

# Application of U.V. and ozone in recirculation systems

Workshop CEFAS

UK

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# What do we want to disinfect?

## □ New water intake:

- According to where it is sourced, it may contain live organisms that we are not interested to find in the system.
- Different sources may be available:
  - River water
  - Pond water
  - Bore hole water
  - Public supply

## □ System water:

- Beside of the fish, the system houses a high load of bacteria and animals grazing on these bacteria. We may need to control their developments
- At a given time we may see pathogens organisms in the system and wish to get rid of them.



# Disinfection of the system water

What is the flow rate we have to disinfect?

From 100 to 10000m<sup>3</sup>/hr

What are the risks?

Bacteria

Parasites, Protozoa

Which technique to use?

Filtration: yes

Micro-filtration: no

Disinfection:

UV,

O<sub>3</sub>,

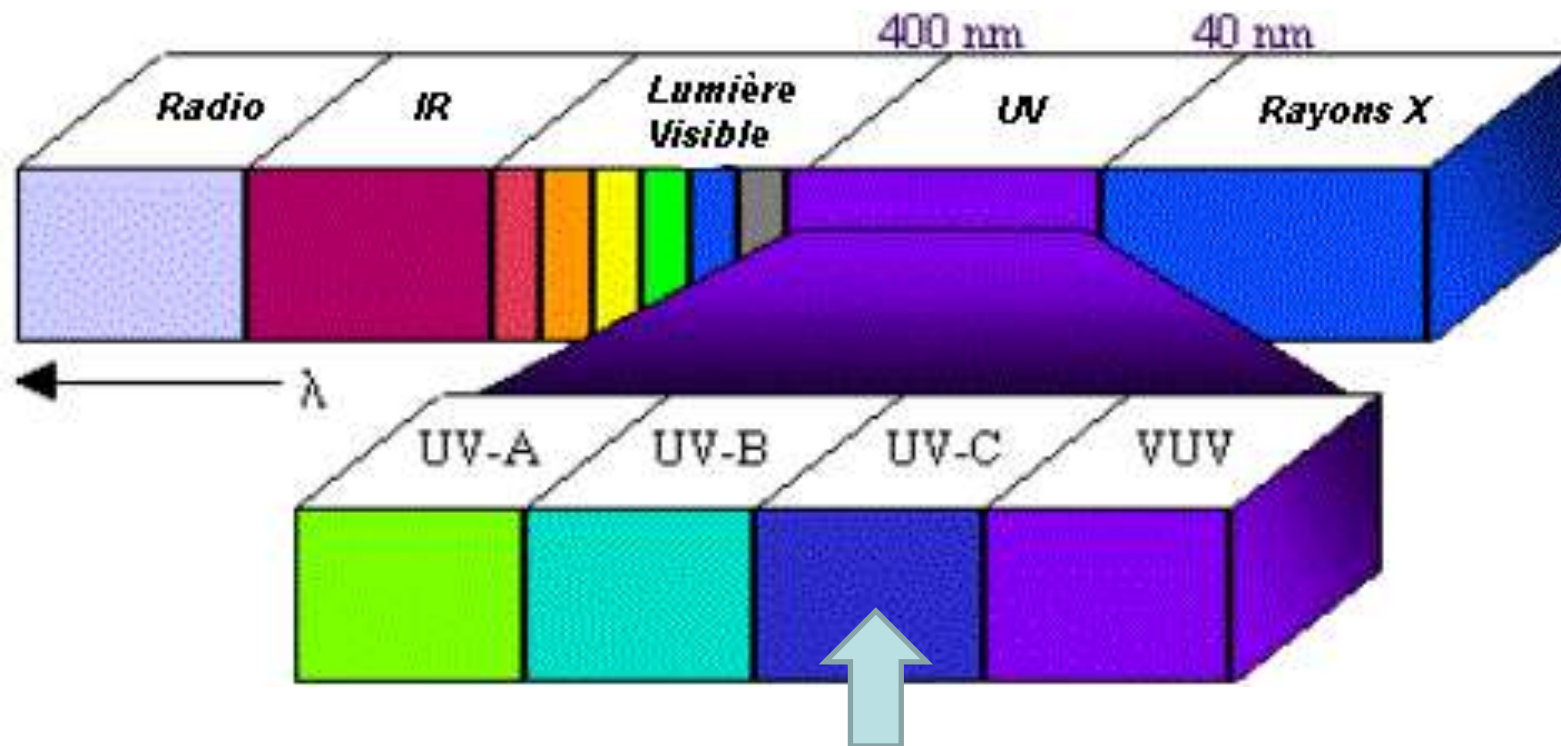
Heat,

chemical, ...?

Where to operate inside the system? Is the mean of disinfection inducing risks?

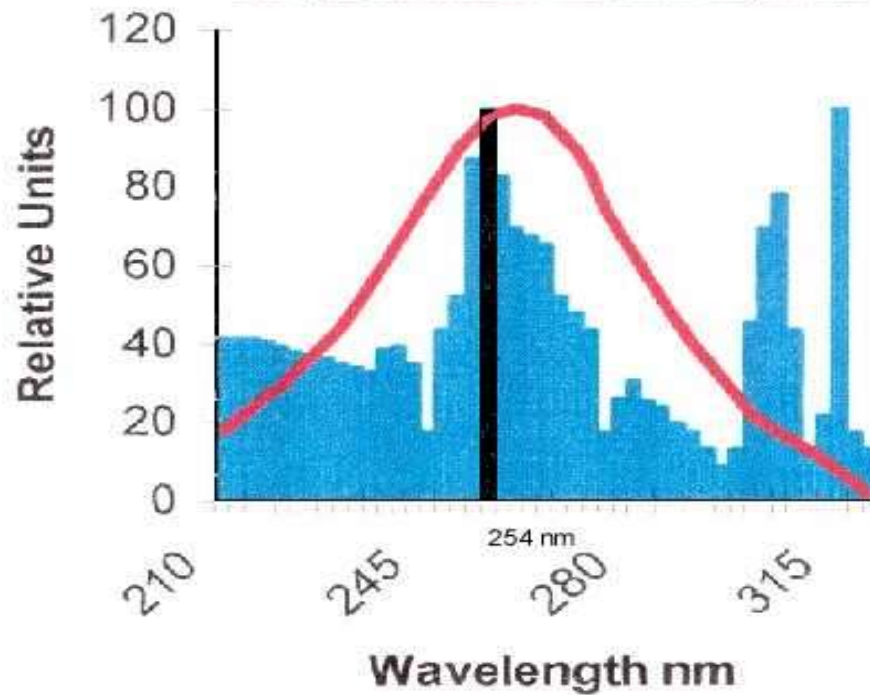
# UV light, how it works?

What is the disinfecting light wave length ?



The 254 nm wave has an effect on the DNA of the organisms

Medium Pressure Lamp  
Output Vs DNA Absorption



■ MP Output      — DNA Absorption  
■ LP output

# Which dose is to be used?

Micro-organism	Dose (mJ/cm <sup>2</sup> )
Bacillus subtilis (spore)	12.0
Clostridium tetani	4.9
Pseudomonas aeruginosa	5.5
Streptococcus faecalis	4.5
Hepatitis A virus	11.0
Hepatitis Poliovirus	12.0
Saccharomyces cervisiae	6.0
Infectious pancreatic necrosis	60.0

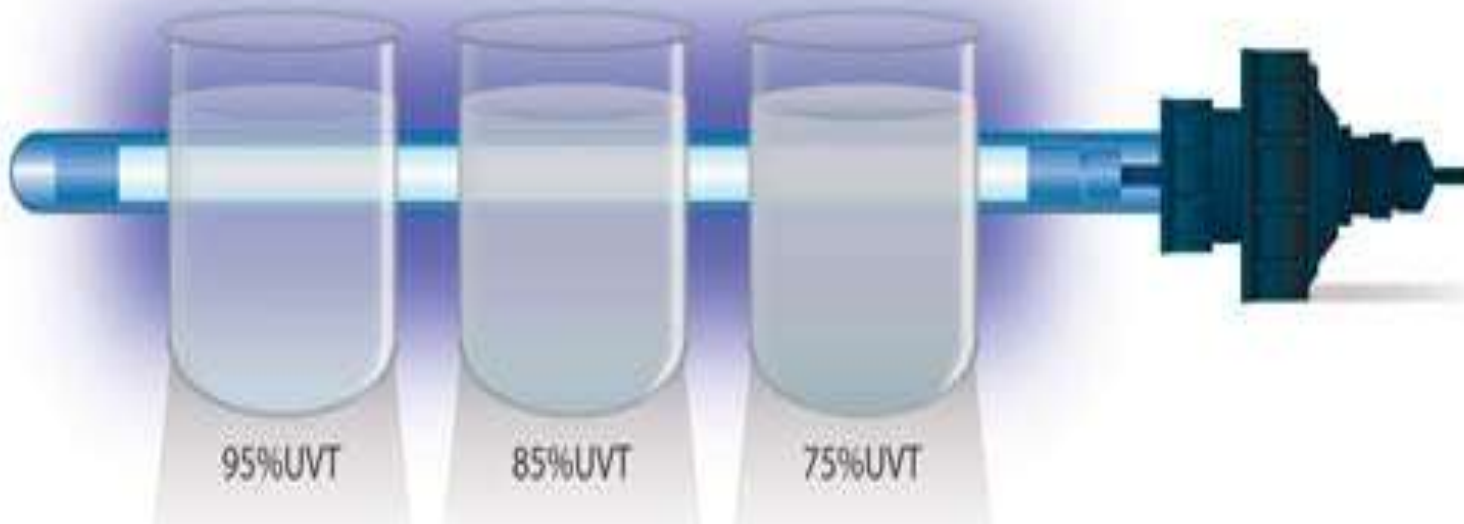
To disinfect, a commonly accepted dose is 25miliJoule/cm<sup>2</sup>, but risks remain!!

Protozoos and micro algae might be sensitive as well, but their transparency to UV light can be poor and therefore protect them

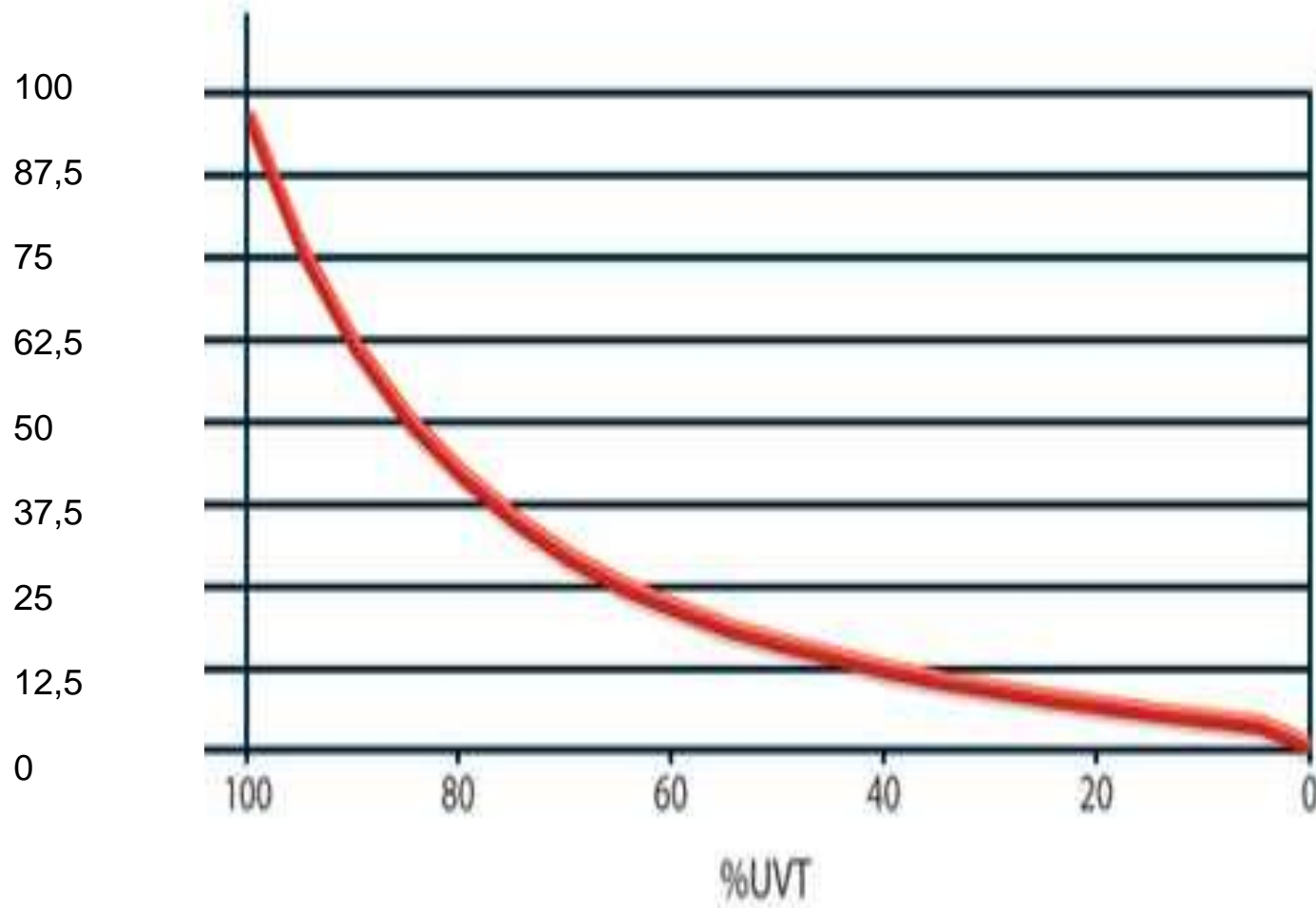
# Effect of the water transparency

The water organic load modifies the capacity of the UV light to reach their goal:  
an intense color, and/or a high load of organic matter in the water reduces the penetration of the UV light.

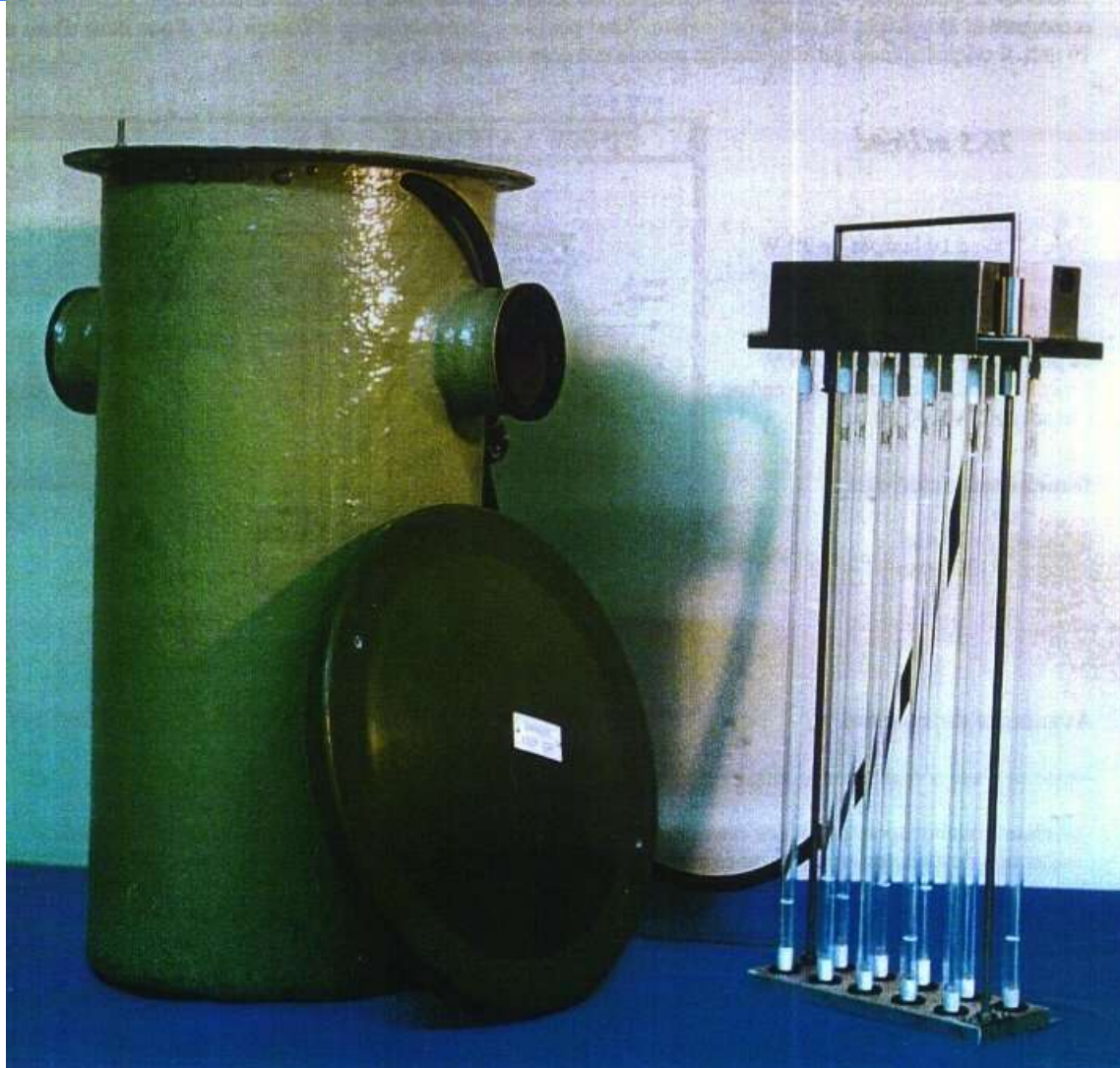
To obtain a given dose, the “transmittance” of UV light in the water is to be considered



# Dose reduction with loss of transmittance



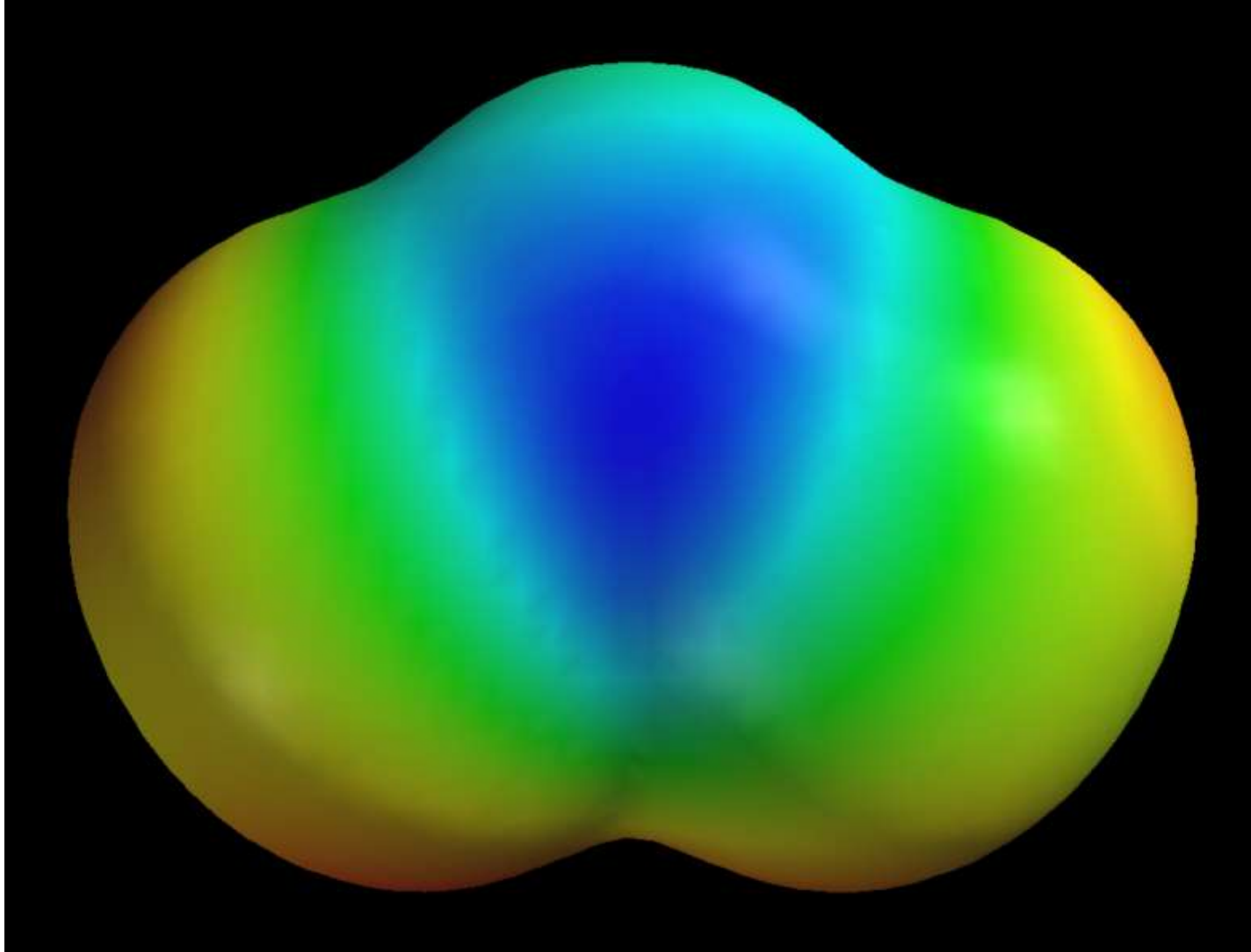
# What type of equipments?



# Floating UVs



# OZONE: 03



# What does Ozone in the water?

- ❑ Ozone is a strong and powerful oxidizing product
- ❑ It delivers one atom of oxygen to oxidize and one molecule of oxygen which can further oxygenate the treated water
- ❑ It will oxidize indifferently organic material, bacteria, viruses and any molecule susceptible to oxidation
- ❑ It goes preferably to the easiest which might not be bacteria or protozoan.
- ❑ Only the dissolved part of the injected ozone will be useful
- ❑ Its direct residues are harmless (oxygen!), but oxidization by-products might be harmful

# What are the expected results?

- Water transparency is improved greatly: the humic acids resulting from fish/feed metabolism giving their “tea like” colour to the recirc waters are easily broken by ozone.
- Protein skimming is easier: large molecules are broken into smaller
- Disinfection can be obtained, but it requires high dosages : the process has to be carefully engineered
- All depends of the dosage!!

# Are there risks?

- YES !!
- Fish are sensitive at a proximate level of )0,1ppm
- Human lungs are as well sensitive to very low levels of residual ozone
- Equipments are needed to measure and control (feed-back) the oxidizing power in the water and as well the potential leakages of ozone in the air around the ozone producing equipments
- Safe levels can be insured thru correct sizing of the equipment in relation to the flow rate

# What type of cost?

- Equipments are obviously to be sized and costed according to flow rate
- Consumables will be KWh and potentially pure oxygen
- Main application is made producing ozone from pure oxygen at an enrichment rate of 6-8%, so overall dissolution process of both gases is a clue in calculating the cost
- Doses from 0,1ppm to 3 ppm could be applied and therefore relative cost depends a lot of the application and expected results

