

# **BALCLOR™ Ballast Water Treatment System**

# INTRODUCTION

- In 2004, the International maritime organization (IMO) has adopted the “**International Convention for the Control and Management of Ships’ Ballast Water and Sediments**”, to regulate discharges of ballast water and reduce the risk of introducing non-native species from ships’ ballast water.
- In response to this, a number of technologies have been developed and commercialised by different vendors to treat ballast water. Many have their basis in land-based applications for municipal and industrial water and effluent treatment, and have been adapted to meet the requirements of the Ballast Water Management Convention and shipboard operation. Among these, **electrolysis technologies** are most widely used.
- This presentation introduce the principle, treatment process, configuration, characters and specification of BALCLOR™ system which is developed by **SunRui Corrosion and Fouling Control Company**.

# Development Status of BalClor™ BWMS

2006 : Start development

2007: Design and manufacture prototype BalClor™ BWMS.

2008: established Land-based set-up in Qingdao

2009: Gesamp group recommend that BalClor™ be granted Basic Approval. Accomplished the type approval of land-based testing.

2010: will submit Final Approval application.



Land-based set-up(Qingdao)



prototype BalClor™ BWMS

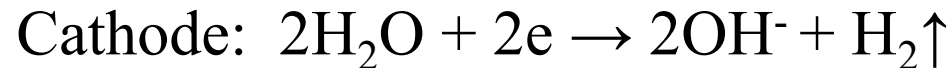
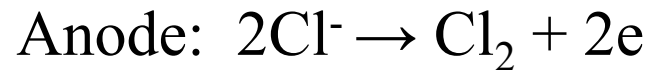
# The Principle of BALCLOR™ System

## **Filtration + Electrolytic process +Dechlorine**

- ◆ **Filtration : removing most large organisms and particles more than 50µm in minimum dimension;**
- ◆ **Electrolytic process: produces sodium hypochlorite solution to kill harmful aquatic organisms and pathogens;**
- ◆ **Dechlorine: TRO will be neutralized to below 0.1mg/L.**

# PRINCIPLE OF ELECTROLYTICAL PROCESS

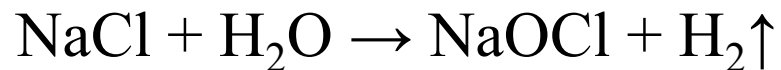
The reaction mechanism is as follows:



Chlorine gas can be dissolved in water to produce hypochlorous acid and hydrochloric acid rapidly:

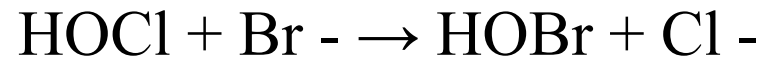


So the overall reaction is:



## THE GENERATION OF HYPOBROMOUS ACID

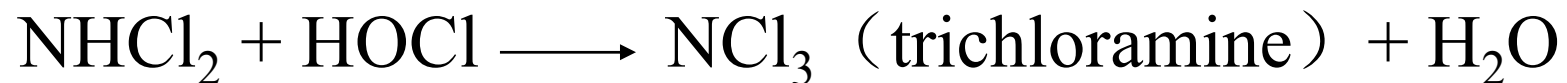
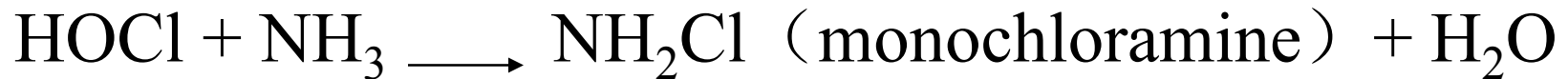
Because there are usually bromine ions with a density of 50~70mg/L existing in natural seawater and the oxidation reaction between hypochlorous acid and bromine ions will produce hypobromous acid:



**Hypobromous acid is also effective biocide**, and more stable than chlorine under alkaline seawater.

## THE GENERATION OF CHLORAMINES AND BROMAMINES

Reaction of hypochlorous acid and hypobromous acid with ammonia in seawater will generate **Chloramines and Bromamines**



## JOINT NAME OF GEMICIDAL AGENTS: TRO

- ◆ Chloramines and bromamines are also gemicidal agents, and it is generally considered that their bactericidal actions are much weaker than those of  $\text{HClO}/\text{ClO}^-$  and  $\text{HOBr}/\text{OBr}^-$ .
- ◆ Therefore, the agents with gemicidal effect are jointly called **Total Residual Oxidants (TRO)**, including  $\text{HClO}/\text{ClO}^-/\text{Cl}_2$ ,  $\text{HOBr}/\text{OBr}^-/\text{Br}_2$ , chloramines and bromamines.





# The treatment process of BALCLOR™ system

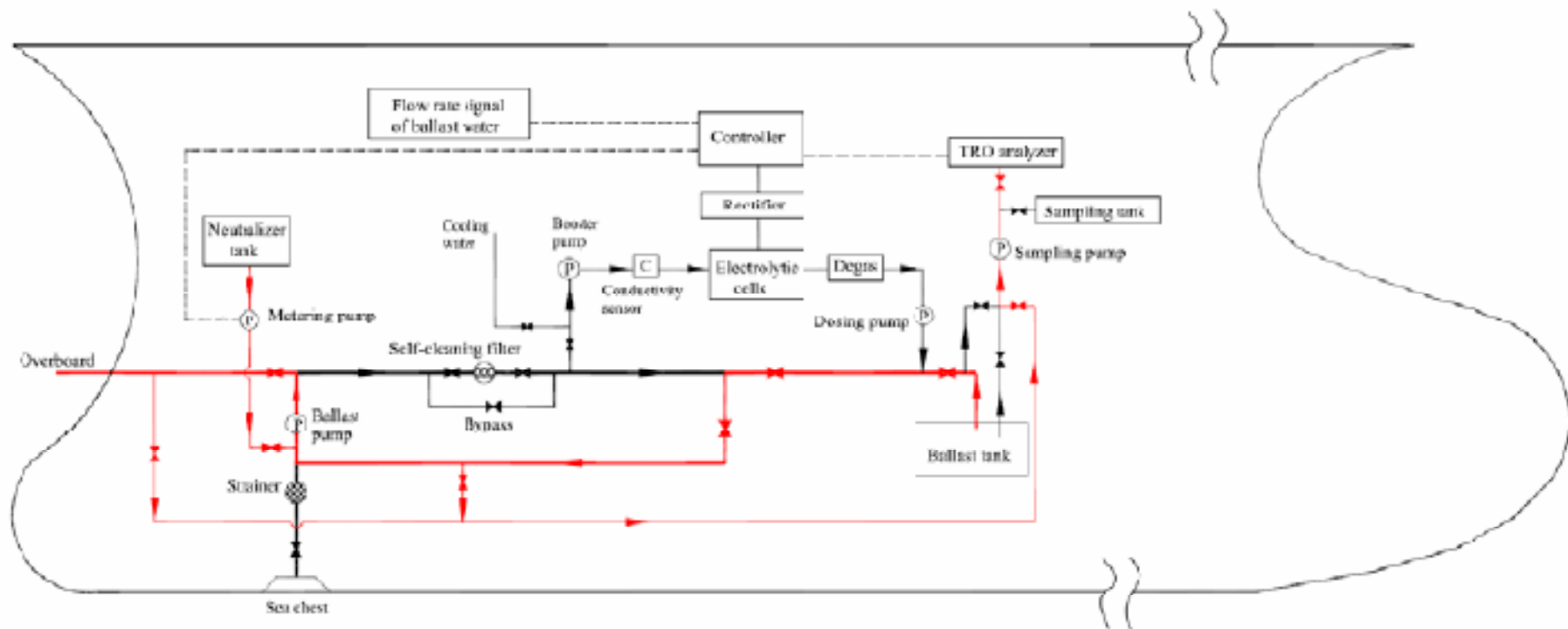


Diagram for flow chart of BALCLOR™ (when de-ballasting)

# BALCLOR™ CONFIGURATION

BALCLOR™ is comprised of the following functional modules:

- Self-cleaning filter;
- Electrolytic unit ( including electrolytic cells and accessory dosing and degassing units );
- Rectifier;
- Controller;
- TRO sensor
- Neutralizing unit;
- Sampling unit;
- Hydrogen gas / chlorine gas alarm.

Accessory units include flow-meters, pumps and valves, etc.

# The self-cleaning filter

- ◆ The self-cleaning filter is a low-pressure type with 50 $\mu$ m precision, which is connected with the main ballast pipeline.
- ◆ To remove most large organisms and particles more than 50 $\mu$ m in minimum dimension

# The electrolytic unit

**Booster pump**

**Flow-meters**

**Electrolytic cells**

**Degas tank (including air  
blowers)**

**Dosing pump**

**Pipelines and valves, etc.**



**Sunrui electrolytic unit**

# Rectifier and Controller

High-frequency power technique helps the rectifier to increase its efficiency while reducing its volume and weight significantly, making the installation very convenient.

The controller consists of programmable logic controller (PLC), human-machine interface (HMI) and controlling circuits for electric facilities.



Control panel

# Neutralizing unit

- ◆ neutralizer tank,
- ◆ metering pump,
- ◆ pipelines and valves etc.

The sodium thiosulfate solution is stored in neutralizer tank as the reductive agent. When de-ballasting, the metering pump, which is controlled by controller, injects certain amount of sodium thiosulfate solution into ballast water to neutralize the residual TRO in the water.



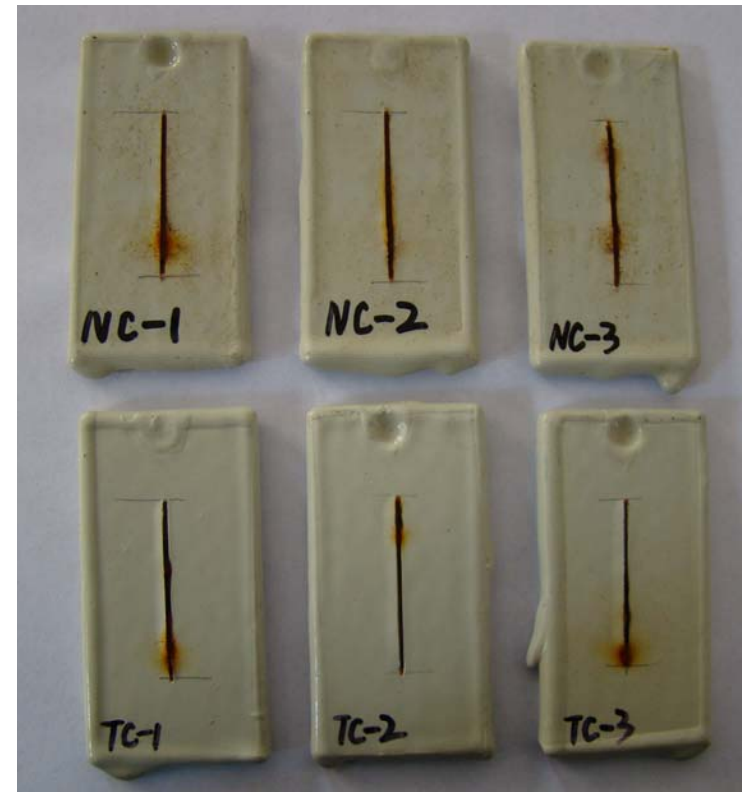
The neutralizer tank

# CORROSION ASSESSMENT

Corrosion experiments have been conducted to evaluate the corrosion of treated ballast water by BALCLOR™ according to G9 and Methodology. Tests include uncoated steels and coated steel (Including pipe steel and tank steel).

The results show that:

- the corrosion morphology of the bare samples in the treated water were similar to those in natural seawater, i.e., all uniform corrosion.
- The corrosion rate of bare ballast pipeline and tank steel in the ballast water treated by BALCLOR™ is at the similar level with that of the steels in nature seawater.



Corrosion morphology of coated steel in natural seawater (NC) and treated seawater (TC).



# Characters of BALCLOR™

- **Friendly to environment**

No wastes like fume and dust that may pollute the environment are produced when the system operates. The substances produced by the system leave no harmful influences on natural environment, and the system works with low noise.

- **Safe for ships and crew**

The system does not produce any substances that do harm to the crew. All electrical and electronic sections that crew shall operate are safe. Adequate alarm system is designed, so that protective action could be taken in time to eliminate potential dangers for ships and crew.

- **Easy operation**

The calibration and setting of the system have been completed in the factory and the operation of the system can be performed in fully automatic mode. It is easy for operators to monitor the operational status of the system on the HMI on the touch screen.

- **Low cost for operating and maintenance**

For the operation of the system, only power consumption and a small amount of inexpensive agent is needed.

# Specfication of BALCLOR™

<b>MODEL</b>	<b>Seawater to be treated m<sup>3</sup>/h</b>	<b>Flow rate to electrolyzers m<sup>3</sup>/h</b>	<b>Required power (AC KVA)</b>	<b>Current (DC A)</b>	<b>Voltage (DC V)</b>	<b>Footprint (m<sup>2</sup>)</b>
<b>BC-500</b>	<b>200-500</b>	<b>5</b>	<b>25</b>	<b>400</b>	<b>60</b>	<b>6</b>
<b>BC-1000</b>	<b>501-1000</b>	<b>10</b>	<b>50</b>	<b>500</b>	<b>90</b>	<b>6</b>
<b>BC-1500</b>	<b>1001-1500</b>	<b>16</b>	<b>75</b>	<b>600</b>	<b>120</b>	<b>8</b>
<b>BC -2000</b>	<b>1501-2000</b>	<b>22</b>	<b>100</b>	<b>750</b>	<b>120</b>	<b>8</b>
<b>BC -3000</b>	<b>2001-3000</b>	<b>22</b>	<b>150</b>	<b>900</b>	<b>150</b>	<b>10</b>
<b>BC -4000</b>	<b>3001-4000</b>	<b>28</b>	<b>200</b>	<b>1500</b>	<b>120</b>	<b>10</b>
<b>BC -5000</b>	<b>4001-5000</b>	<b>36</b>	<b>250</b>	<b>1500</b>	<b>150</b>	<b>11</b>
<b>BC -6000</b>	<b>5001-6000</b>	<b>45</b>	<b>300</b>	<b>1800</b>	<b>150</b>	<b>13</b>
<b>BC -7000</b>	<b>6001-7000</b>	<b>55</b>	<b>350</b>	<b>2100</b>	<b>150</b>	<b>13</b>

# CONCLUSION

The BALCLOR™ system use the advanced technology (efficient filtration+electrolytic process+neutralization ) and optimum design.

Treatment capacity range from 200m<sup>3</sup>/h to 7000 m<sup>3</sup>/h of seawater .

It has been proven to be an effective, economical and easy operation device to treat ballast water with no adverse effects on the marine environment.

Third-party testing of the BALCLOR™ system has confirmed that the biological efficacy meets regulation D-2.