Microwave UV

An Everlasting Bulb?

BCWWA May 2006

Paul O' Callaghan R.P.Bio

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Objective

Introduce a new way of generating UV light

- Uses Microwave energy as opposed to electrical energy
- As a result, bulbs do not blow

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Structure of Presentation

- Introduction to UV Disinfection
  - What is UV Light?
  - How is it generated?
  - Brief History of UV Technology
- Describe how new technology works
- Discuss Advantages, Disadvantages & Costs

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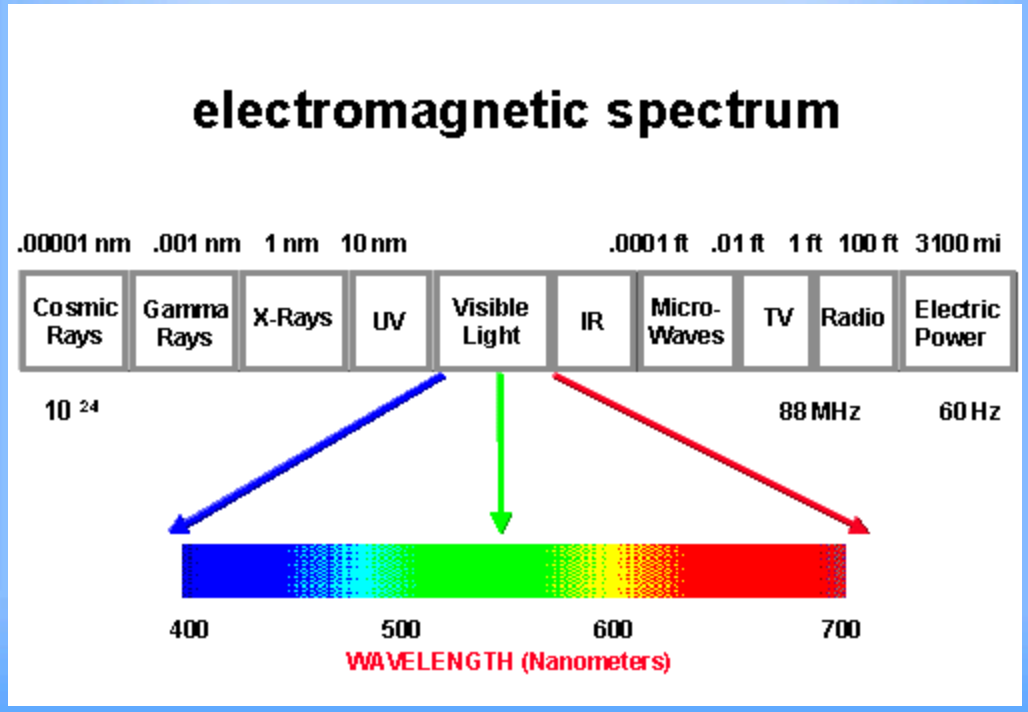
What is UV Light?

- UV is part of the electromagnetic spectrum



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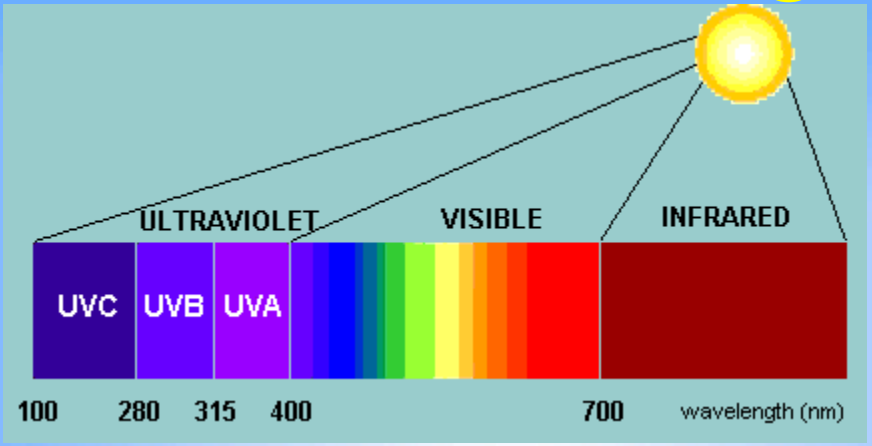
What is UV Light?



- UVA 315 – 400 nm Sun tanning
- UVB 280 – 315nm Sun burning
- UVC 200 – 280nm Skin cancer
- Vacuum Ultraviolet 100 – 200nm

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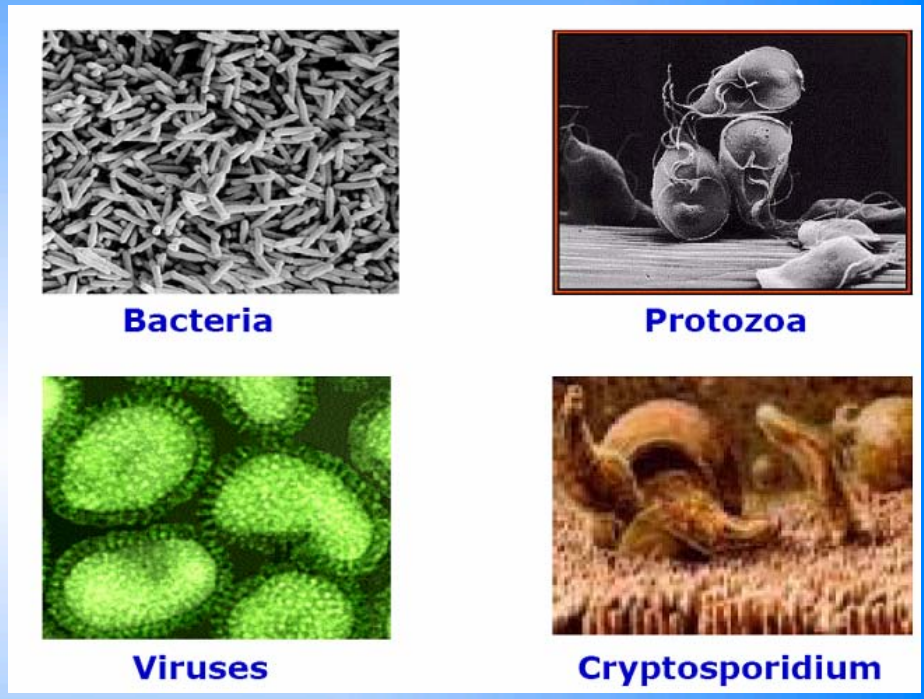
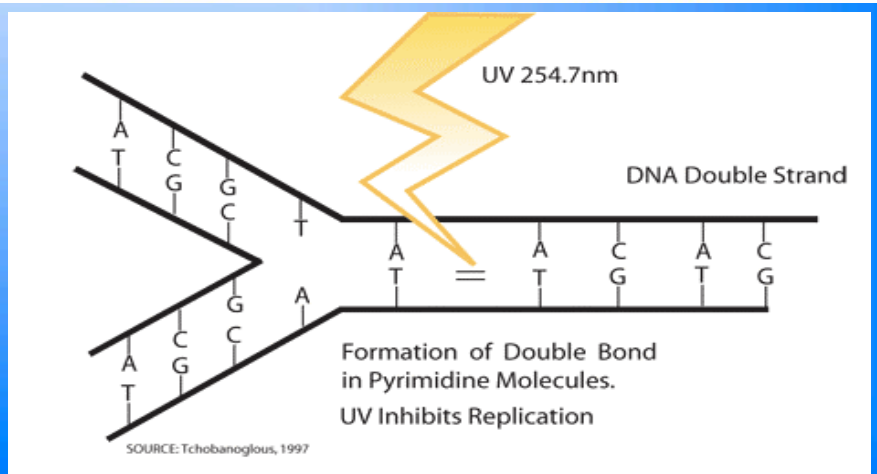
UVC
A Natural Disinfectant

- Absorbed by DNA and RNA
- Inhibits the ability of micro-organisms to replicate
- Effective wavelength is at 265nm





History of UV Technology

- UV Inactivation of Micro-organisms first discovered 1878
- Major Advancement in 1970's due to
  - Concerns about chlorine by-products
  - Stringent Permits for chlorine disinfection byproducts
  - Safety Concerns re handling of chlorine gas
- Today UV Disinfectant of choice for wastewater
  - Effective against all bacteria and viruses
  - No chlorine by-products
  - Enables re-use of wastewater

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How is UV Light Generated?

"Electrons enter an excited state and on return to a lower energy state they emit energy as radiation"

- Typically generated using an electric current- electrode in a bulb.

  - Low Pressure
  - Low Pressure High Output
  - Medium Pressure

Challenges with Electrode Bulbs

- High failure rate – bulbs blow
- Bulbs have to be replaced every 8,000 hours
- Up to 100% Redundancy Required
- Output degrades over time

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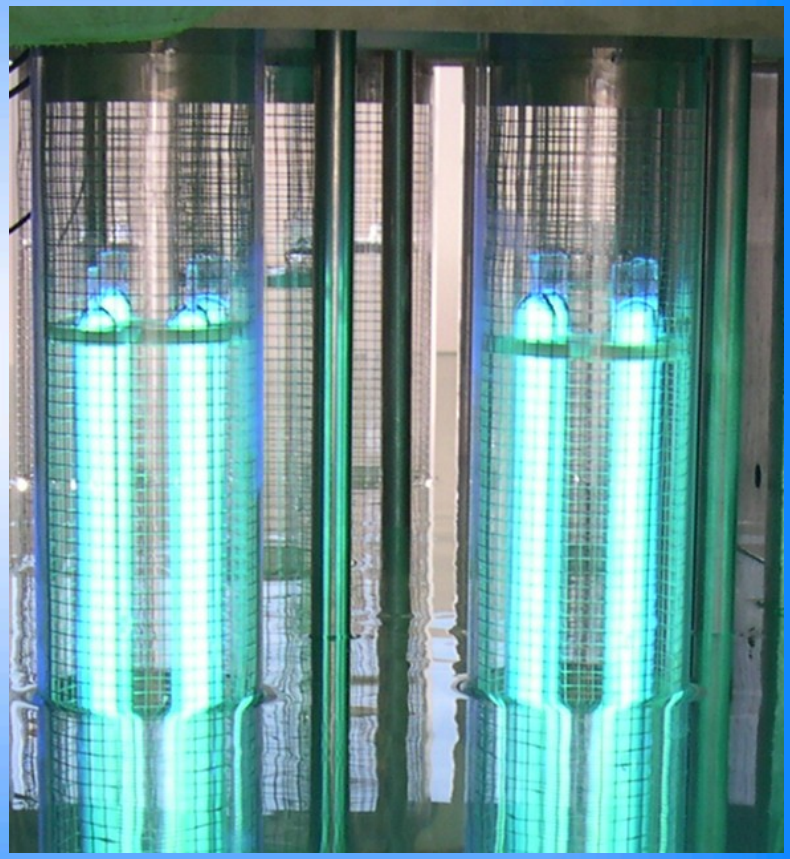
An Alternative ….. Microwave Generated UV

- Uses Microwave energy to excite the gas particles to emit UV Light



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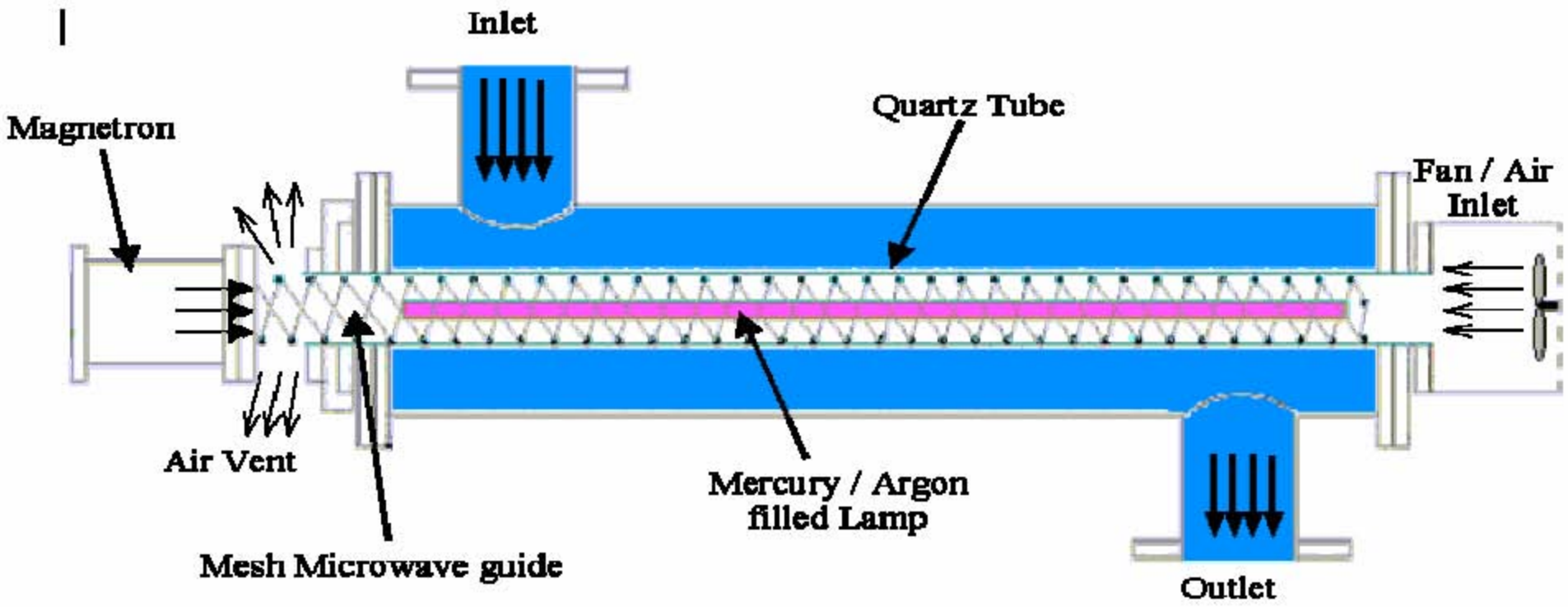
Elements of the Quay™ System



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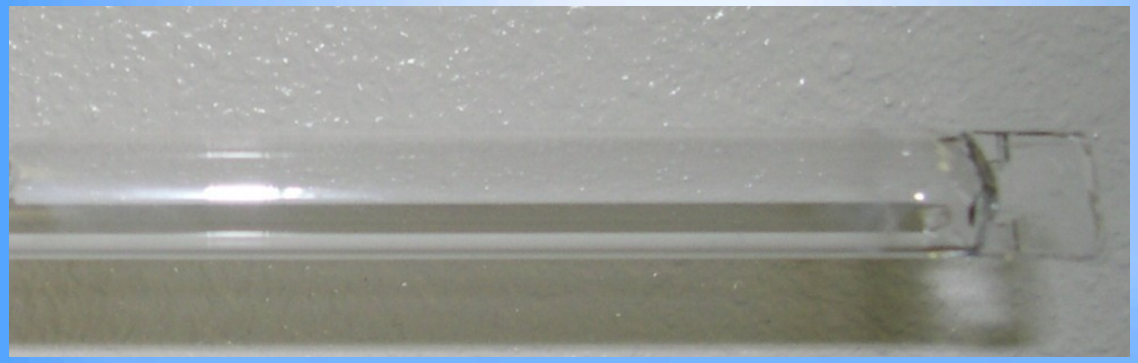
Comparison of Electrode Lamp and Quay Lamp

Electrode Lamp

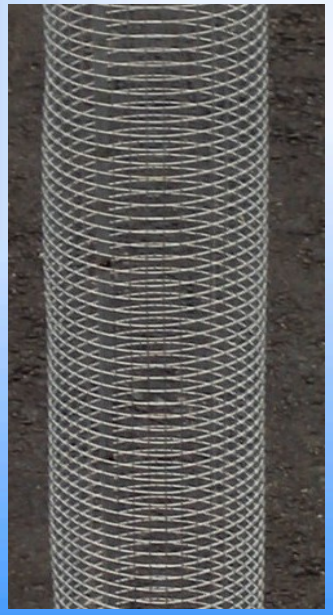


Quay™ Lamp

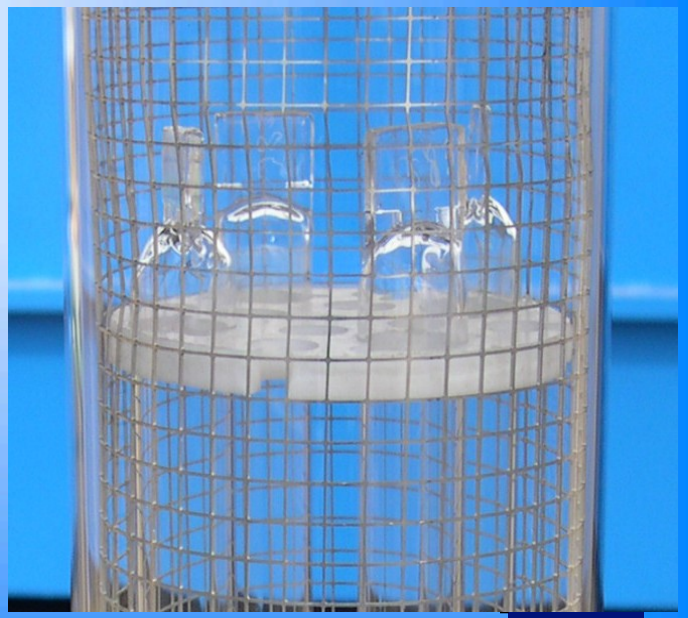
Elements of the System

4 Lamps
in a bundle

Waveguide



Quartz
Sleeve



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How the System is Assembled

4 Bundles in a Module

Microwave Source Fitted

Placed in Channel

Title 22 Testing underway…

System in Roseville
undergoing "Title22" program

Wastewater for re-use

- crop irrigation
- golf courses

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Microwave UV

- Advantages
  - Bulb warranted for three years.
  - UVC output is constant throughout life of bulb
  - Only 20% redundancy required
  - All serviceable parts are above the waterline
  - Lower Whole of Life Costs
- Disadvantages
  - Magnetrons have to be replaced
  - Power supply has to be replaced
  - Magnetrons are quite large results in minimum spacing
  - Some attenuation of energy in the wave guide

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Comparison of Cost of Electrode Lamps with Microwave System

Whole-life cost for 8 MGD of UV treatment*, $			
	Medium Pressure	Low Pressure	**QUAY**
Capital cost	1,027,644	936,523	998,107
Operating cost**	221,132	283,292	124,188
Total present worth	***3,564,028***	***4,344,310***	***2,422,543***

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