Application of photo-catalytic technology in ships' ballast water treatment

—China Association of the National Shipbuilding Industry

CANSI

Contents

- background
- current status of the convention
- disinfection mechanism
- technical features
- comparison of PCT with UV
- factors determining
- OceanDoctors BWMS

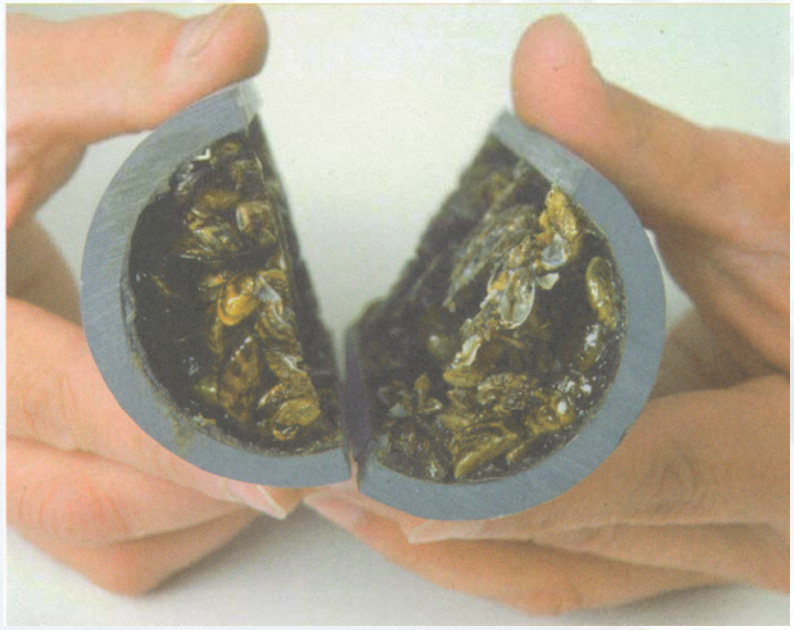
Background

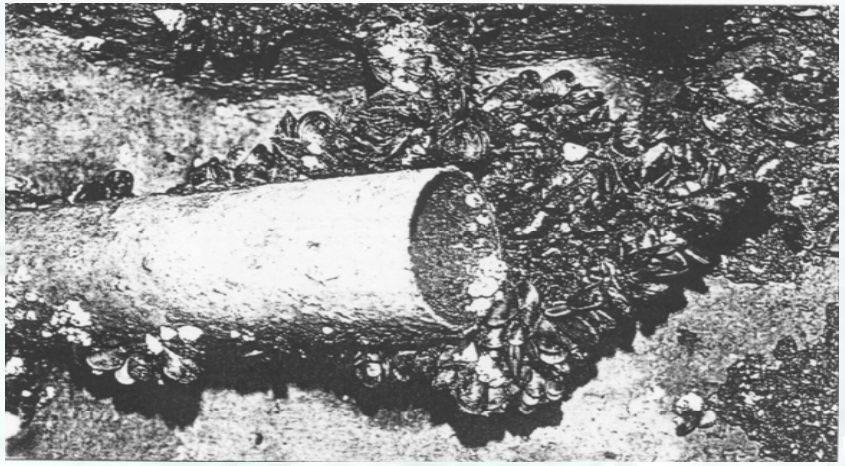
■ 80% of the total cargo tonnage relies on ship transportation

■ ballast water is indispensable to keep a safe, stable and reliable sailing of ship

■ the unlimited ballast water discharging could induce serious ecological, economic and public heath impact to the receiving environment

Background





CANS I

Background

■2004, IMO 《the International convention for the Control and Management of Ships' Ballast Water and Sediment》

■USCG and New York have established discharge standards of their own.

Background

生物	IMO	Califonia	HR2830	New York	USCG No 1	USCG No 2
≥50um	＜10	0	＜0.1	0	＜10	＜1
＜50，≥10um	＜10	＜0.01	＜0.1	＜0.01	＜10	＜1

Current status of the Convention

- Entry into Force: 30 States / 35% of the world's the world tonnage
- To date: ratified by 38 countries representing just over 30% of the world tonnage
- USCG AMS: 2013-12-01

Disinfection Mechanism

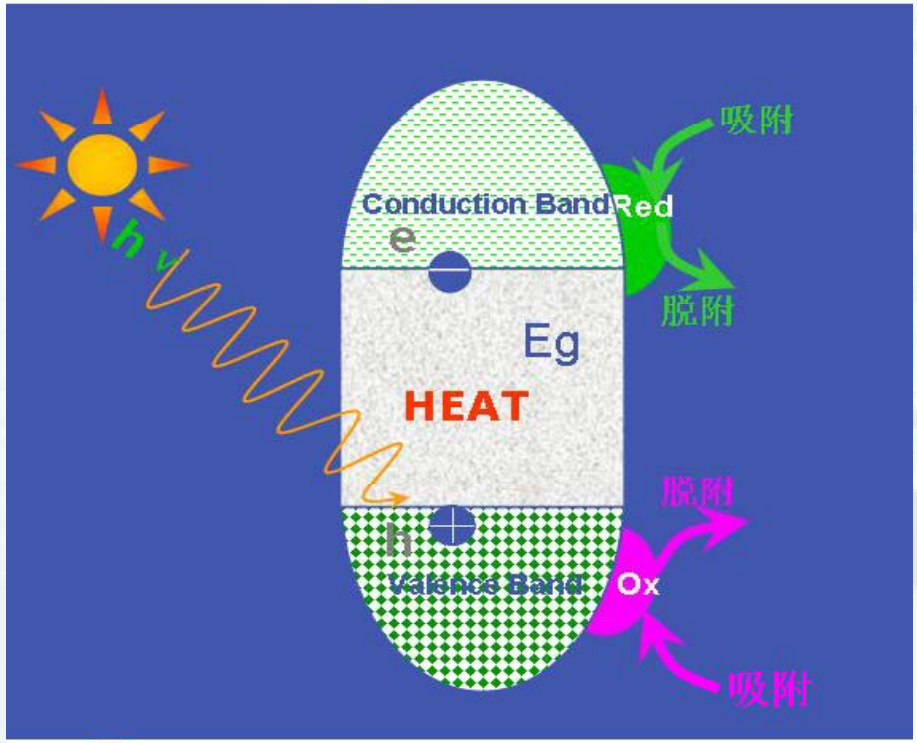
■ The Photo-Catalysis Technology (PCT) is combination of UV irradiation and photo-catalytic oxidation

■ UV irradiation , the DNA, RNA and proteins in cells of organism will absorb the UV light , the replication and reproduce of DNA will be inhibited

Disinfection Mechanism

■ Photo-catalytic oxidation , the UV light irradiates on the surface of TiO2 nano film , which generates hydroxyl radicals. The hydroxyl radical is a powerful oxidant which can react with hydrogen (H) in the cell membrane of the organisms and break up the cell membrane, further rupture substances such as protein, carbon hydrates and DNA of organisms; as a consequence, organisms are inactivated

Disinfection Mechanism



$$TiO_2 + h\nu \rightarrow h^+ + e^-$$

$$OH^- + h^+ \rightarrow \cdot OH$$

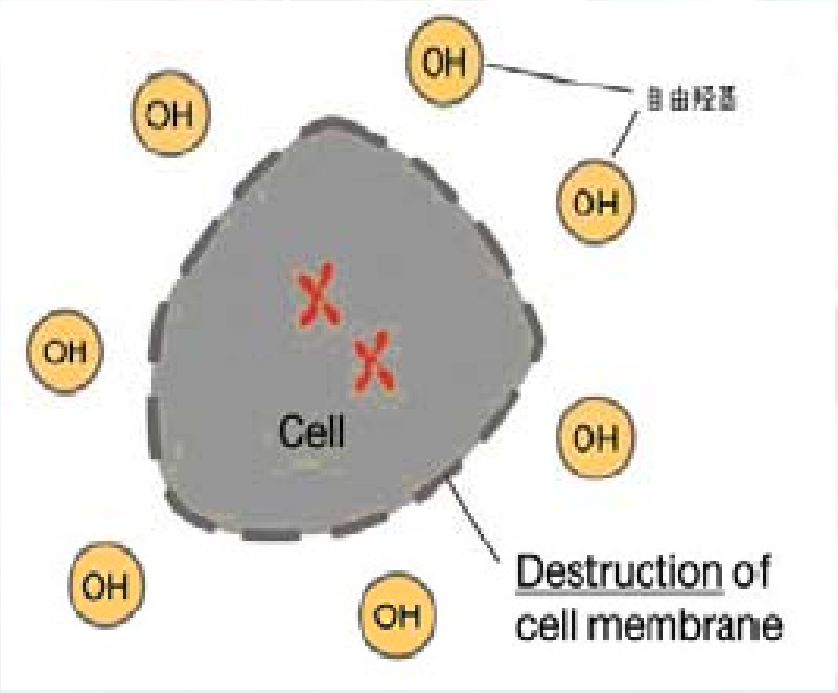
$$H_2O + h^+ \rightarrow \cdot OH + H^+$$

Technical Features

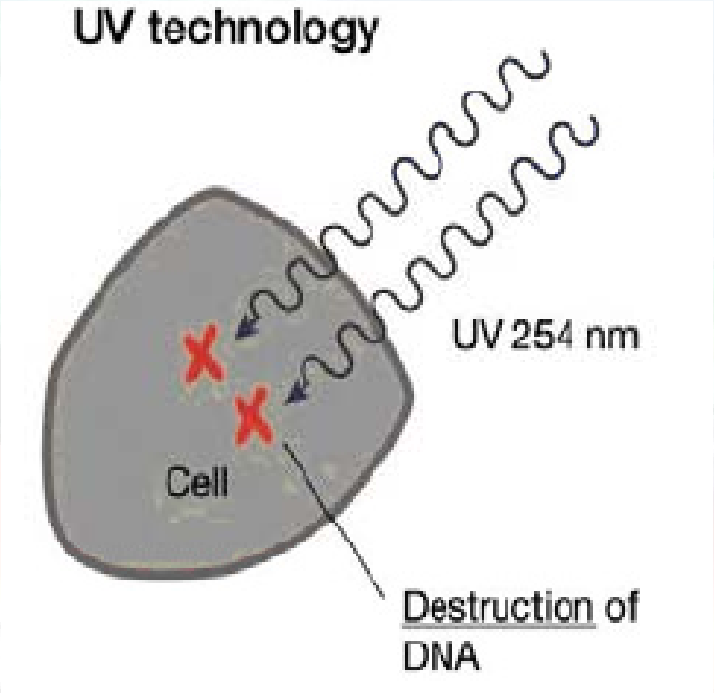
- Only one stage treatment, and the treated ballast water is discharged directly
- Low operation and maintenance cost
- No ship corrosion risk

Comparison of PCT with UV

PCT



UV

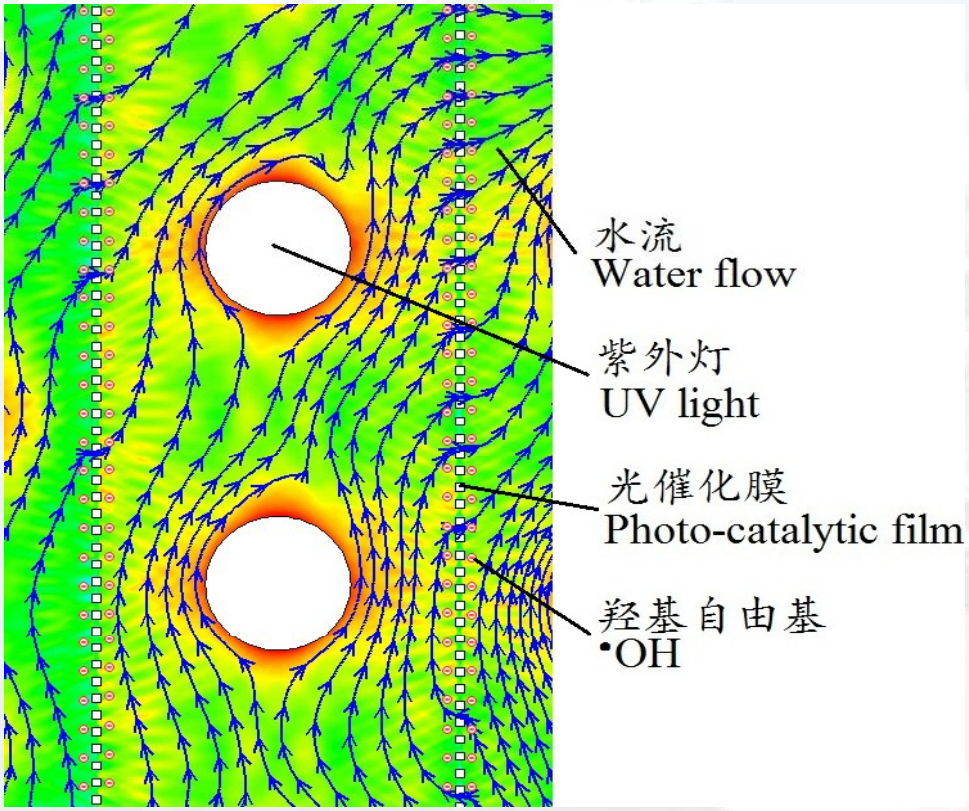


Factors Determining

- the concentration of the Hydroxyl radicals,

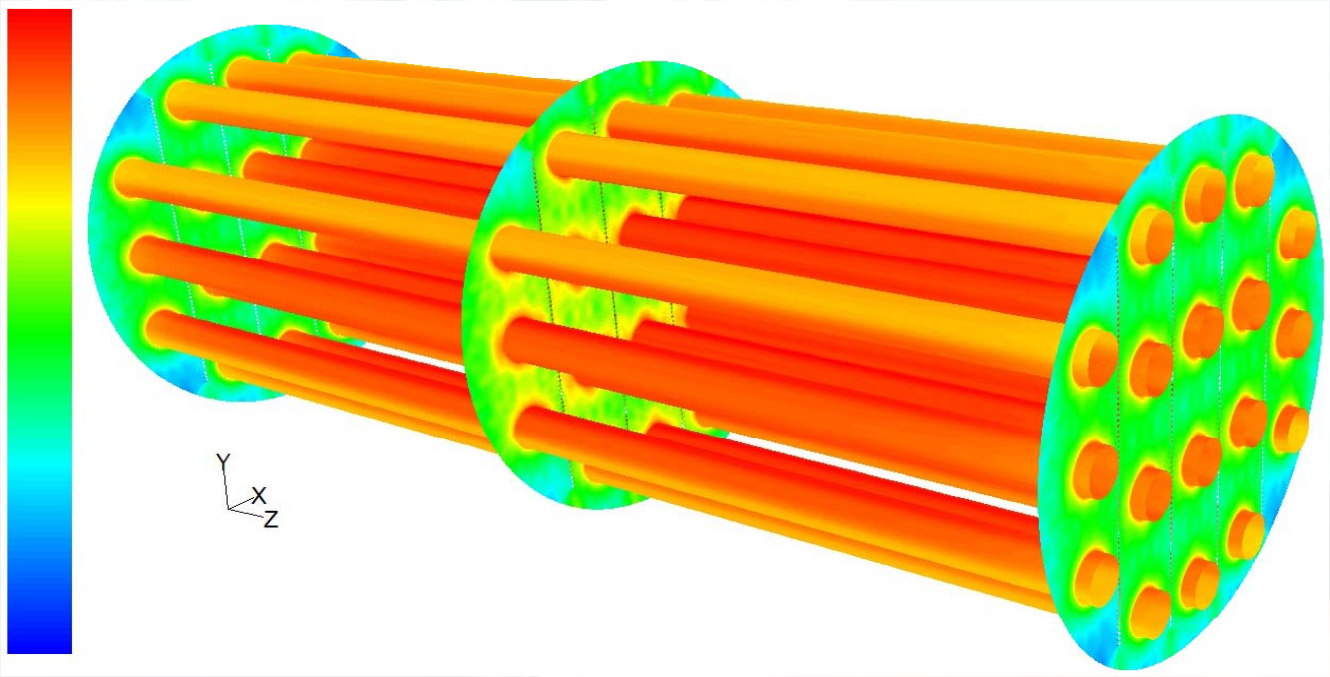
- the sufficiency of contact between water to be treated and photo-catalytic film.

Factors Determining



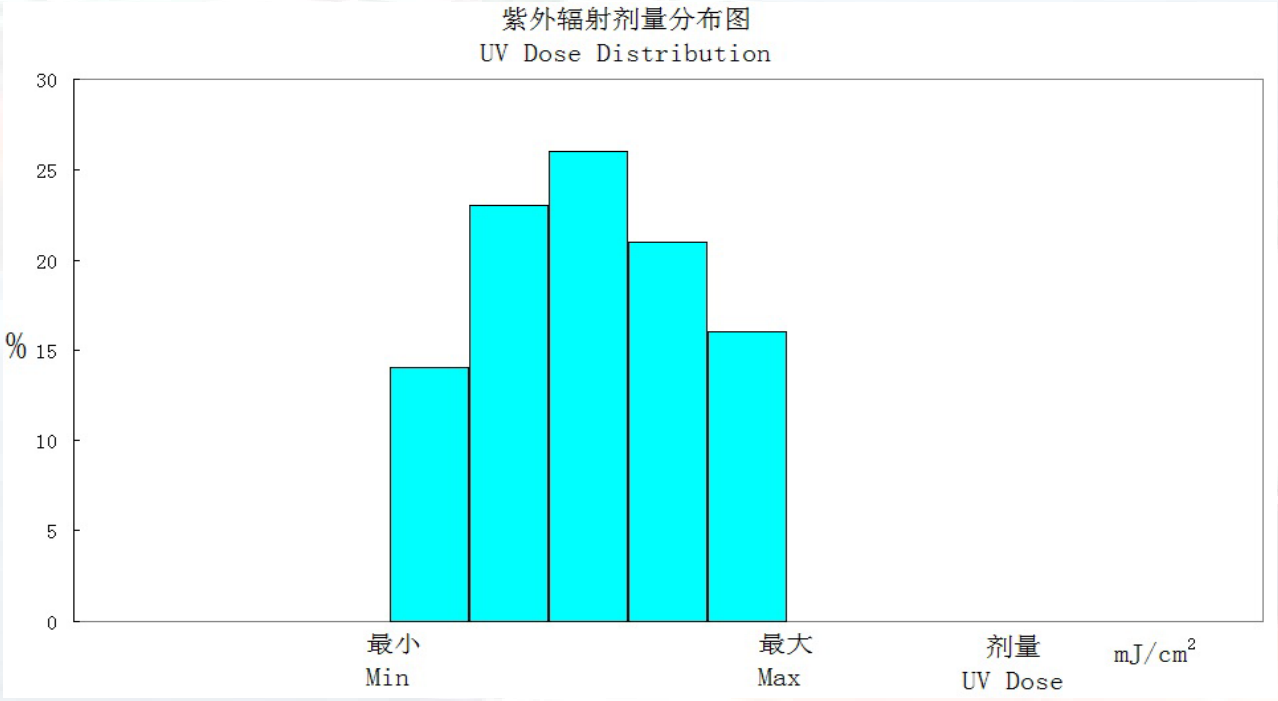
fluid simulation

Factors Determining



simulation of UV irradiation dose

Factors Determining



UV dose distribution

CANSI

Ocean Doctor BWMS

Ocean Doctor BWMS with a TRC 500m3/h

CANSI

Advantages

■ **Great biological efficacy:**

Innovative combined effect of UV disinfection and photo-catalytic oxidation, one stage treatment and high disinfection efficiency. The discharge can meet the requirements of more stringent standards as prescribed by US.

Advantages

■ **Economical**:

combined effect of UV disinfection and photo-catalytic oxidation, low operation and maintenance cost, essential components with a long lifespan extending the vessel's whole service life cycle

Advantages

■ **Environment benign:**

No chemical substance is added during the disinfection treatment, no pollution will be caused by the treated discharge; no unacceptable risk will be posed to safety of the ship and its crew.

Advantages

■ **Wide application:**

Modular design, small footprint, easy to install, suitable for newbuildings and retrofits. No chemical in added during treatment, and the system is effective under a wide range of challenging environmental conditions including variable temperature, salinity, nutrients and suspended solids (sea, brackish and fresh).

Conclusion

Photo-catalytic disinfection is a highly promising technology in ballast water treatment. It is featured with high disinfection efficiency, low operation cost and environmental friendly. It is greener, cleaner and more economical.

Thank you!

Contact：daiyi zhang

Addres：jiujiang jiangxi china

Tel ：+86(0)792 8369025

Fax：+86(0)792 8369302

Email：zdy6354@126.com