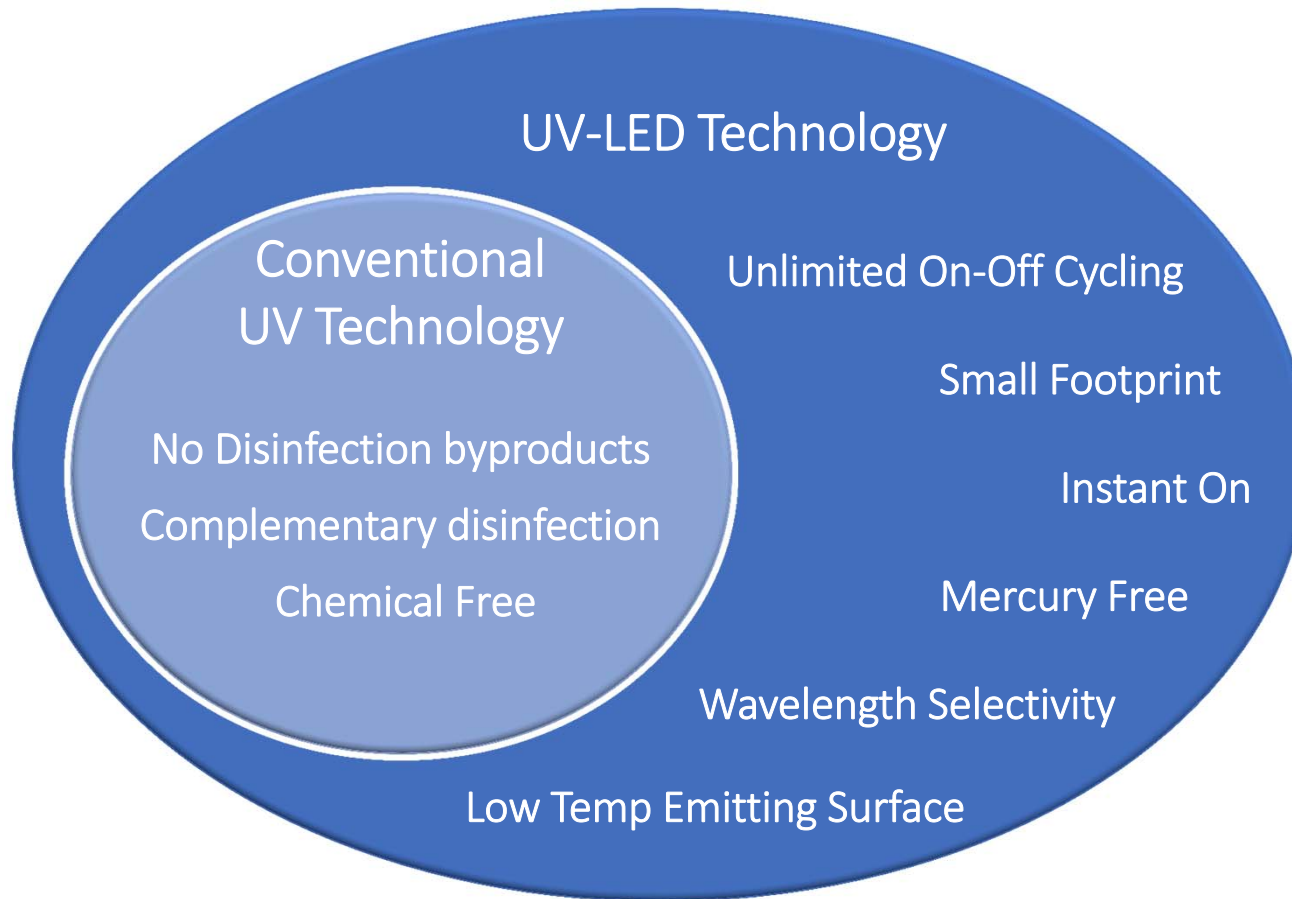
V. Henry et al. 1910



Pictures courtesy of Wedeco & Halma



# UV-LEDs: a whole new world

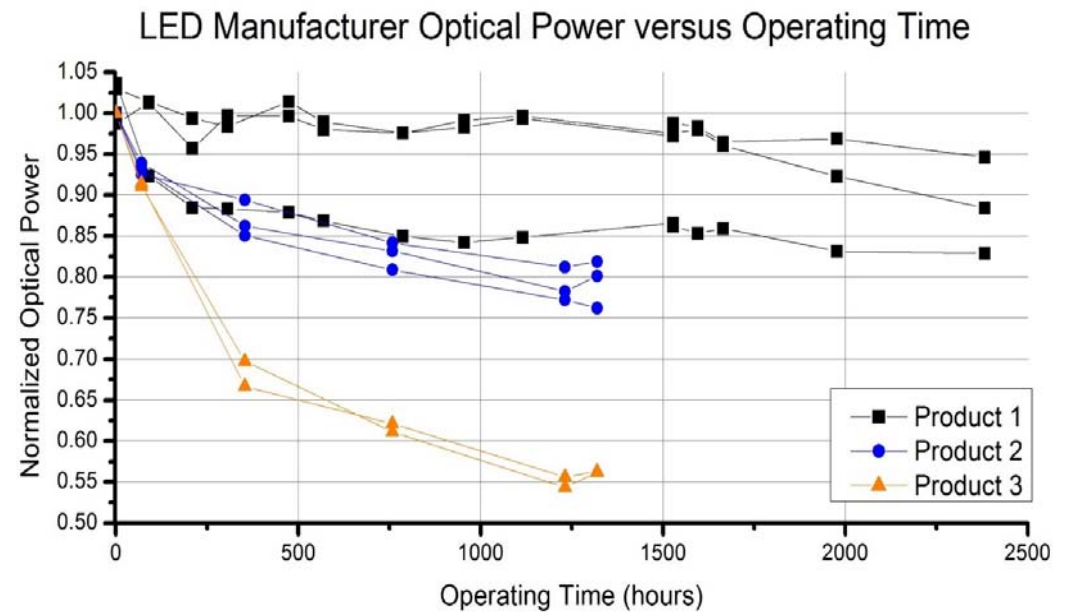
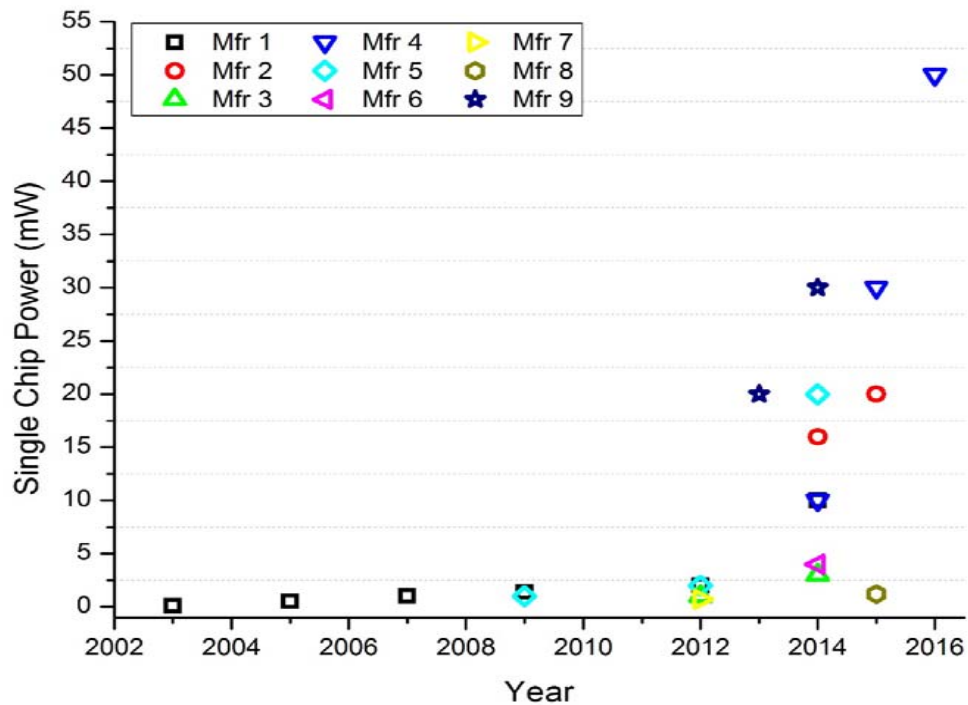


## Product Implications

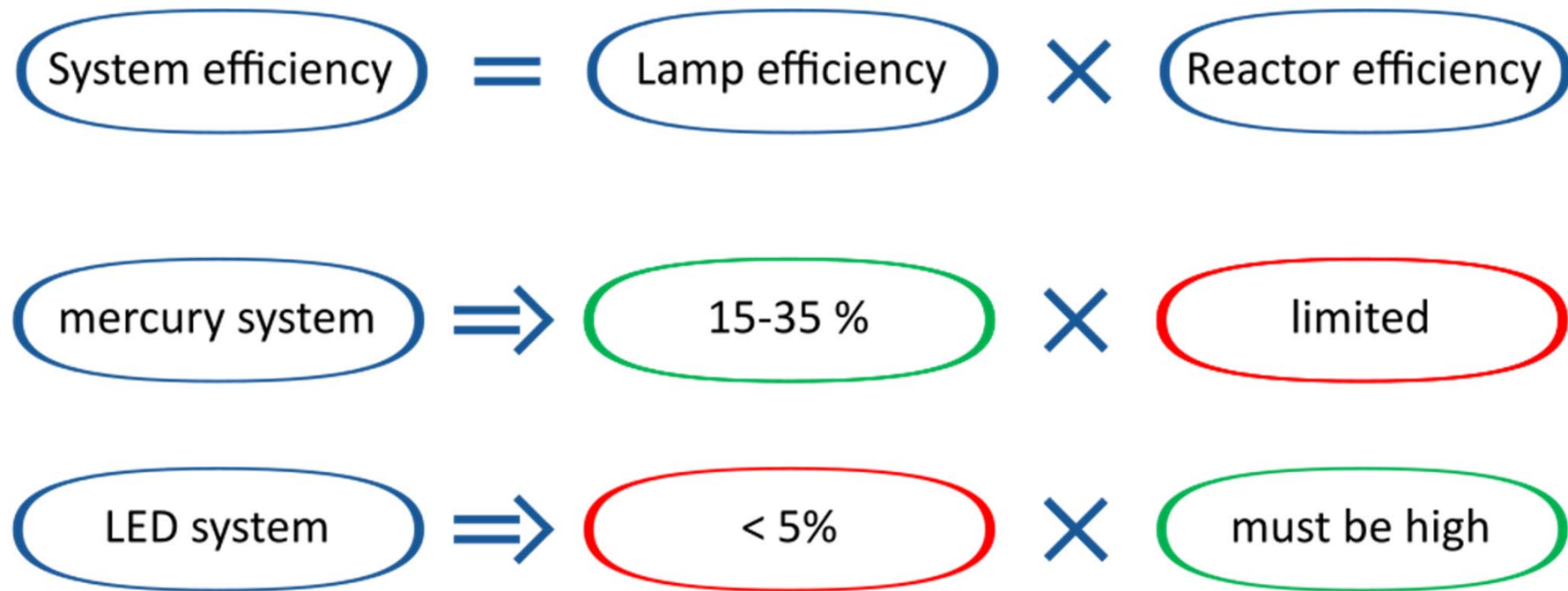
- Safe Disposal
- Intermittent Flow Friendly
- Targeted Performance
- Ultra-long Life
- Battery/Solar Realistic Option
- Simple Operation
- Few Components

# State-of-the-Art in UVC-LEDs

Output Power of Commercially Available UV-C LEDs



# UVC-LEDs in water disinfection systems

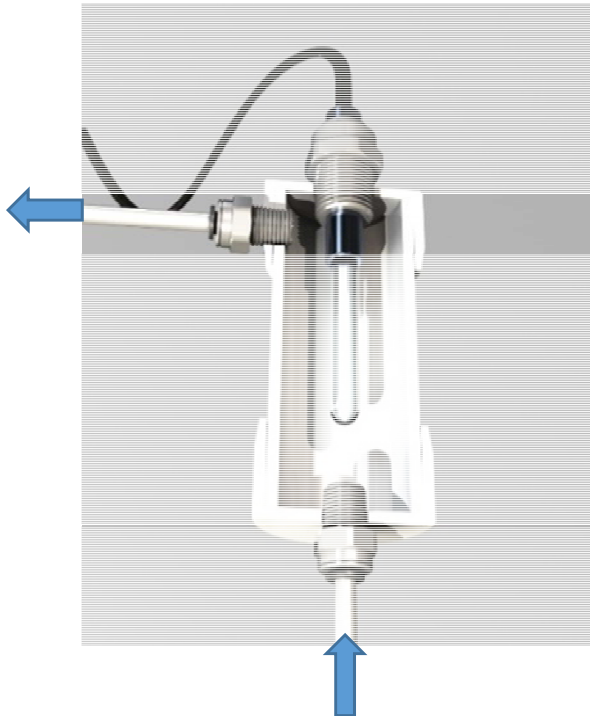


# Reactor design

Identical UV System Design Parameters

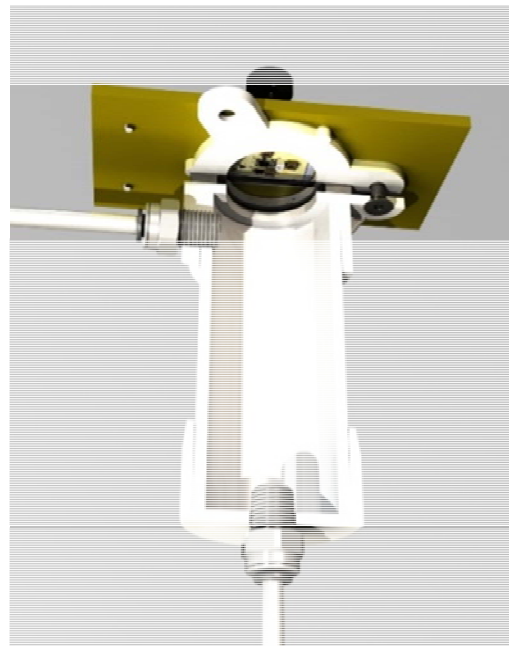
- UV-C Output Lamp Power
- Internal Volume

**System A**  
Hg Based Lamp  
Generic Design



UVC-LEDs in closed loop disinfection systems

**System B**  
UV-C LED Based  
Generic Design



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**System C**  
UV-C LED Based  
AquiSense Design

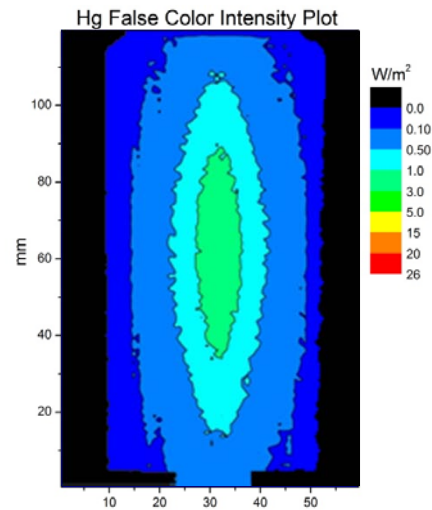
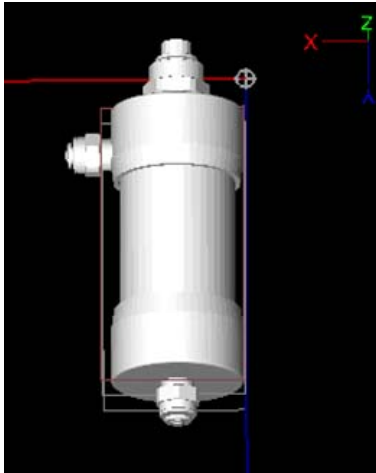




# Optical Design

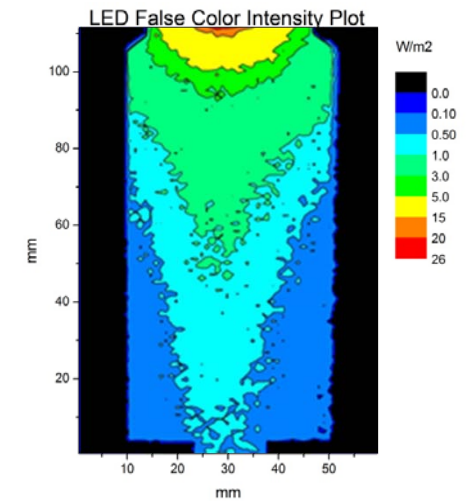
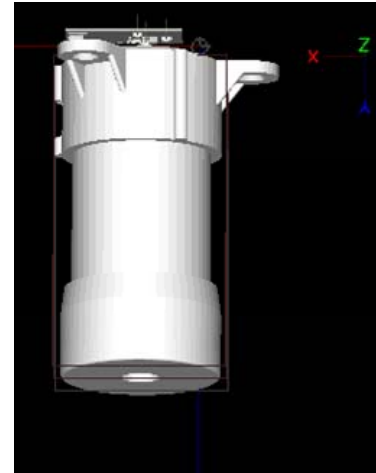
## System A

Hg Based Lamp  
Generic Design



## System B

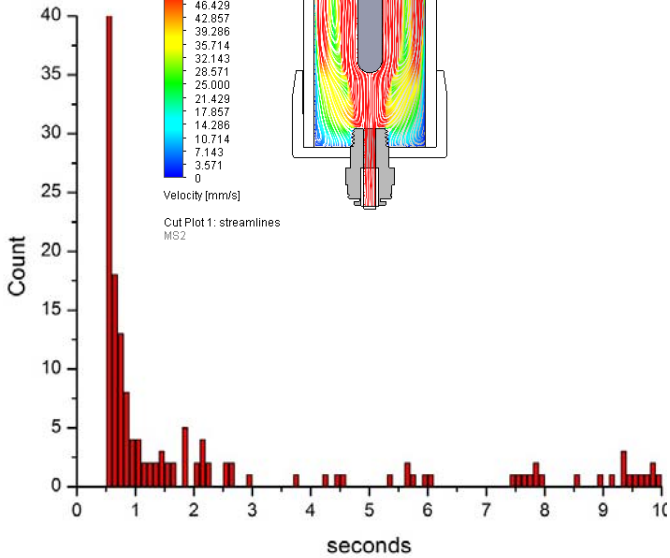
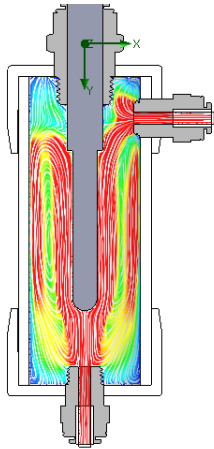
UV-C LED Based Lamp  
Generic Design



# Fluid Dynamics Design

## System A

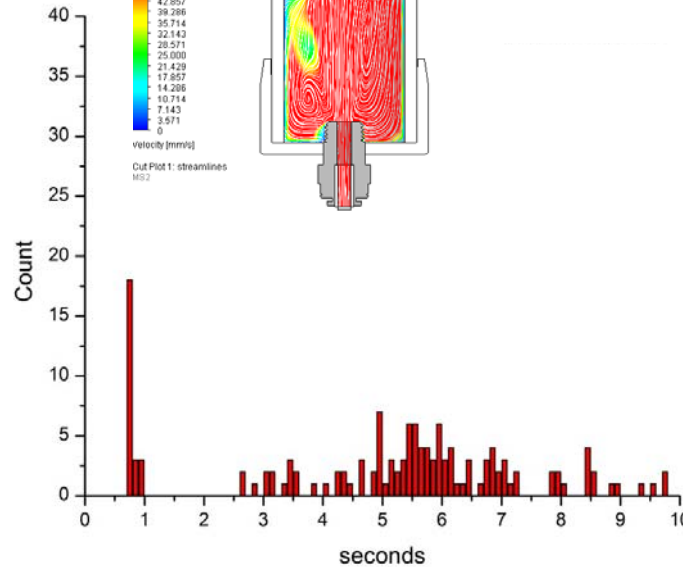
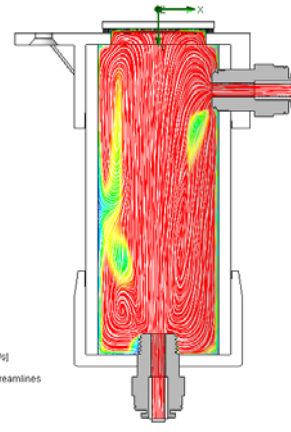
Hg Based Lamp  
Generic Design



UVC-LEDs in closed loop disinfection systems

## System B

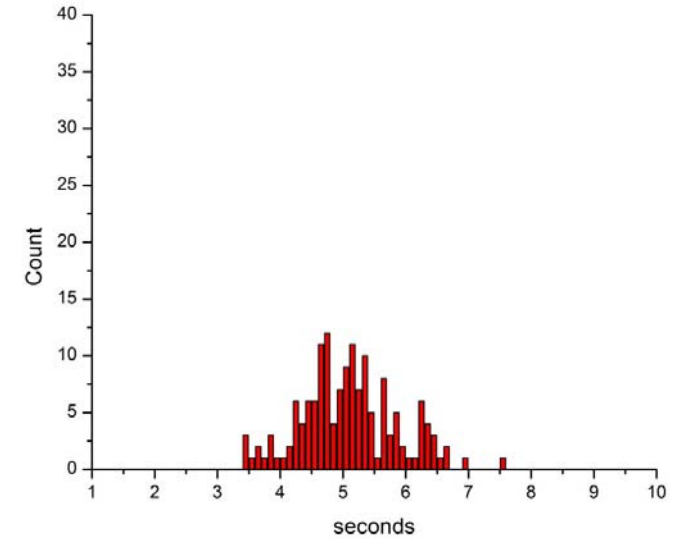
UV-C LED Based Lamp  
Generic Design



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## System C

UV-C LED Based Lamp  
AquiSense Design



# Combined Benchmarking Results

## Key Elements

- Flow Conditioning
- Inlet Positioning
- Reactor Body Shaping
- Light Source Positioning

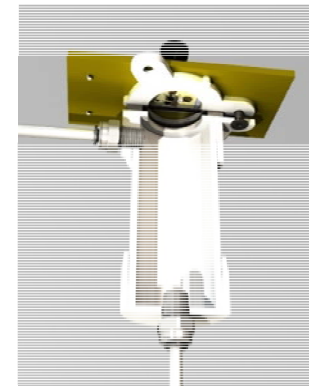
### System A

Hg Based Lamp  
Generic Design



### System B

UV-C LED Based  
Generic Design



### System C

UV-C LED Based  
AquiSense Design



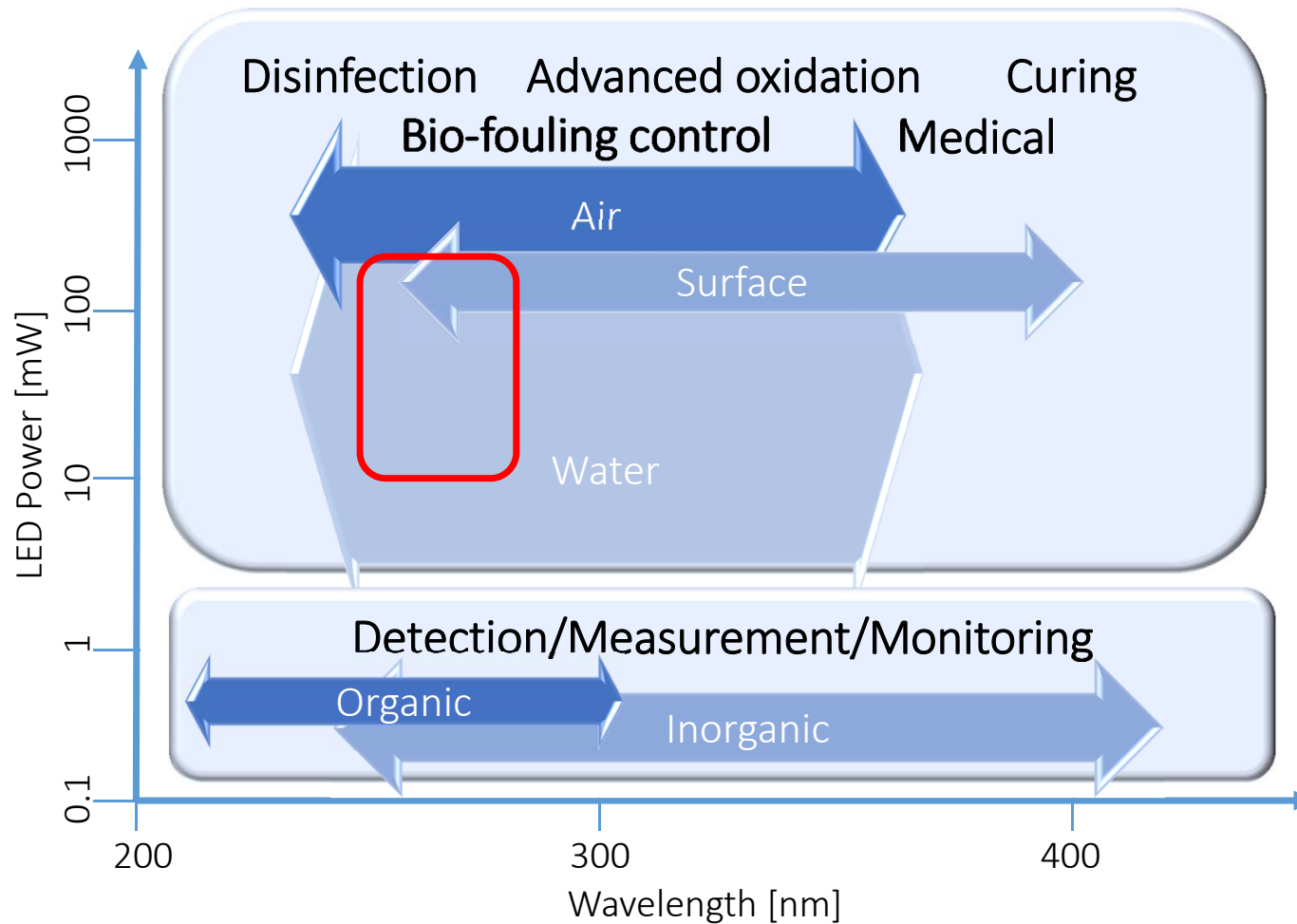
Optical Design

Fluid Dynamics

Overall Performance

Fluence rate uniformity (% St.Dev.)	83-172	76-134	16-21
Residence time (first out, s)	0.55	0.75	3.40
UV Dose (RED MS-2 Phage, mJ cm <sup>-2</sup> )	8.3	12.9	78.0

# UV-LED Technology Applications



- TOC reduction
- Drinking water
- Coolant loops
- Air recirculation
- Growth surfaces
- Food preparation

# Thank you for your time

## ***Company History***

2003 – Dot Metrics established to develop quantum dot LEDs

2008 – Dot Metrics begin work on UV-C LED system design

2012 – PearlAqua, first generation UV-LED system launched

2015 – Aquisense Technologies founded, acquiring Dot Metrics

- PearlAqua UV-C LED disinfection system introduced with new design

- PearlAqua awarded Aquatech Innovation Award

2016 – Aquisense joins BIOWYSE consortium as UV disinfection specialist

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