

# Next Generation UV Disinfection – How UV-C LEDs Will Enable New Applications

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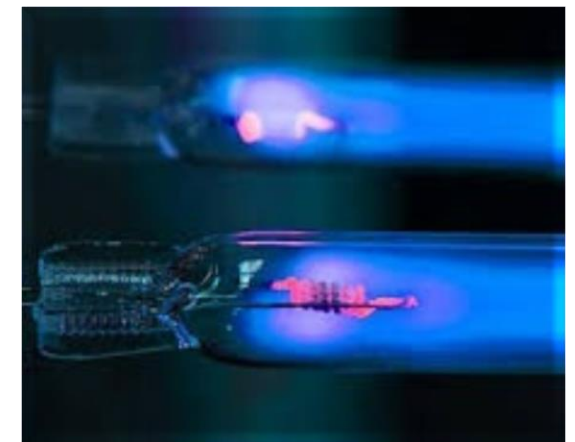
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# Why Ultraviolet Light Treatment?

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- No pathogen is immune to UV damage
  - But some are chemical resistant, e.g. *Cryptosporidium* oocysts
- Safe Technology
  - Chemical facilities pose risk to workers and local community
  - Treatment chemistries may create harmful by-products
- Lower Total Lifecycle Cost
  - Electricity & Lamps < Chemical Supply & Storage
  - Infrastructure lasts longer when chemicals are not corroding it



# Ultraviolet Disinfection – A Star Performer

UV disinfection has been one of the fastest growing treatment technologies over the past decade.

	Ultraviolet Light	Sodium Hypochlorite	Chlorine gas
Disinfection effectiveness	HIGH	HIGH*	HIGH*
Disinfection by products	NO	YES	YES
Safety risks	LOW	HIGH	HIGH
De-chlorination required	NO	YES	YES
Contact channel	SMALL	LARGE	LARGE
pH dependency, Corrosion	NO	YES	YES
O&M Cost	LOW	HIGH	MEDIUM
Capital Investment	MEDIUM	LOW	HIGH

\*Cryptosporidium and Giardia are resistant against chlorination.

# Best For Now

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- Since the 1970s, Mercury-based lamps have been the best disinfection treatment available.
- Still are the best available for many applications, but not without their own limitations.





# Limitations of Mercury-based Technology



## Materials

- Mercury
- Quartz



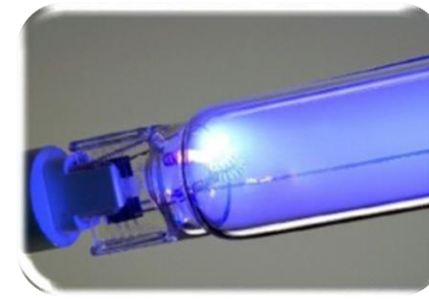
## Operation

- Warm-up time
- Limited on/off cycles



## Durability

- Fragile quartz tube



## Footprint

- Low power density
- Large ancillaries



## Weight

- Reactor
- Electronics



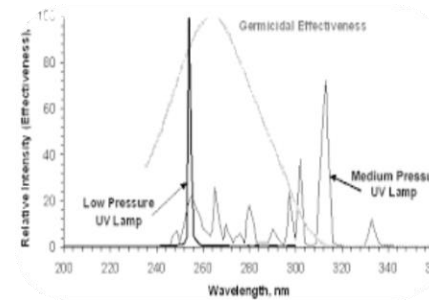
## Power

- AC Mains Voltage only



## Temperature

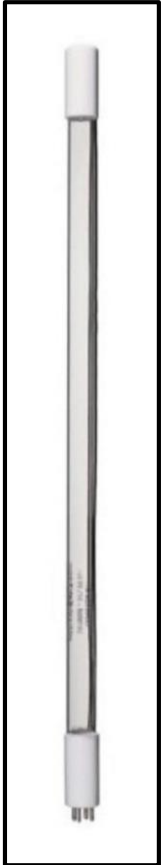
- 100-600 °C impacts process fluid



## Wavelength Compromise

- LP: 254nm
- MP: 200-300nm

# Additional Benefits of LED Technology



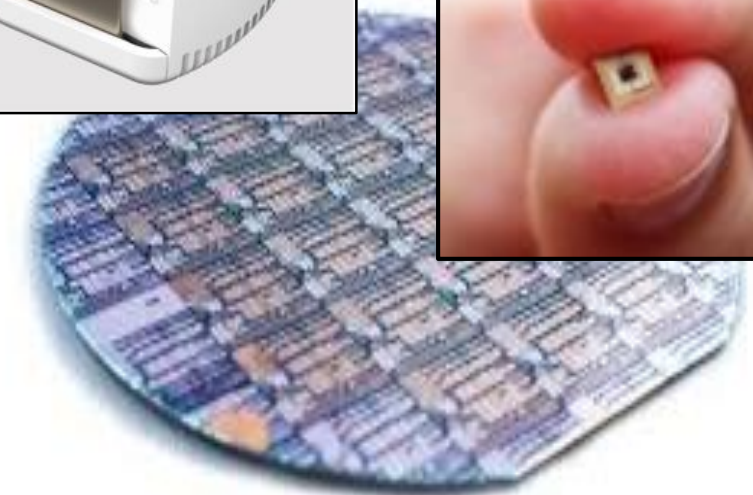
	Mercury	LED
Chemical Free	✓	✓
No Byproducts	✓	✓
Cost Effective	✓	✓
Mercury Metal Free		✓
High Power Density (Small Footprint)		✓
Instant On		✓
Unlimited On/Off Cycling		✓
Wavelength Selectivity		✓



# Implications of LED Technology

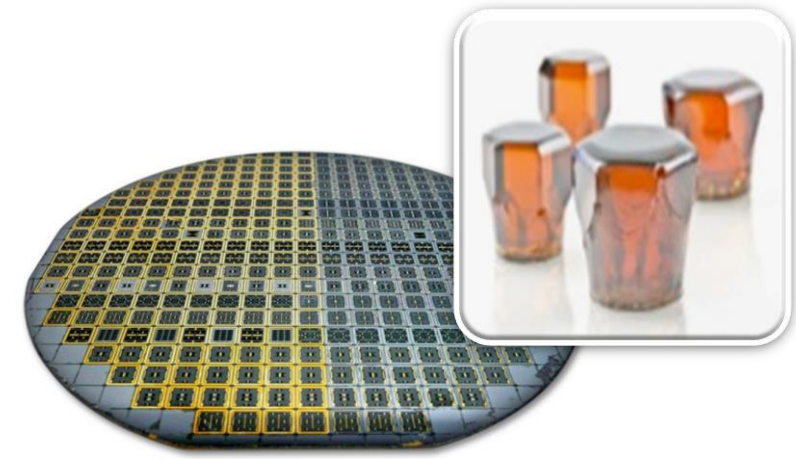
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- Safe Disposal
- Intermittent Flow
- Longer Lamp Replacement Interval
- Simpler Systems
- Systems are Easier to Use and Maintain
- Solar or Battery Powered
- Less Heat Generation
- Improved Lamp Output Monitoring



# Material Risk

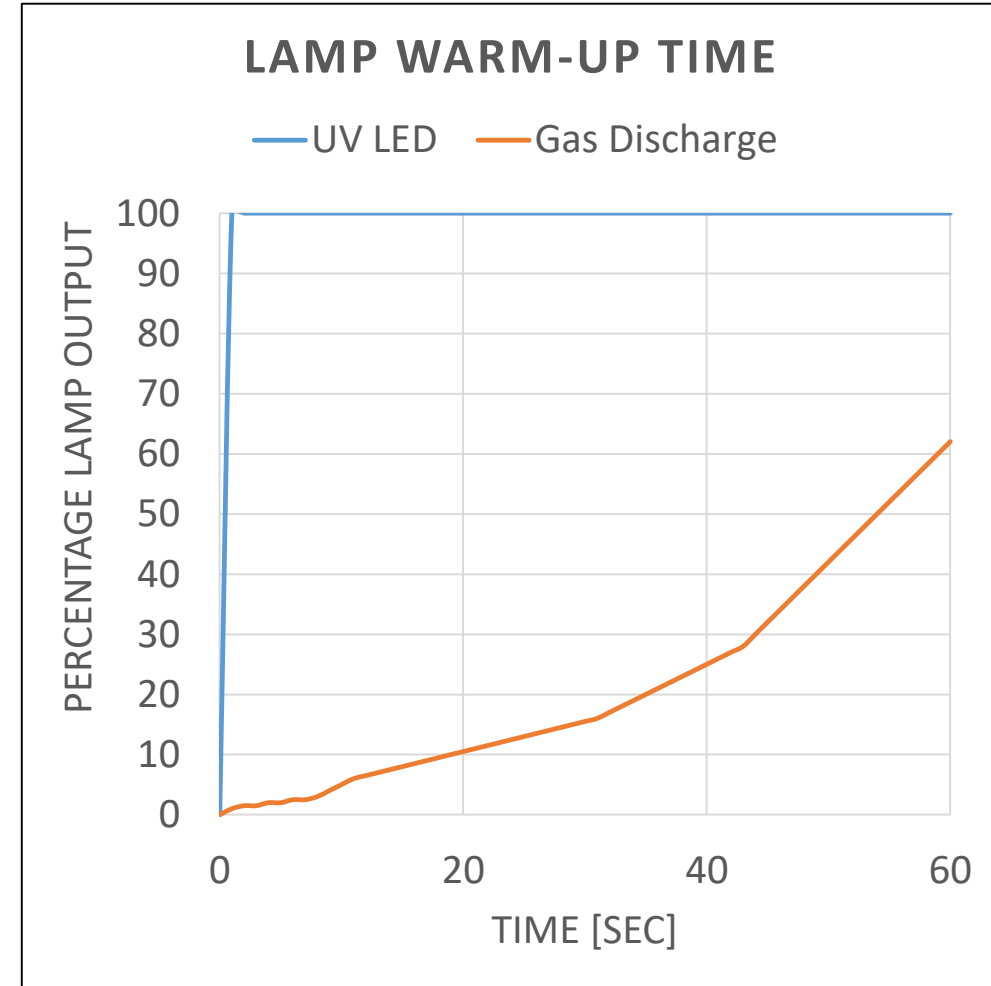
- Mercury-based Lamp Technology
  - Breakage leaks heavy metal into the water
  - Vapor, liquid or amalgam form
- LED Lamp Technology
  - Key materials: Al, Ga, N, Si, Mg
  - Robust Package
  - Materials bound in crystalline structure
  - Bonds broken (leach risk) over 1,200°C (2,192°F)





# Instant On / Unlimited On-Off Cycles

- Mercury-based Technology
  - Takes minutes to achieve maximum output
  - Multiple power cycles diminish lamp life
  - Recommend <5 power cycles per day
- LED Technology
  - Solid-state needs nano-sec warmup time
  - Can endure infinite on/off cycles
- Eases intermittent flow treatment
  - System on only when water is flowing
  - Extends lamp replacement interval



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This is a sample of the presentation material.  
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