
Water Quality Management

# Water Filtration (Mechanical)

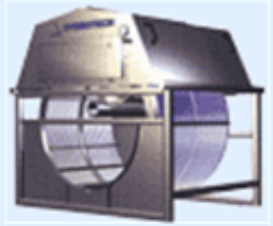
# Mechanical filtration

- Mechanical filtration is used to remove solid waste quickly and effectively.
- The type of mechanical filter will depend on
  - the flow of water to be treated,
  - the size of the particles which need to be removed
  - the clarity required.

# Types of mechanical filters

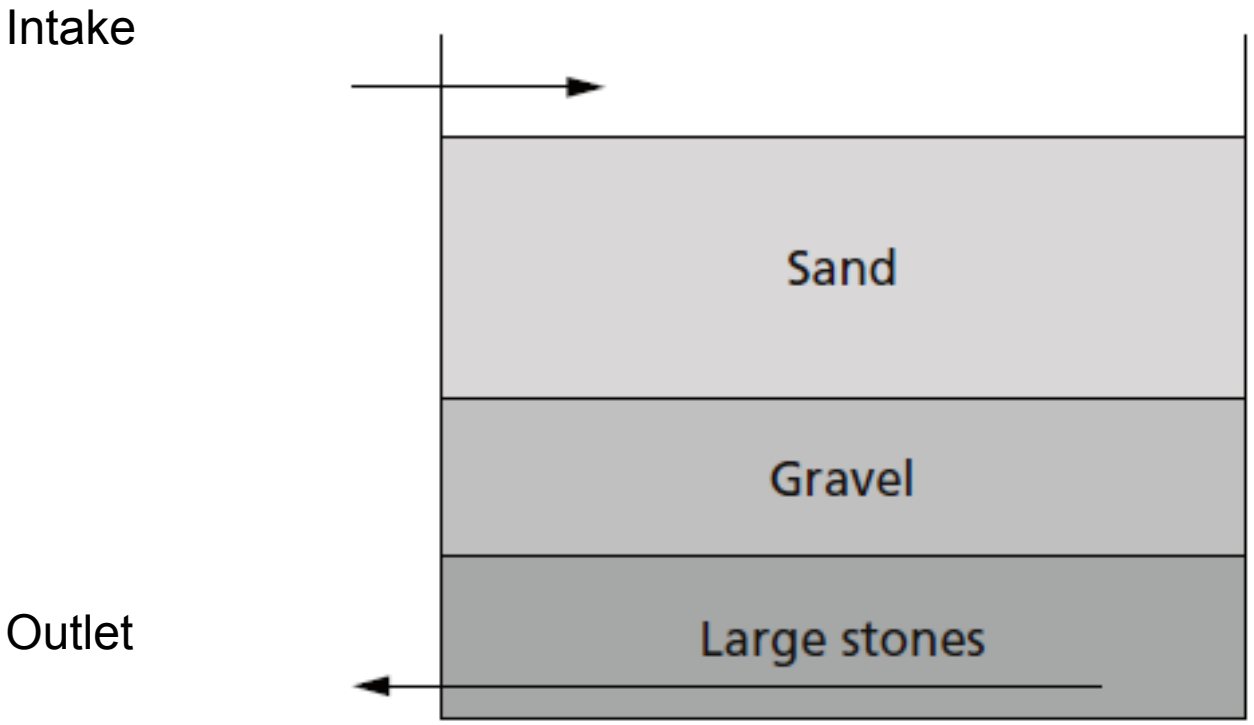
| | Advantages | Disadvantages | Applications |
|---|---|---|---|
| **Cartridge Filter**  | • Small footprint<br>• High surface area | • Difficult to clean: sometimes requires the use of chemicals<br>• Pressurised<br>• Replacement cartridges expensive | • Low flows with low to medium suspended solids<br>• 1 - 50 µm |
| **Sand Filter**  | • Variety of media can be used | • Water loss during backflushing<br>• Risk of channeling<br>• Needs to be pressurised | • Medium to high flows with low to medium suspended solids<br>• 21 µm |
| **Bag Filter**  | • Replacement bags inexpensive<br>• Very little head loss<br>• Gravity fed or pressurised | • Low surface area<br>• Needs to be cleaned and replaced regularly | • Low flows with low to medium suspended solids<br>• 50 - 400 µm (gravity fed)<br>• 1 - 100 µm (pressurised) |

# Types of mechanical filters

| | | | |
|---|---|---|---|
| **Screen Filter**<br>  | • Separates solids from system water<br>• Medium maintenance | • Limited installation options<br>• Gravity fed only | • Medium to low flows with medium to high suspended solids<br>• 200/300 µm & 300/600 µm |
| **Drum/Disc Filter**<br>  | • Separates solids from system water<br>• Low maintenance<br>• Fine filtration of high water flows | • Expensive<br>• Large footprint | • High flows with medium to high suspended solids<br>• 10 - 100 µm |
| **Swirl Filter**<br>  | • No replacement of mechanical parts | • Large footprint<br>• Does not remove fine particles | • Low to medium flows with medium to high suspended solids<br>• > 1mm |

# Simple mechanical filter

# Simple mechanical filter




*Sand filter tank set up with layers of different filter media. Water is pumped in at the top of the tanks, flows through the various media, and out at the bottom of the tank.*

# Bag Filters

- Bag filters load solid waste efficiently and are easily cleaned.
- These bags not expensive, very durable and can be used to filter hatchery water

# Mechanical filtration – sand filters

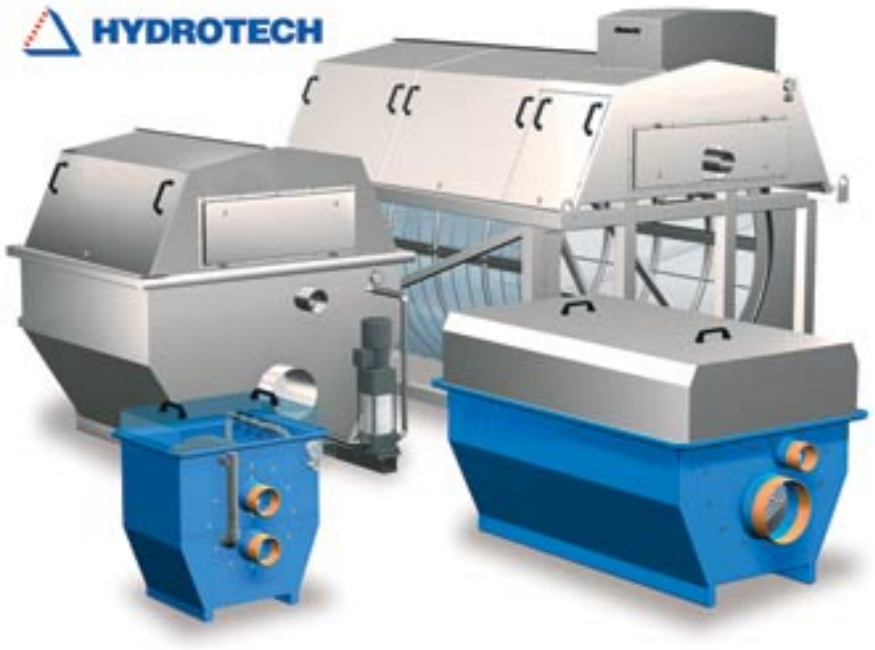
Sand or AFM media to filter to 10µ.

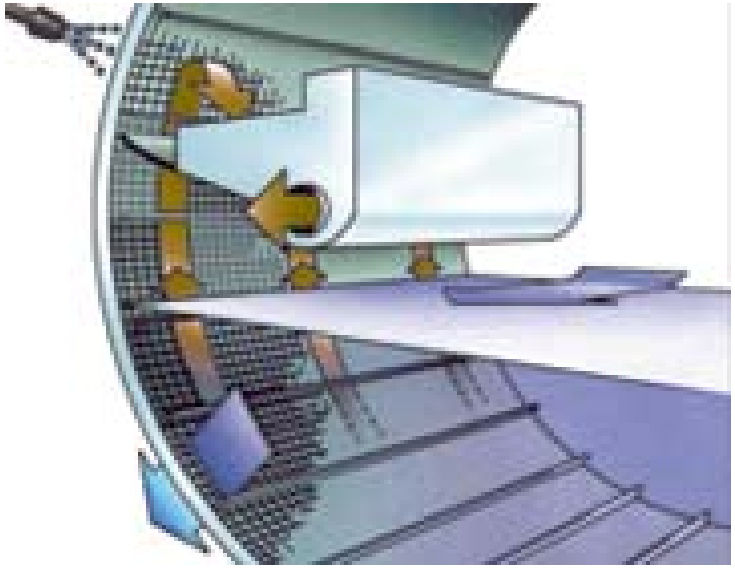
- Media does not clog or need renewing.
- Keeps very clean and requires lower pressure to pass same volume of water.
- Particularly suited to situations where water quality is more constant.

Water filtration

# Mechanical filtration - Drum filters

- Drum filters from 200 to 10µ mesh.
- Work well in situations where:-
- Suspended solids vary a lot from day to day.
- When particle size range has been previously measured.



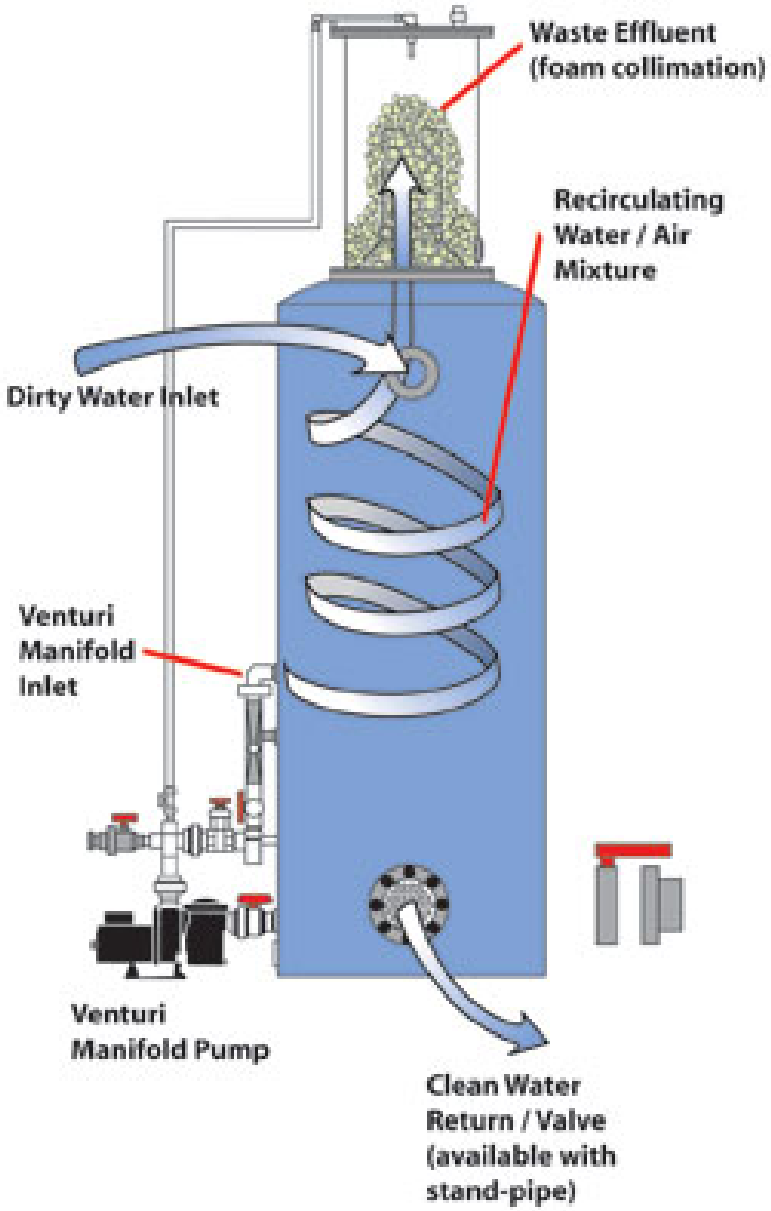
# Protein skimmers

1. Venturi Air Injection Manifold
2. inlet pressure gauge, critical to operating efficiency, identifies the pressure before the venturi injectors.
3. venturi pump supplies water to the venturi manifold and waste collector wash-down nozzle.
4. outlet valve controls the column height inside the reactor
5. waste collector can be easily disassembled for periodic cleaning,
6. wash-down nozzle
7. Protein skimmer vessel

# Protein skimmers

Protein Skimming (Foam Fractionation)

- Remove solid / dissolved organic waste
- Increase dissolved oxygen
- Reduce the biological demand on the biofilter
- Improve water clarity



# Borehole water supplies

<u>Advantages</u>

- Constant temperature
- Low bacterial levels
- High clarity
- Little or no need for filtration
- Stable conditions for larval rearing

# Water Disinfection (UV)

# Water Disinfection

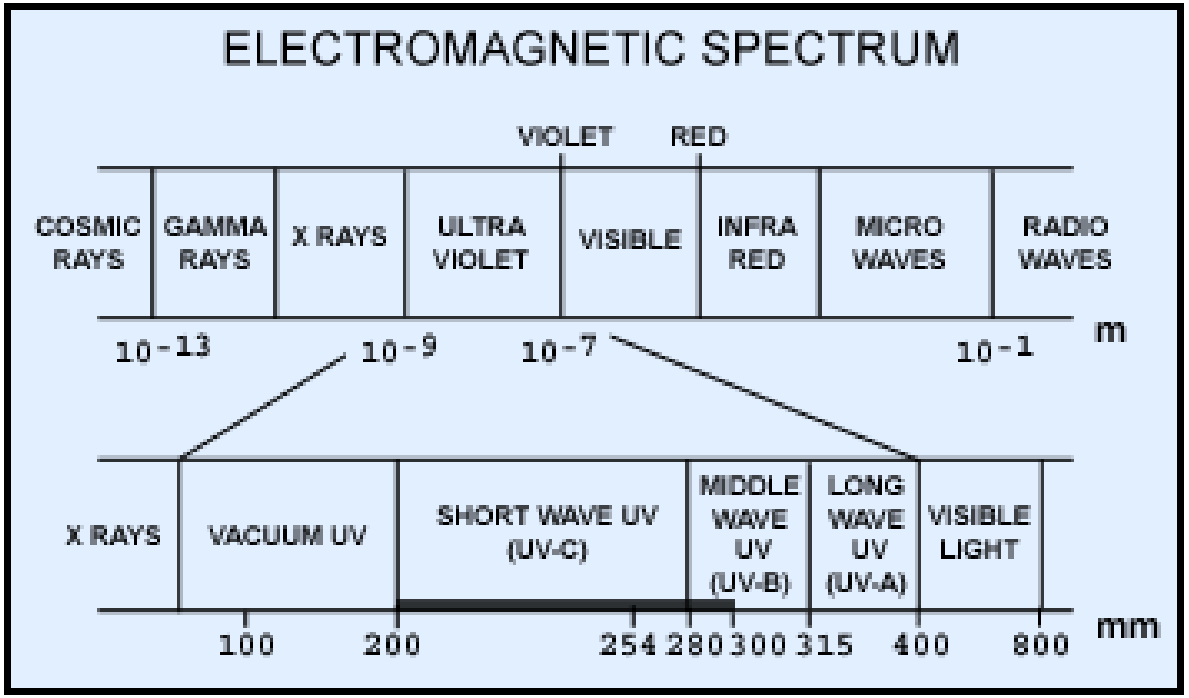
## Ultra Violet

- UV at a minimum of 30,000 mW/cm2.
- For nodavirus need >100,000.

Ultraviolet disinfection

# Ultraviolet disinfection

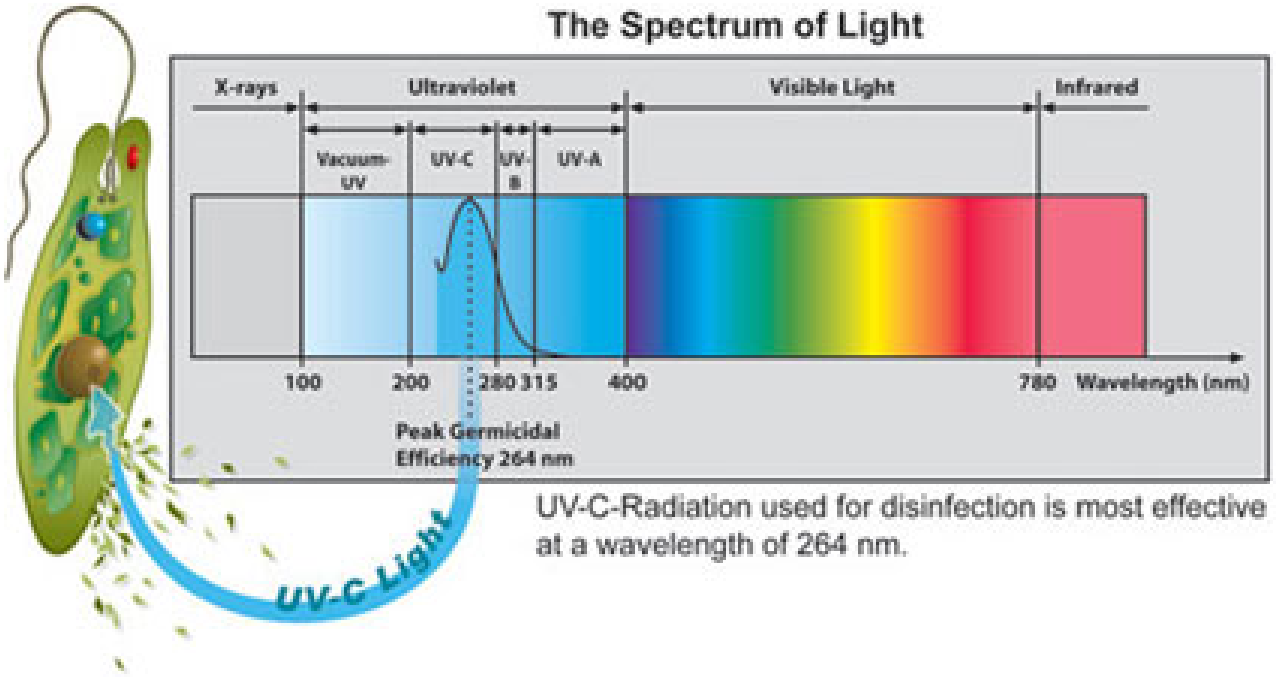
- Ultraviolet is a the blue violet range of the visible spectrum
- The ultraviolet spectrum is divided into three separate bands:-
  - **UVa** From 315nm to 400nm
  - **UVb** From 280nm to 315nm
  - **UVc** From 200nm to 280nm
- UVc is often referred to as the germicidal wavelength, because of its ability to destroy micro-organisms.



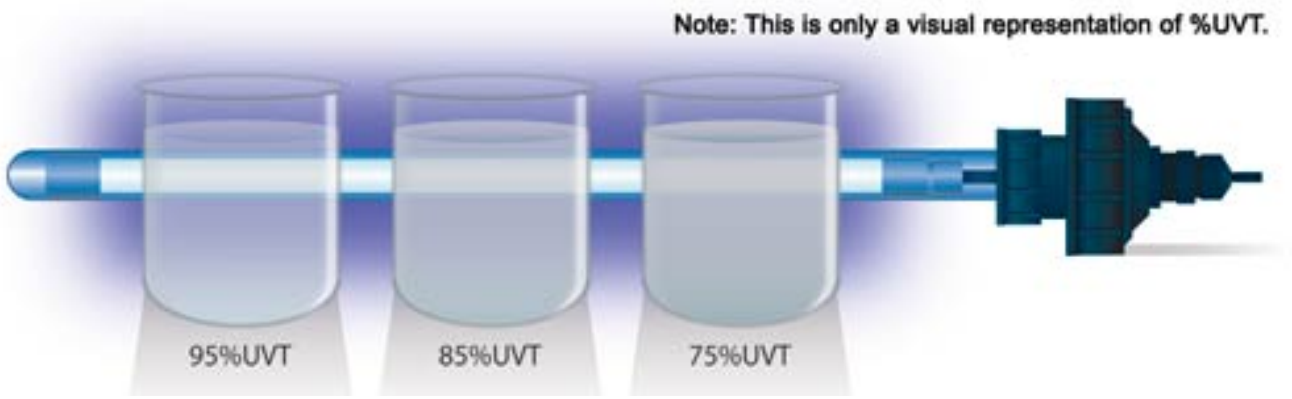
# Ultraviolet disinfection

- When water is passed through a UV steriliser, micro-organisms contained in the water come into contact with UVc radiation which penetrates the cell membrane and either destroys or debilitates the micro-organism.
- Different micro-organisms vary in their susceptibility to UVc radiation.
- Correct application will dramatically reduce the likely spread of most primary infections such as Oodinium sp. and Cryptocaryon sp., at the same time almost eliminating the risk of secondary bacterial infection which is so often the real cause of fish loss.
- It is important to consider
  - the contact time
  - distance between the UVc source and the micro-organisms
- The contact time is the actual time it takes for the water to pass through the chamber.

# Ultra Violet wavelength and efficiency




UV-C-Radiation used for disinfection is most effective at a wavelength of 264 nm.



# Exposure to kill 99.9%

| Micro-Organism | UV Dosage Required µWs/cm²* |
|---|---|
| **Bacteria** | |
| *Eschericia coli* (E-coli) | 7 000 |
| **Cyst** | |
| *Vibrio cholera* (cholera) | 6 500 |
| **Algae** | |
| *Chlorella vulgaris* (common green algae) | 22 000 |
| **Moulds** | |
| *Saprolegnia sp. zoospore* (egg fungus) | 35 000 |
| **Viruses** | |
| Rota virus | 24 000 |
| **Parasites** | |
| *Trichodina sp.* (fish parasite) | 35 000 |
| Nematode eggs | 92 000 |
| *Icthyophthirius sp.* (white spot) | 336 000 |

# Water Disinfection - ozone

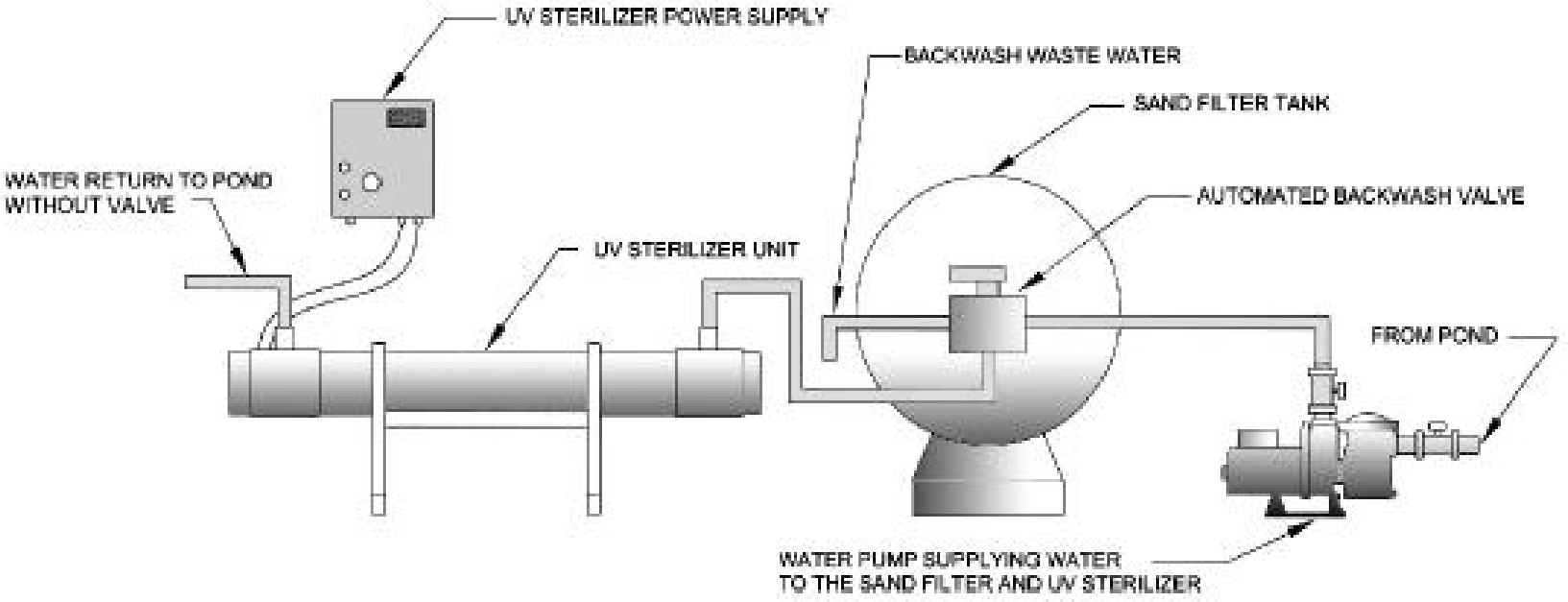
- Ozone is a powerful oxidizer, but it is also an unstable gas.
- Ozone is created by drawing dry air, or pure oxygen, and  electrified by an electrical spark.
- During this process, the oxygen molecule is split into three parts and ozone gas is created.
- When applied to water, ozone gas searches out organic contaminates to oxidize.
- The performance of ozone is affected by water temperature and organic load.

# Water Disinfection - ozone

- Ozone at a maximum dose rate of 1g/m3/hr flow.
- Redox after ozone kept at 300 mv falling to 150 after Ultraviolet.
- Deep water redox lower than surface water.
- Main problem with
  - Danger to human health
  - reliability of redox probes.

Ozone

# Hatchery water treatment

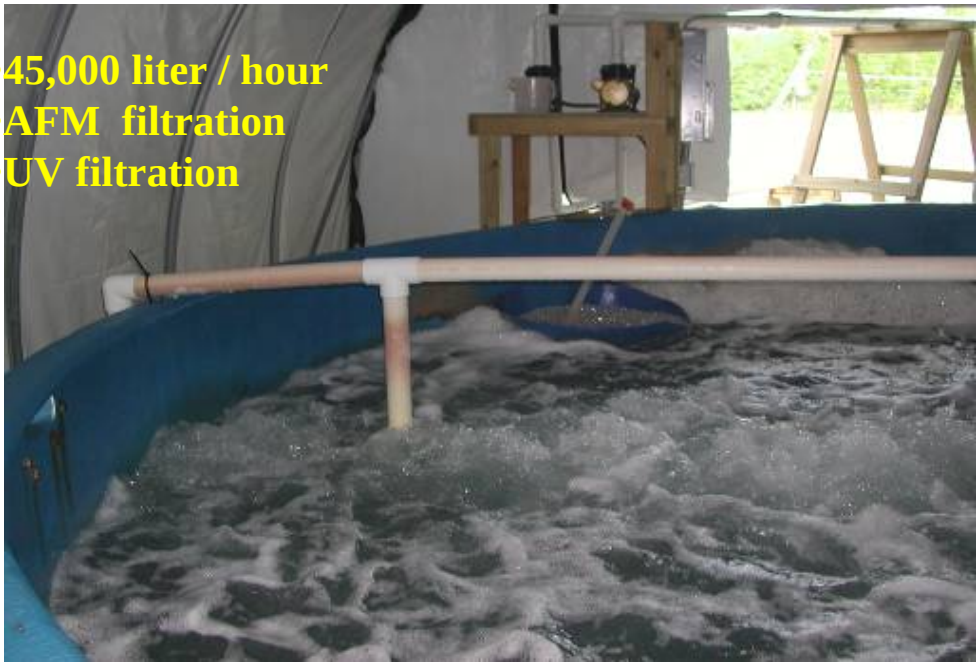



Oxygenation and Degassing water

# Degassing water

| | $H_2S$ | pH | $CO_2$ | $O_2$ |
|---|---|---|---|---|
| BEFORE DEGAS | 2.8 mg/l | 7.5 | 150 ppm | 0 |
| AFTER DEGAS | 0.003-0.001 | 7.7-7.9 | 25-35 ppm | 100 % |

- 45,000 liter / hour
- AFM filtration
- UV filtration



# Degassing columns to remove supersaturated gasses

# Industrial degassing

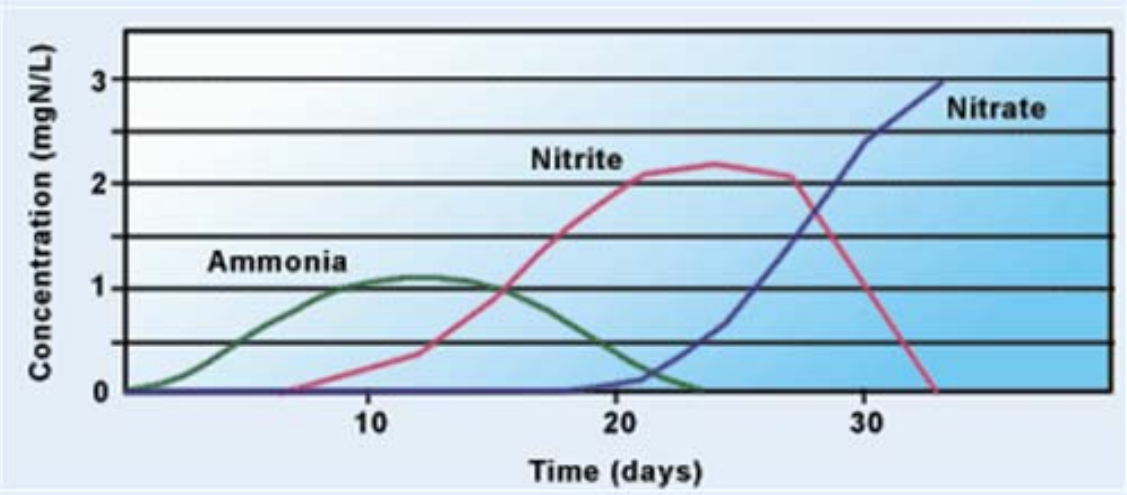
# Liquid oxygen supply essential for live food production and intensive culture methods


# Conditioning water

# Probiotic, conditioners or starters

- The use of probiotics can improve the efficiency of biological filters.
- It facilitates the removal of ammonia and nitrite.
- It usually contains a live culture of concentrated nitrifying bacteria that biologically convert ammonia and nitrite to relatively harmless nitrate.
- It can dramatically reduce the start-up period of the nitrogen cycle to get new systems up and running in up to ten days (depending on water conditions).
- The biological filters of new recirculation systems can be prone to colonisation by unbeneficial non-nitrifying bacteria, particularly in the first six months. Inoculating the new reciruclation system with probiotics can significantly reduce this risk, by colonising the system with concentrated nitrifying bacteria.

# Recirculation start up




Using probiotics or starters