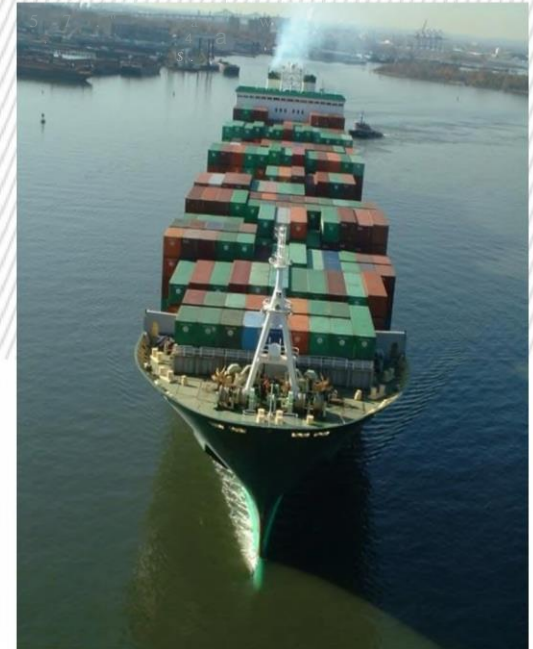


Update on Ballast Water Management Technology

BCSEA Project Training on the IMO's BWM Convention

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- Approximately 3-4000 million t discharged every year in ports
- More than 10000 marine species transported every day in ballast water across the oceans
- Serious disturbance or alteration of ecosystems by invasive alien species **{IAS}**
- Ballast water most significant pathway of unintentional introduction of IAS
- Possible major socio-economic damage
- Possible threats to human health, e. g. through consumption of contaminated food
- **Over 60 BWMS** have Basic Approval and almost 50 have Final Approval



- **Solid-liquid separation {usually precedes chemical physiochemical unit process}**

1. Filtration:

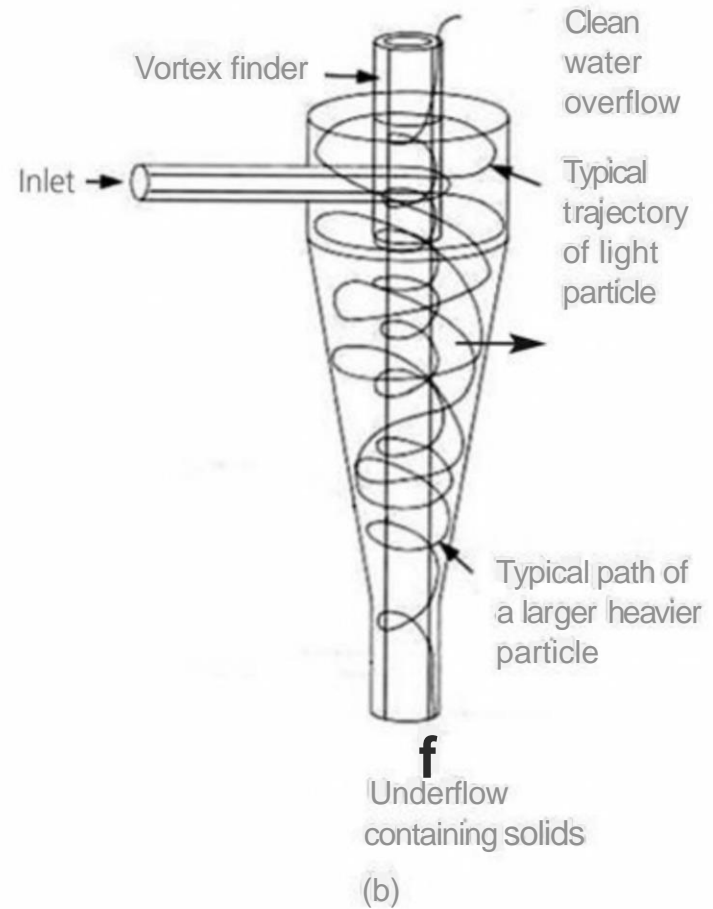
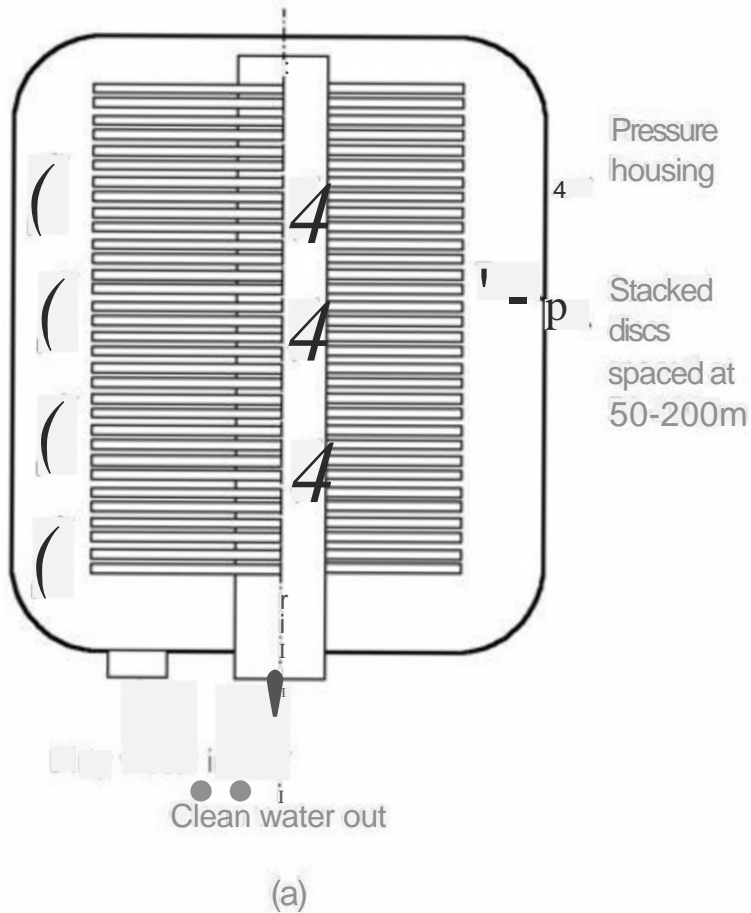
- In BWM usually backwashing system
- BWM standards are size based -> mesh size between 10 and 50µm most common
- More effective for larger particles/organisms

2. Hydrocyclones

- Alternative technology to filtration
- Water injected at high velocity
- rotational motion of the water leads to separation of particles from water
- Effectiveness depends on difference in density of particle and surrounding water, size of particle speed of rotation and residence time



- **Solid-liquid separation (examples)**





3. Coagulants:

- Can be used to increase efficiency of filtering or hydrocyclones;
- Time dependent
- Requires big tank
- Efficiency can be increased by adding ancillary powder of high density (e. g. magnetite or sand)



Chemical Disinfection

- Chlorination/Electrochlorination: relatively inexpensive, but virtually ineffective against cysts. Can lead to undesirable chlorinated by-products.
- Ozonation: fewer harmful by-products, but requires relatively complex equipment to both produce and dissolve it into the water
- Chlorine dioxide: normally produced on the spot, but critical (reagents used are themselves hazardous)
- Peracetic acid: infinitely soluble in water, few harmful byproducts, relatively stable as Peraclean. Problem: relatively expensive, dosed at high level and require considerable storage facilities
- Hydrogen peroxide: see peracetic acid
- Menadione / Vitamin K: natural product and safe to handle

Pre-treatment desirable (filtering, hydrocyclones); post-treatment of residuals necessary



Physical Disinfection

- Ultraviolet irradiation: most well established method; well known to be effective against wide range of micro-organisms (e. g. viruses and cysts); relies on good UV transmission through the water -
clear water and unfouled clean quartz sleeves needed for effectiveness; removal of water turbidity essential; UV can be enhanced by combining with another reagent, such as ozone, hydrogen dioxide or titanium dioxide
- Deoxygenation: takes a couple of days to come into effect due to the length of time it takes organisms to be asphyxiated micro-organism and disrupts the Cell wall
- Cavitation: acts at the surface of the through the collapse of micro bubbles
- Ultrasonic treatment: see cavitation





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