

UV BASICS, ADOPTION, AND ADVANCEMENTS IN UV TECHNOLOGY



Efficient - Cost-effective - Easy Maintenance

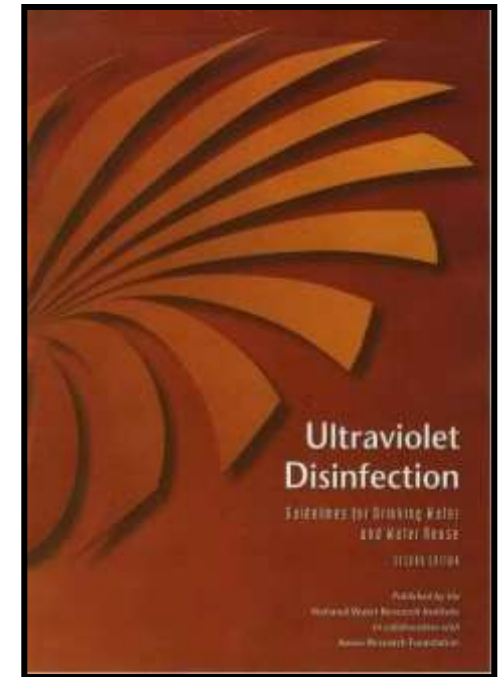
/ Water
Confidence™

TROJAN UV SIGNA™

- Acceptance of UV
- UV Basics and Theory
- Advancements in UV Technology
- Questions

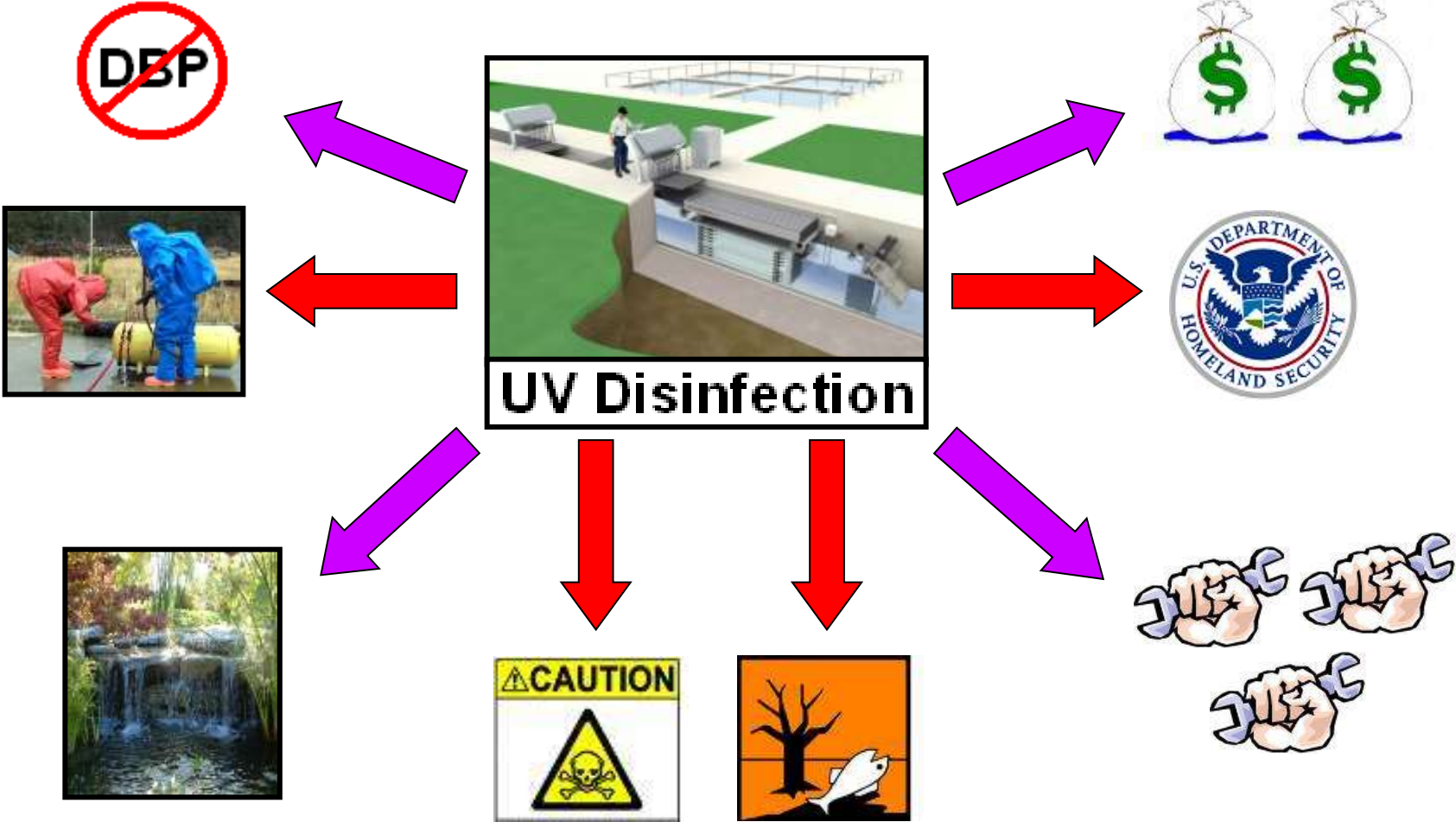
Acceptance of UV as a Disinfection Method

- 1910** - UV first used for water treatment
- 1972** - First regulations introduced on wastewater treatment standards in US
- 1976** - Limits put on chlorine levels in effluent
- 1978** - USEPA funds several full-scale UV systems with positive results
- 1986** - USEPA Design Manual endorses UV for wastewater disinfection
- 2003** - NWRI / AwwaRF publishes UV Guidelines for DW and Water Reuse
- 2010** - Over 25% of North American wastewater treatment plants now disinfect with UV



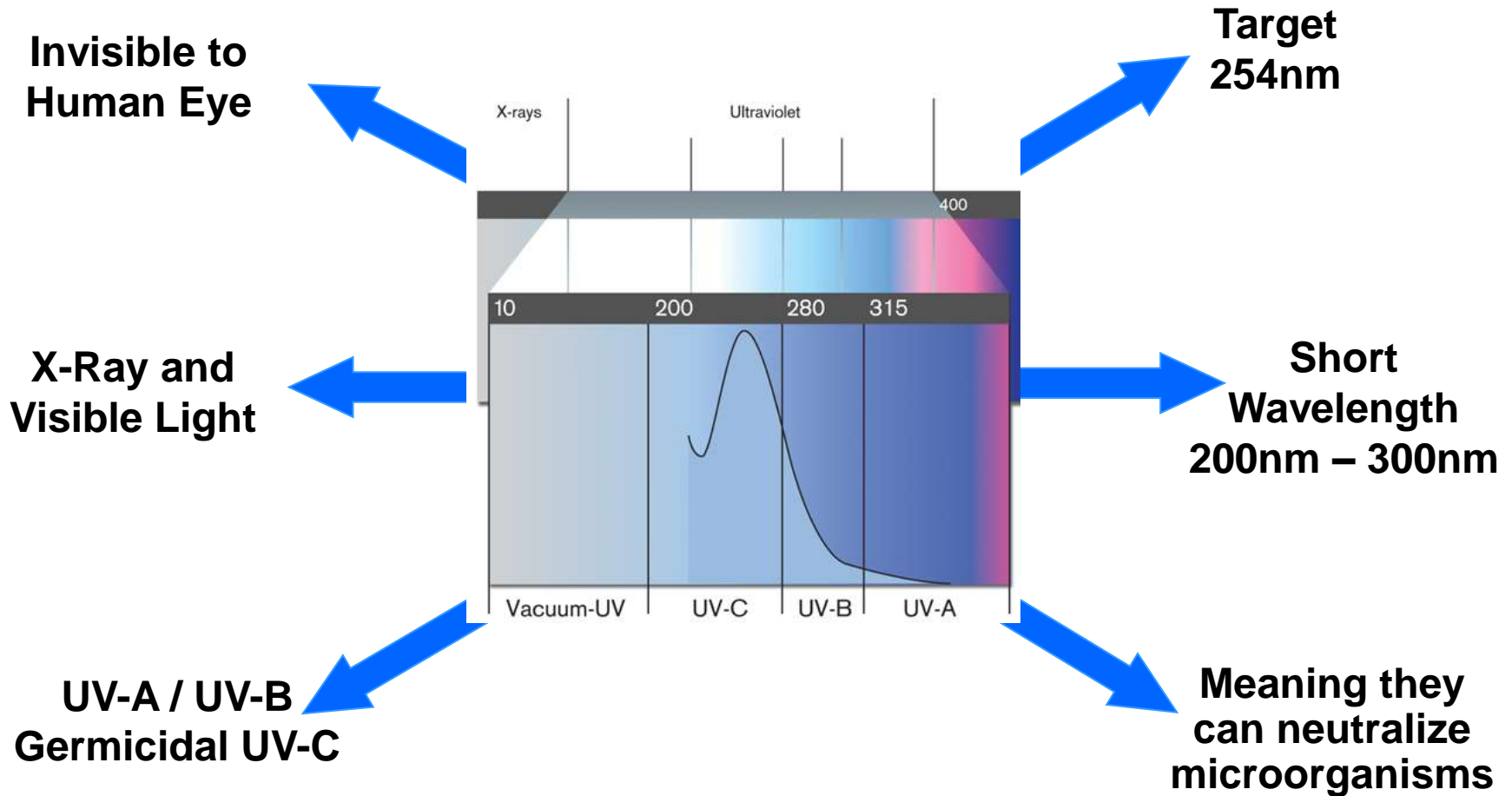
Today **UV** is Installed in Over **Half** of all WW Plants in
North America

The Benefits Of UV Are What It Doesn't Do:



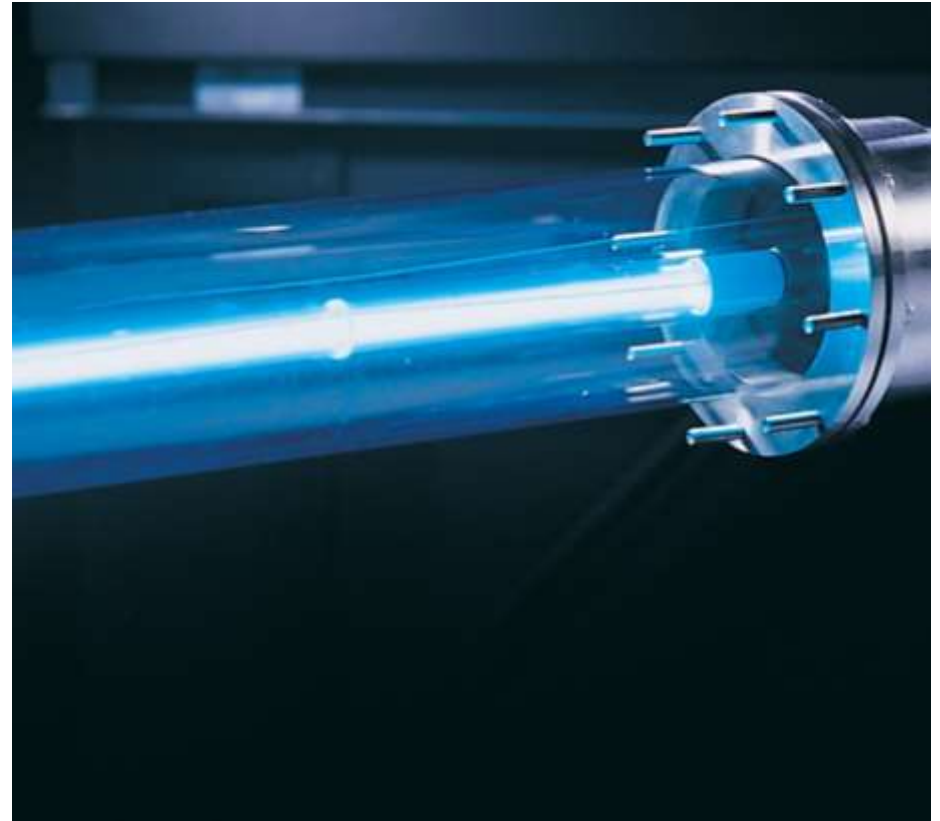
UV THEORY

How It Works - UV Light



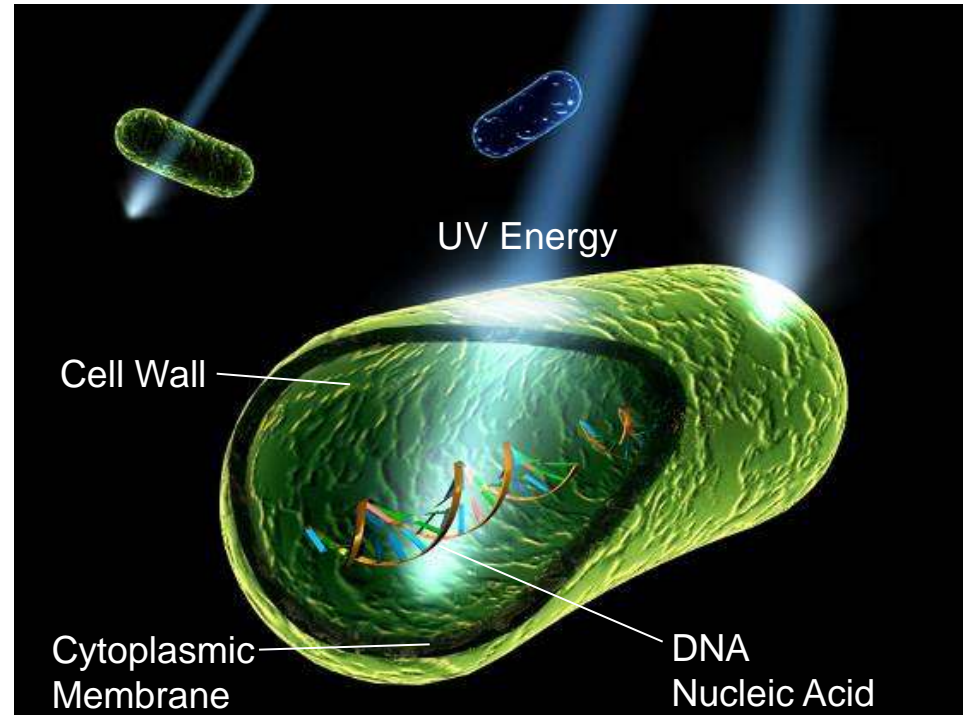
UV Lamps: **How They Work**

1. Power applied to lamp electrodes
2. Arc is generated from ionized gas which conduct electricity
3. As arc temperature rises, mercury in lamp converts to a gas
4. Mercury vapor conducts electricity, completing the circuit
5. UV light photons released as vapor conducts electricity

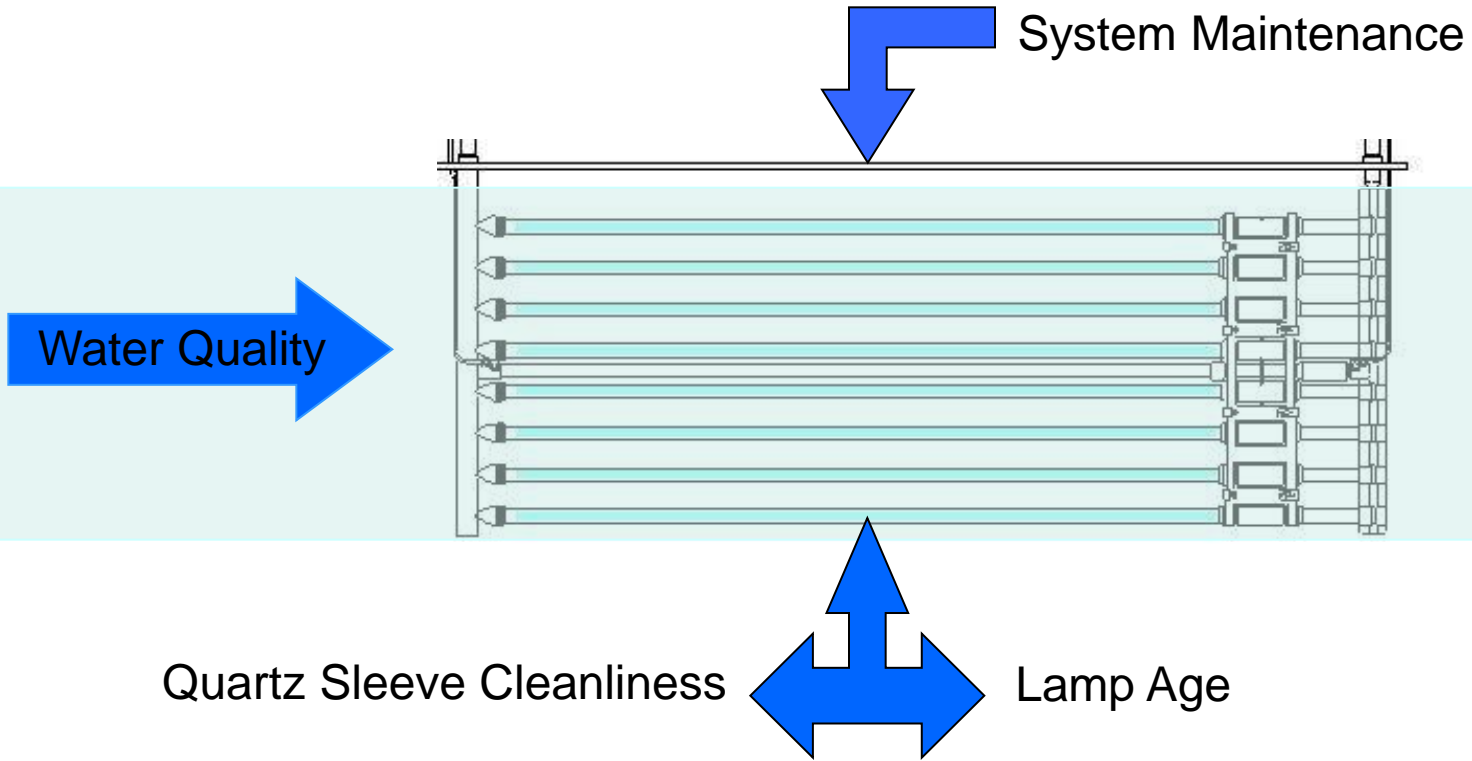


How Does UV Disinfect?

- UV light penetrates the cell wall
- The UV energy permanently alters the DNA of the microorganism
- Microorganisms are “inactivated” and unable to reproduce or infect

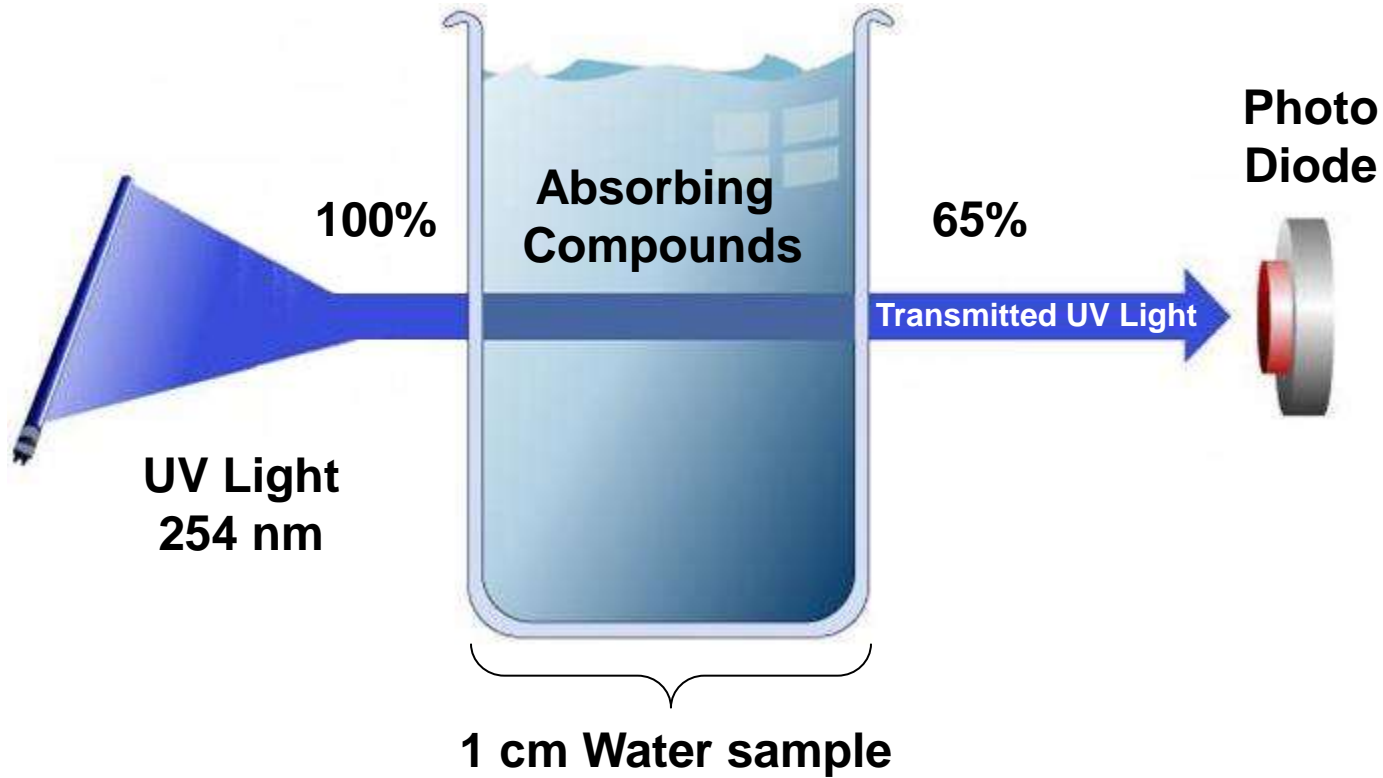


FACTORS AFFECTING UV



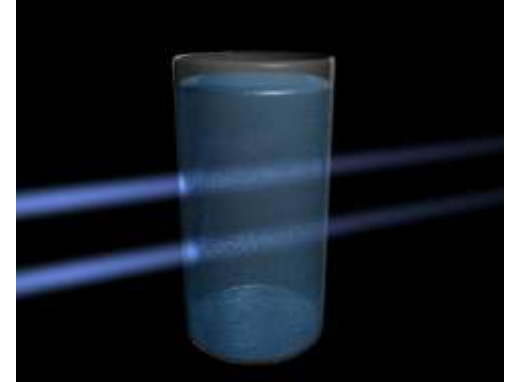
UV Transmittance

- The ratio of light entering the water to that exiting the water

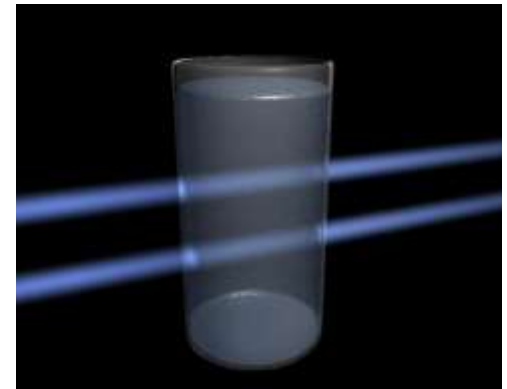


Water Quality - UV Transmittance (UVT)

- UVT is affected by:
 - Water Quality (i.e. iron, particles size, and TSS)
- Typical readings:
 - Treated Wastewater: 50 – 75%
 - Drinking Water: 80 – 95%
- UV is capable of disinfecting wastewater to a low of 10% UVT



Low UVT



High UVT

System Maintenance **Affects Performance**

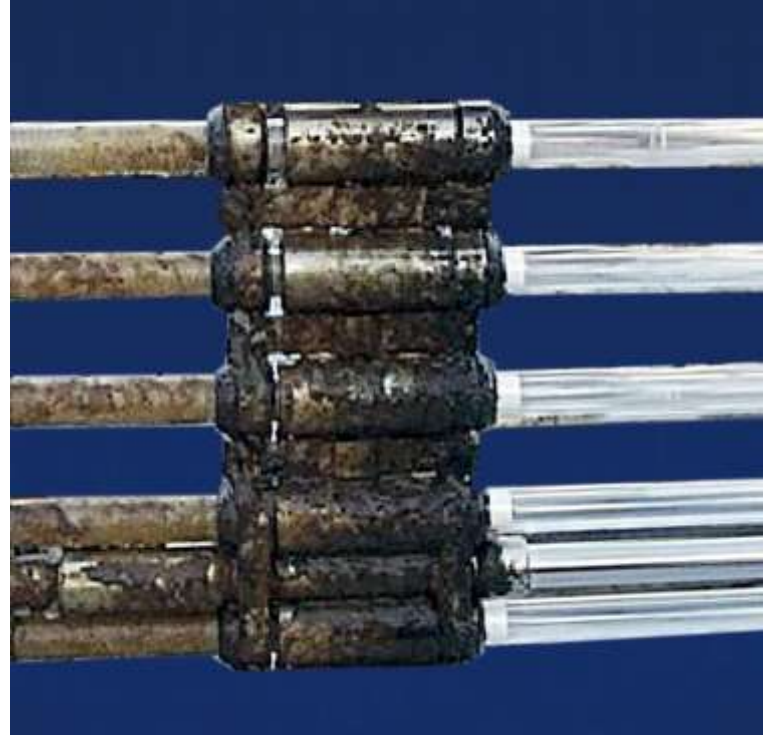
Ensure optimal operation by:

- Maintaining cleaning system
- Replacing aged or failed lamps



Keep Lamps **Clean**

- Fouled (dirty) Lamps/Sleeve absorb UV Light and reduces disinfection
- Automatic Cleaning Systems cleans fouling – must be inspected & maintained
- Manual cleaning must be performed on a regular basis – cleaning Interval is specific to water quality
- Inspect Sleeves when dry – wet Sleeves look clean



Understanding UV Dose

Dose



X

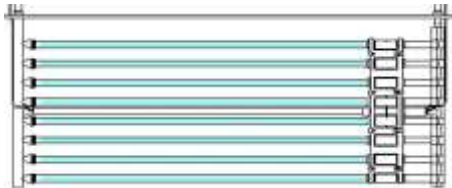
Contact
Time



=

Chlorine
Residual

Intensity



X

Contact
Time



=

UV
DOSE

ADVANCEMENTS IN UV TECHNOLOGY

UV Lamps

4 TYPES IN USE:

Low-Pressure, Low-Output (LPLO)

- For small applications, low UV output

Medium-Pressure, High-Output (MPHO)

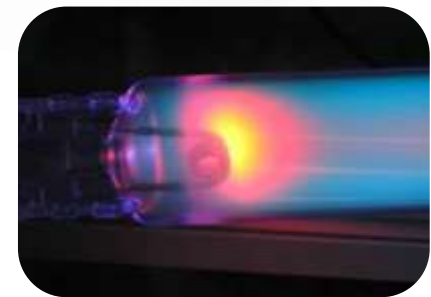
- Highest germicidal output
- Small footprint – compact lamp
- High energy consumption
- Good for low water quality applications (SSO's)

Low-Pressure, High-Output (LPHO)

- For medium to large applications
- Amalgam lamps

TrojanUV Solo Lamp (1000 W Amalgam Lamp)

- For Large Applications (>7 MGD)
- Lowest lamp count and still has highest efficiency



- 1000 Watt amalgam lamp
- Guaranteed 15,000 hour lamp life (1.7 years)
- Lamp dimming from 100 to 30%
- Highly stable, consistent lamp output (regardless of water temperature)
- Instant start – no cool-down period
- Optimal balance – offers fewest lamps and highest electrical efficiency



BENEFITS OF HIGHER POWERED LAMPS

- Lowest lamp count: Fewer parts, sleeves, ballasts, seals → high reliability & lowest maintenance
- In-situ lamp replacement: Bank stays in place while individual lamps changed
- Maintain disinfection while other lamps and banks remain on-line
- Quick diagnostics: LED on/off status for each lamp



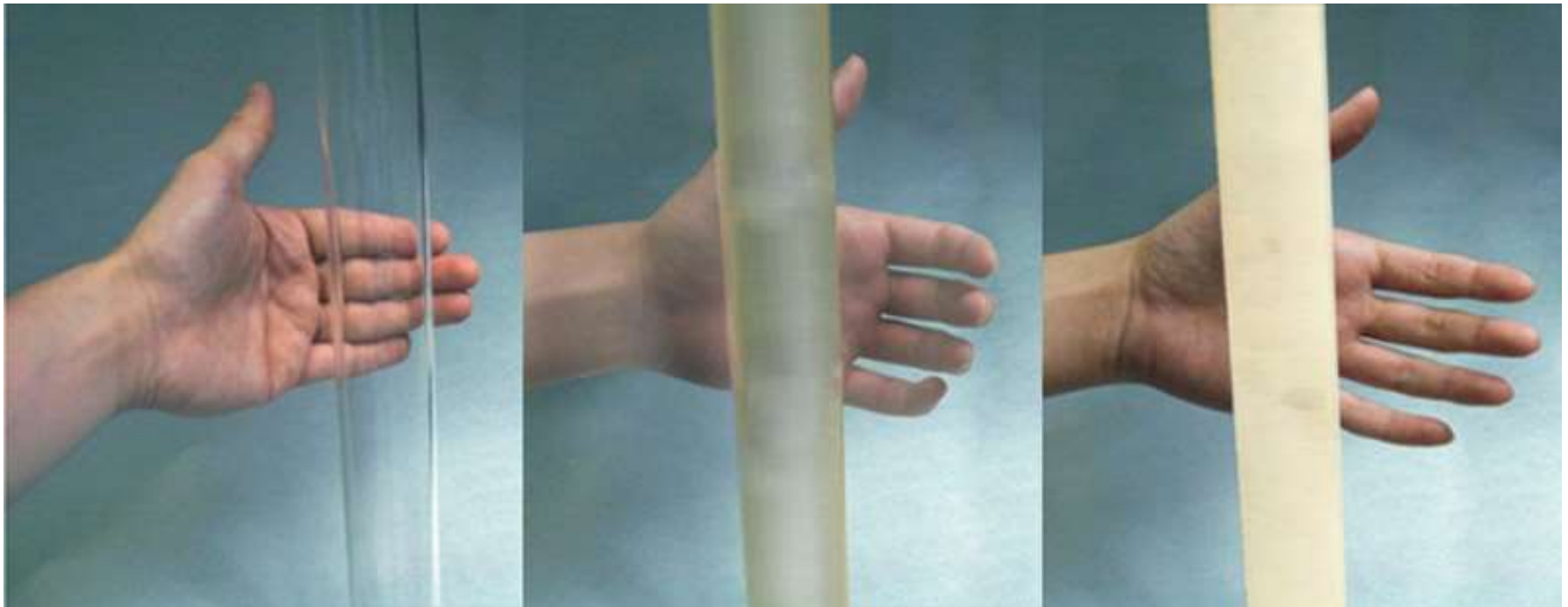
6 MGD, single channel

Advancements in Cleaning

Chemical Mechanical
Wiping

Mechanical Wiping

No Cleaning



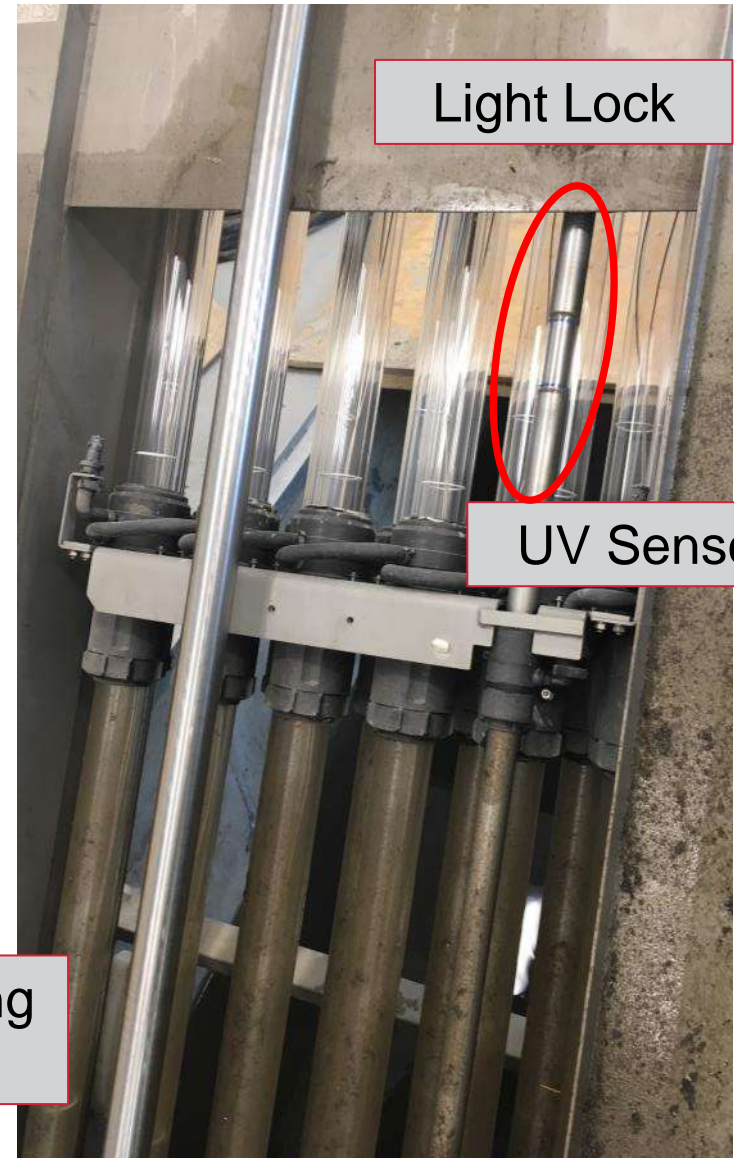
> 95% UVT

~ 70% UVT

> 50% UVT

- Chemical/mechanical wiper collar with debris scraper
- Hydraulic wiper drive; no screw in effluent
- Intensity sensor cleaned simultaneously
- Fouling factor validated in secondary wastewater with actual wiping collars

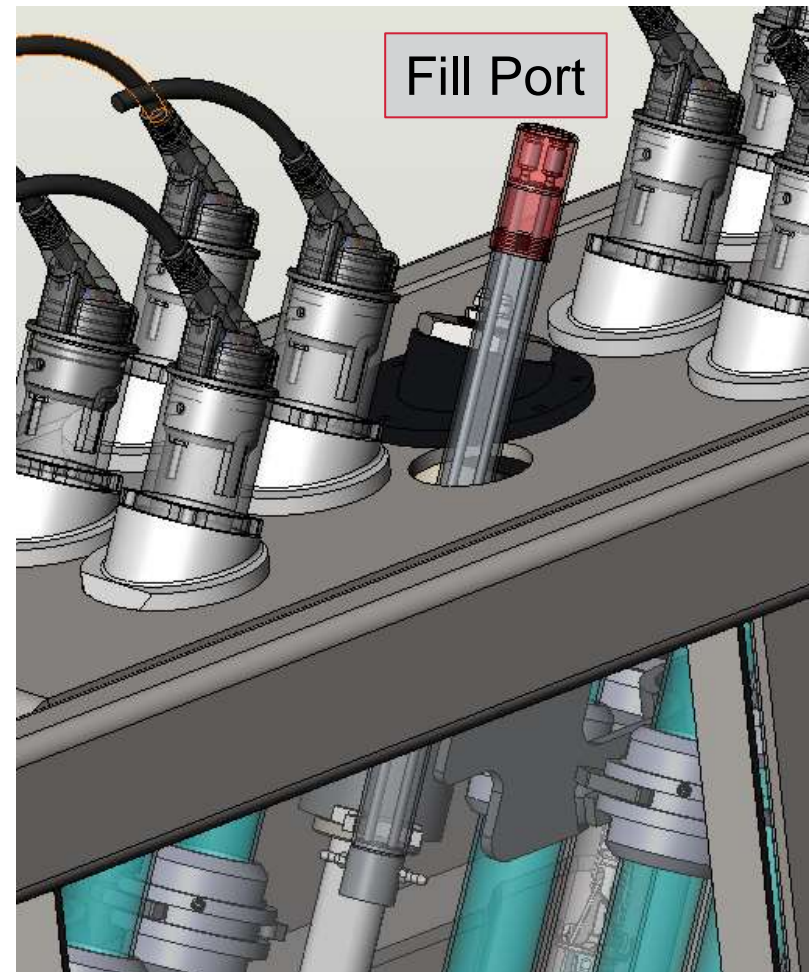
4 weeks of accumulated fouling
45% UVT wastewater



CHEMICAL MECHANICAL CLEANING REDUCES LABOR

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- Banks stay in place during cleaning and during solution replacement
- Visual indicator for wiper home position
- Fill multiple wiper collars at once through single port at top of bank
- Replace wiper seals per maintenance schedule



CLEANING SYSTEM COMPONENTS

Debris scraper



Two wiper seals keep solution contained



Wiper collars daisy-chained

ADVANCED LAMP DRIVER TECHNOLOGY

High Reliability & Efficiency:

- 10-year warranty
- Power factor of 99%
- Humidity controlled & factory-tested
- Rack Mounted / easily replaced
- Smart driver self-diagnoses & makes trouble-shooting easy

Cost Effective:

- Very compact, outdoor 4X rating
- Minimizes footprint and installation cost
- Lowest lamp count → fewest drivers



Unique PDC Panel Design:

- Panels have up to six sections
- Each electrically independent
- Safe bank isolation for driver removal
- Other banks stay on safely while one panel is open

Cost Effective:

- Minimizes # of panels, footprint and wiring
- Provides electrical redundancy within a single panel



ADVANCEMENTS IN REACTOR DESIGN

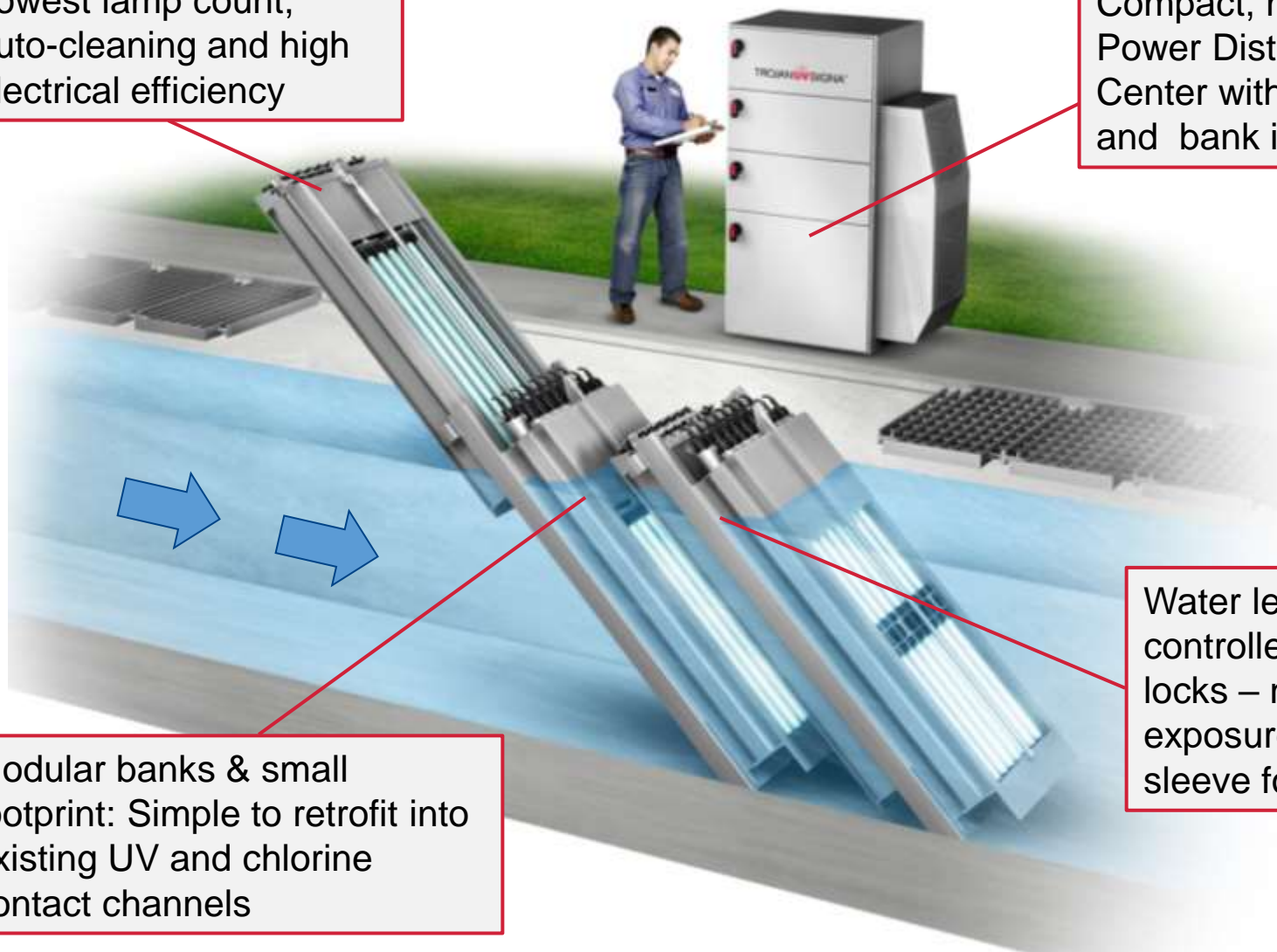
TROJAN^{UV}

Lowest lamp count,
auto-cleaning and high
electrical efficiency

Compact, modular
Power Distribution
Center with A/C
and bank isolation

Modular banks & small
footprint: Simple to retrofit into
existing UV and chlorine
contact channels

Water level
controlled with light
locks – no UV
exposure to air or
sleeve fouling



MAINTENANCE MADE EASY WITH ARM

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- Hydraulic lifting device on each bank
- Push-button activation
- Safe, one-person operation
- No crane or channel entry required
- Bank inspection, cleaning, sleeve removal are simple, safe and easy
- No submerged tracks or screw drives located in effluent

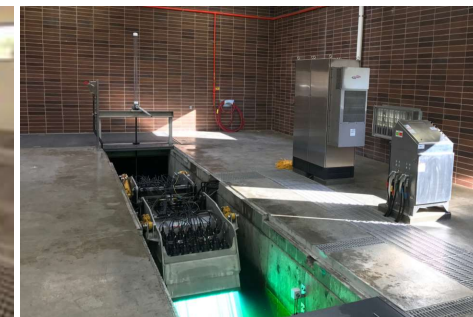


INSTALLATIONS



Sample Installations

- Almost 300 in WI
- South Milwaukee, WI
- Waukesha
- Fond Du Lac
- Racine
- Sun Prairie
- Chicago – 530 MGD



AVON LAKE, OH 15 MGD (57 MLD)

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Replaced old UV System; reused channels



PROVO, UTAH 25 MGD (92 MLD)

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Chlorine conversion to UV



CHICAGO, IL 535 MGD (2,025 MLD)

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Selected based on O&M and sustainability benefits



Advancements in UV make it more cost effective:

1. Lower lamp count → lower maintenance & cost
2. Simple & reliable reactor design
3. Chemical & mechanical cleaning reduces cost and labor
4. Flexible design options for new channels or retrofit

Trojan offers:

- Over 40 years of experience in UV water solutions
- Knowledge & experience from over 10,500 municipal installations
- Continuous innovation to leverage latest technologies
- Local service & support to ensure successful long-term operation

DISCUSSION & QUESTIONS



CONTACT INFORMATION

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