

The 3rd Asian Shipbuilding Experts' Forum

Current Circumstance of Ballast Water Management System

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1. Issues on current trend and effect of IMO ballast water convention

2. Current trend on R&D progress in this field in Japan

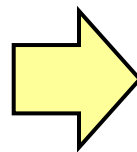
3. Hitachi Ballast Water Purification System Introduction of “Clear Ballast”

● Ballast Water Convention

International Maritime Organization (IMO*) Feb. 2004

“Regulations for the control and management of ships’ ballast water and sediments” (Ballast Water Convention) was adopted.

Large amount of aquatic organisms in ballast tank



- Environmental issues (Settlement and procreation)
- Spread of epidemic

● Ratification Trend

Requirement of ratification

- Ratifying countries : over 30
- Total shipping tonnage : over 35%

Current as 31st of Oct. 2009

- Ratifying countries : 18 countries
- Total shipping tonnage : 15.36%




- Ratifying countries (Requirement could be fulfilled by EU ratification.)
- Total shipping tonnage (Panama’s trend is marked.)

● Date of regulation application

- Application to a ship constructed during 2009 is reserved by annual survey held in year-end of 2011 (second class annual interim survey)
- Regulation is retroactively applied to a ship constructed after 2010

■ :Application

Construction Period (Keel Lay)	Ballast Water Capacity	Time line											
		'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19
Before 2008 (Retrofit)	Less than 1500m ³												
	Greater than 1500m ³ and less than 5000m ³												
	Greater than 5000m ³												
During 2009 to 2011 (Newly-built ship)	Less than 5000m ³												
	Greater than 5000m ³												
After 2012 (Newly-built ship)	All the ships												



A ship constructed in 2009
A ship constructed in 2010
A ship constructed in 2011

All the guidelines were adopted by MEPC58 (2008.10)

Guideline	Date of adoption (MEPC)
Sediment Reception Facilities (G1)	2006.10 (55)
Ballast Water Sampling (G2)	2008.10 (58)
Ballast Water Management Equivalent Compliance (G3)	2005.7 (53)
Ballast Water Management And Development Of Ballast Water Management Plans (G4)	2005.7 (53)
Ballast Water Reception Facilities (G5)	2006.10 (55)
Ballast Water Exchange (G6)	2005.7 (53)
Risk Management (G7)	2007.7 (56)
Approval Of Ballast Water Management Systems (G8)	2005.7 (53)

Guideline	Date of adoption (MEPC)
Procedure For Approval Of Ballast Water Management Systems That Make Use Of Active Substances (G9)	2005.7 (53)
Approval And Oversight Of Prototype Ballast Water Treatment technology programs (G10)	2006.3 (54)
Ballast Water Exchange Design And Construction Standards (G11)	2006.10 (55)
Design And Construction To Facilitate Sediment Control On Ships (G12)	2006.10 (55)
Additional Measures Regarding Ballast Water Management Including Emergency Situations (G13)	2007.7 (56)
Designation Of Areas For Ballast Water Exchange (G14)	2006.10 (55)

Regulations of Ballast Water Discharge

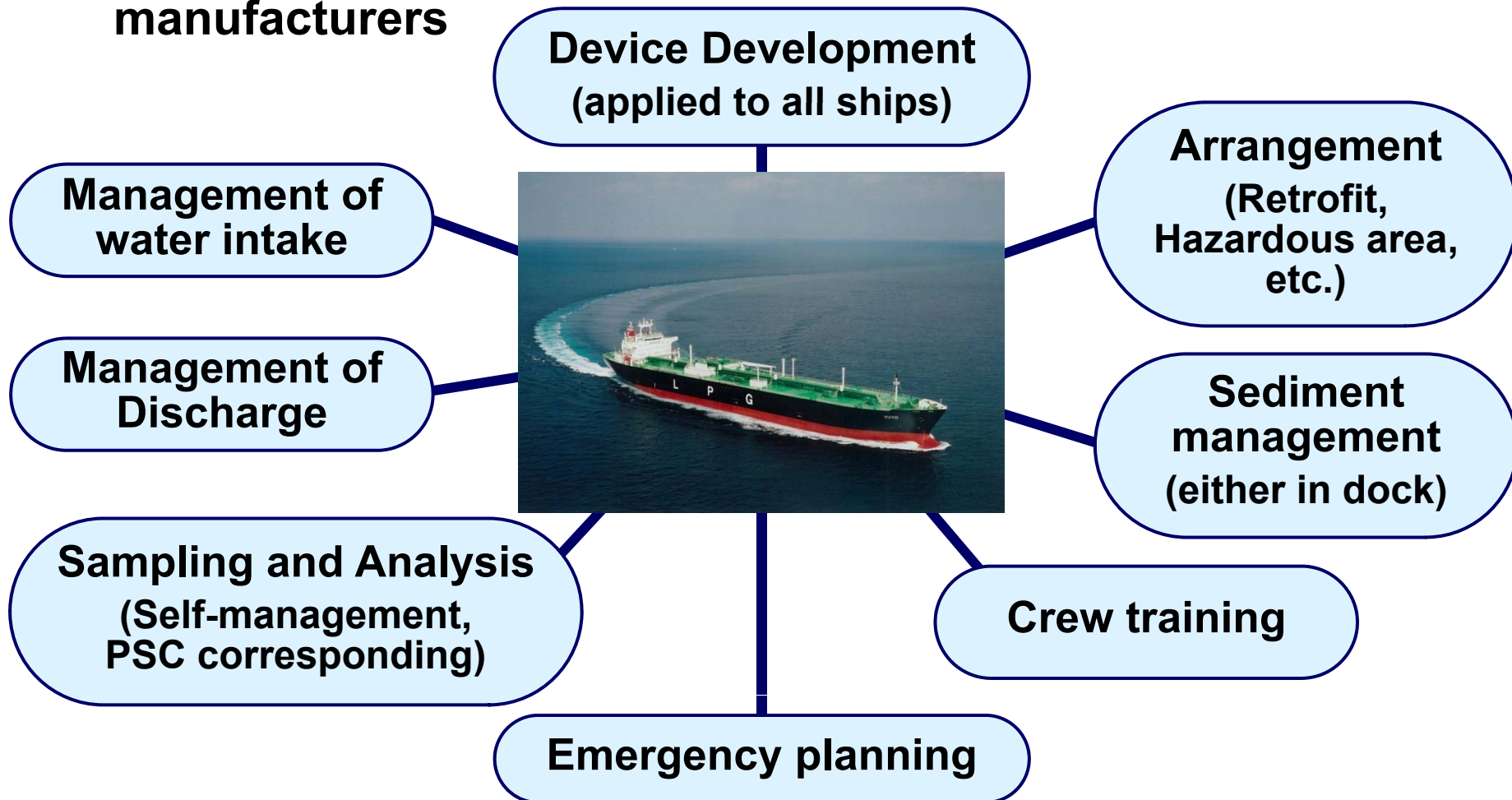
ClearBallast

Organism group	IMO	e.g. USCG STEP	
		PHASE-1	PHASE-2
Organisms > 50µm (individuals/m ³)	<10	<10	<0.1
Organisms 10 – 50µm (individuals/mL)	<10	<10	<0.1
E. coli (cfu/100mL)	<250	<250	<126
Enterococcus group (cfu/100mL)	<100	<100	<33
Vibrio cholerae (cfu/100mL)	< 1	<1	<1
Bacteria (cfu/100mL)	-	-	(<1000)
Virus (cfu/100mL)	-	-	(<10000)

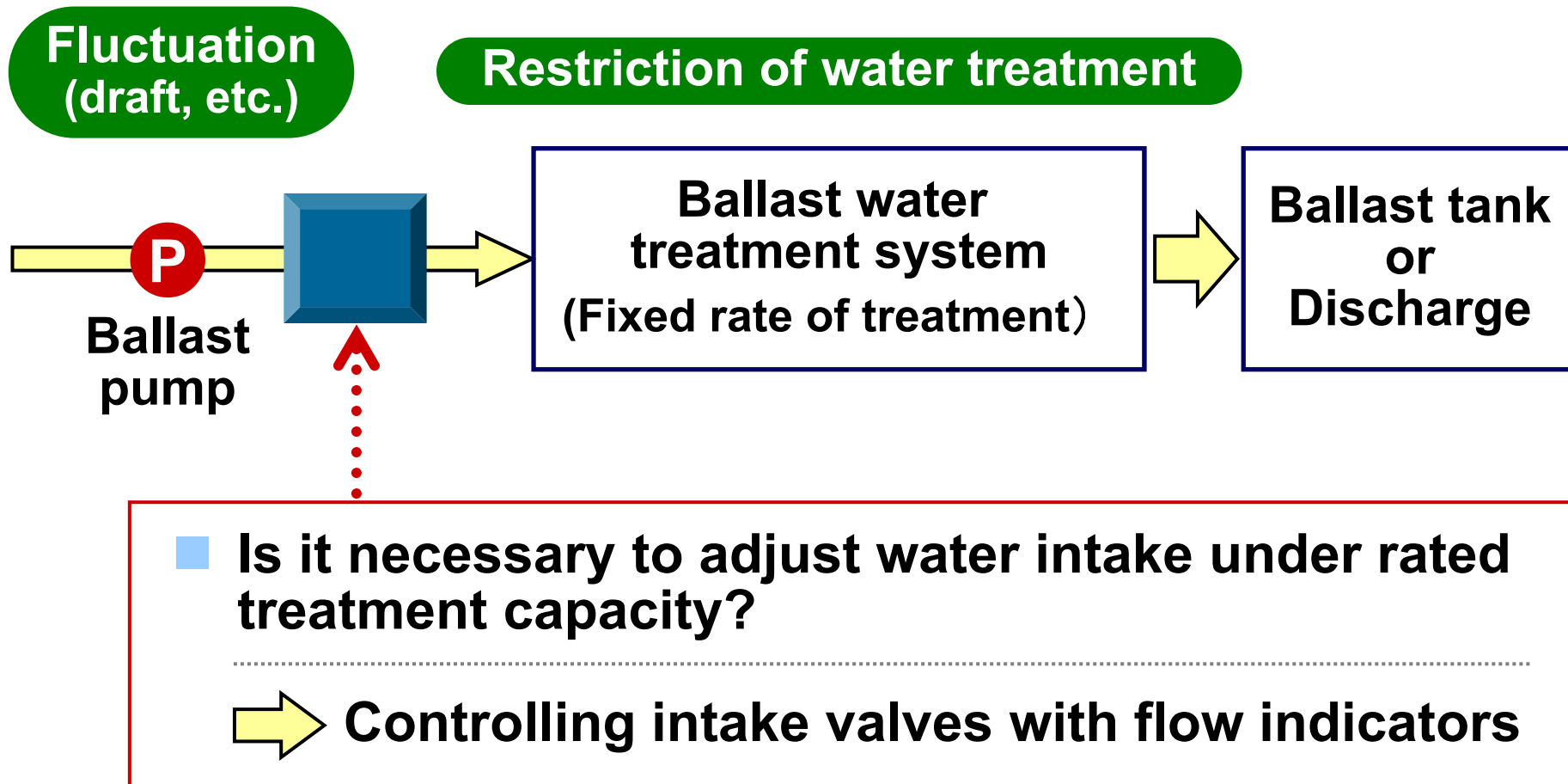
**It is extremely important
not only to *meet regulation of water quality*,
but also to *consider environment*.**

● Key Point

- System formulation as well as device development
- Coalition between ship owners, shipbuilders and device manufacturers



● Control of water intake



● Sampling (G2)

General requirement

- Sampling device of water suction with constant speed at compliant location laid by guideline

Port state control corresponding

- Establishment of analysis method (including simple analysis), and evaluation method
- Development of on-line bio monitoring device

● Sediment Control (Article 5-B-5-G1-G12)

Facilities accepting sediment

- Less advanced trend on facilities to accepting sediment

➔ Major issue : treatment of sludge from cleaning and repairing ballast water tank

Hull structure

- Design of ballast water tank, and hull structure to avoid sediment accumulation in ballast water tank

➔ Major issue : treatment of sludge from cleaning and repairing ballast water tank

**More discussion on these issues
is necessary for details.**

The clock is ticking

Cladoceran Water Flea

Cholera

North American Comb Jelly

North Pacific Seastar

Mitten Crab

Toxic Algae (Red/Brown/Green Tides)

Round Goby

European Green Crab

Asian Kelp

Zebra Mussel

Area of

This will have to be discussed by *experts* from *various fields*.

Trend of development progress in Japan

ClearBallast

Manufacturers	Method	G9		G8
		Basic	Final	
Hitachi Plant Technologies	Coagulation and Magnetic Separation	Approved	Approved	Under exam
Mitsui Engineering and Ship-buildings and The Japan Association of Marine Safety, Pj	Special-pipe+O ₃	Approved		Under exam
JFE Engineering	Filter + Hypochlorous acid + Venturi (Cavitations)	Approved		Under exam
SHINKO	Special-pipe + Paraclean	Approved		
KURARAY	Nonwoven Filter + Solid form chemicals			
TAIKO SNAGYO	Heat sterilization			
Sumitomo Electric Industries	Magnetic Separation			

● **SP-Hybrid (O)**

Method	Special-Pipe + O₃
Active Substance	O₃ + Byproduct



special pipe



ozonizer

* From catalogue

● JFE-BWMS

Method	Filter + Hypochlorous acid + Venturi (Cavitations)
Active Substance	Hypochlorous + Byproduct



* From catalogue

● ClearBallast

Method	Coagulation and Magnetic Separation
Active Substance	Coagulants (used for drinking water process) + Magnetic Powder



ClearBallast : Concept

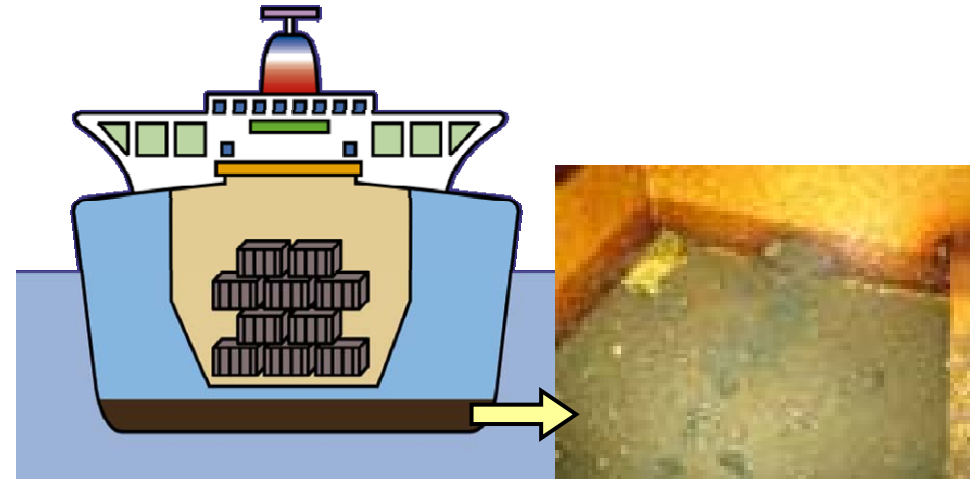
ClearBallast

- Consideration to environment



No pollution by chemicals
in discharged water

- Simultaneous solution

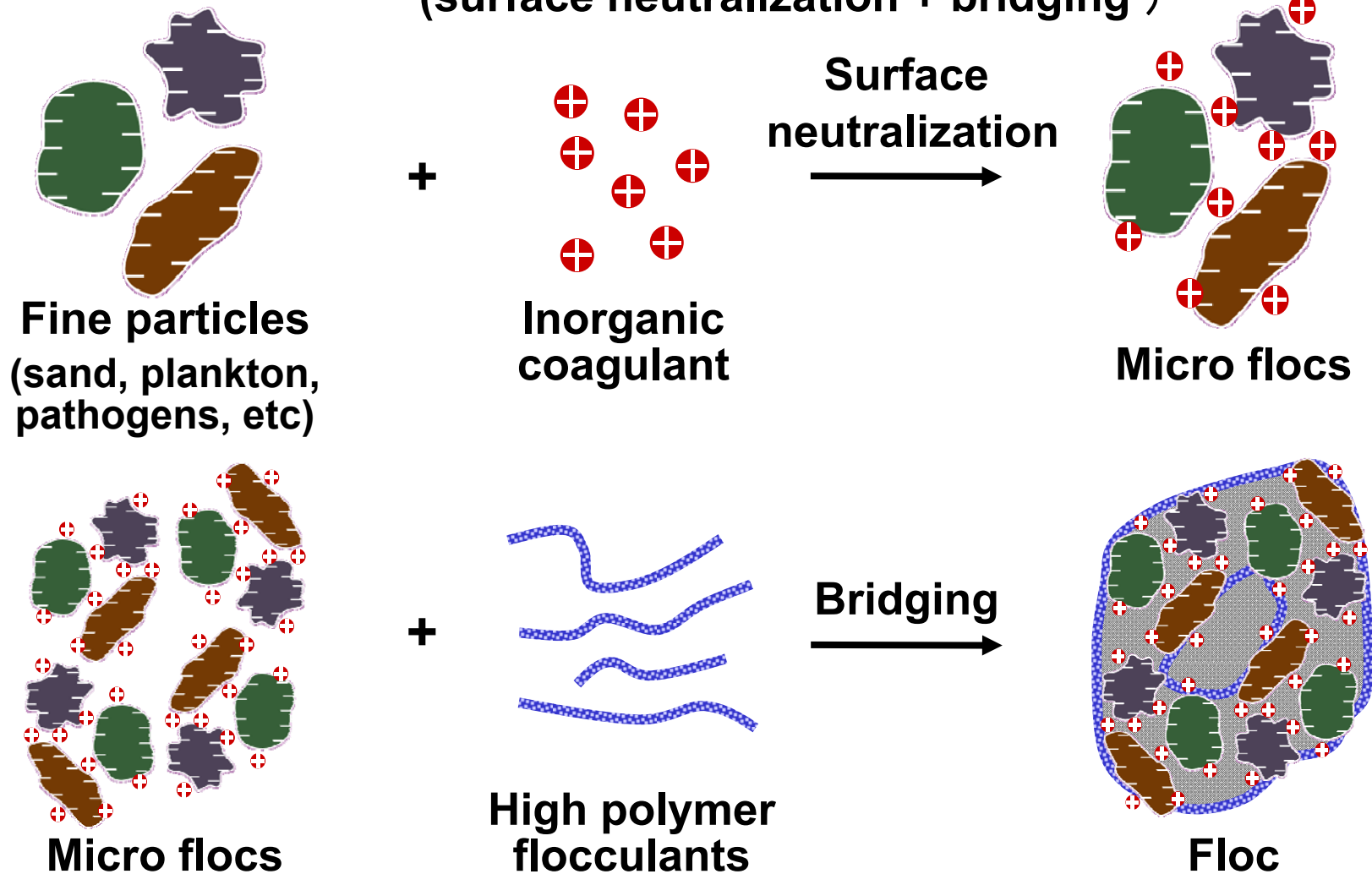


Drastic reduction of mud
sedimentation
(SS & Dead marine organisms)

Application of coagulation method

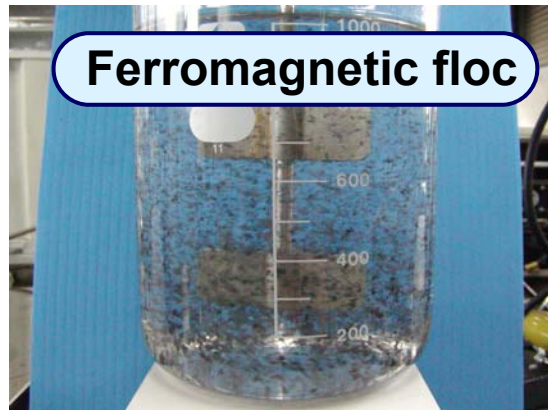
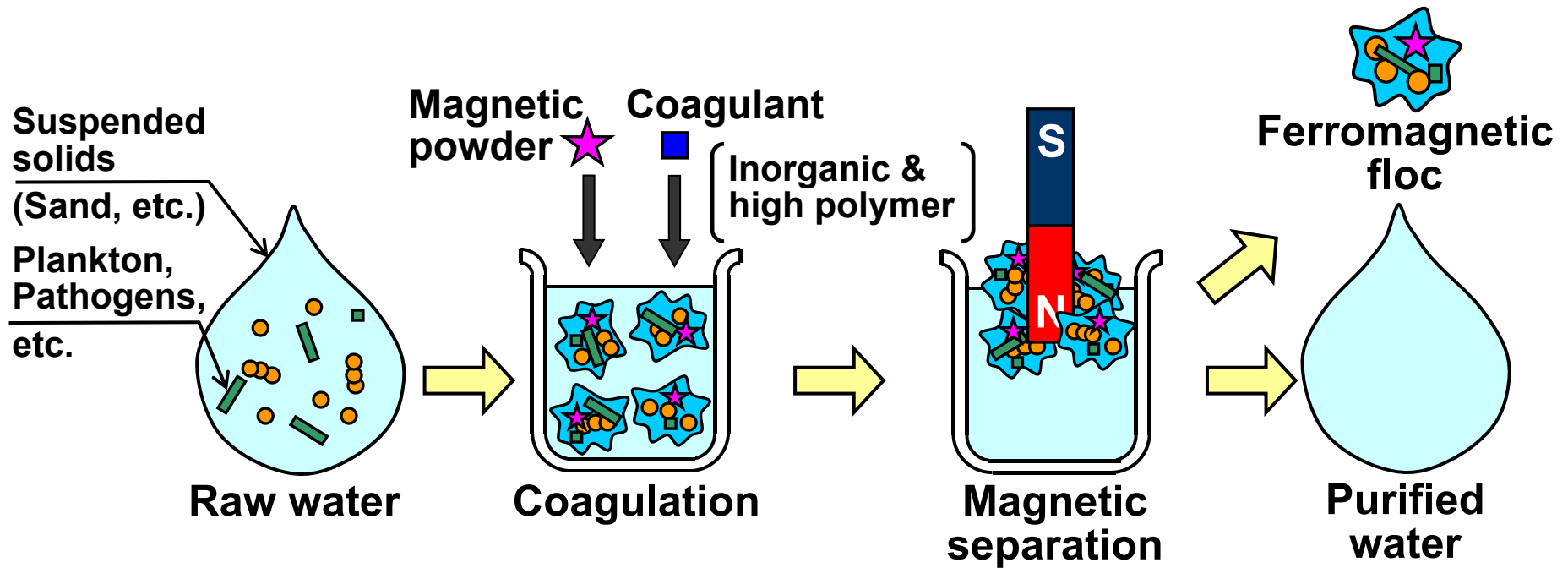
● Mechanism of coagulation & flocculation

(surface neutralization + bridging)



ClearBallast : Coagulation and Magnetic Separation

ClearBallast



Water after flocculation



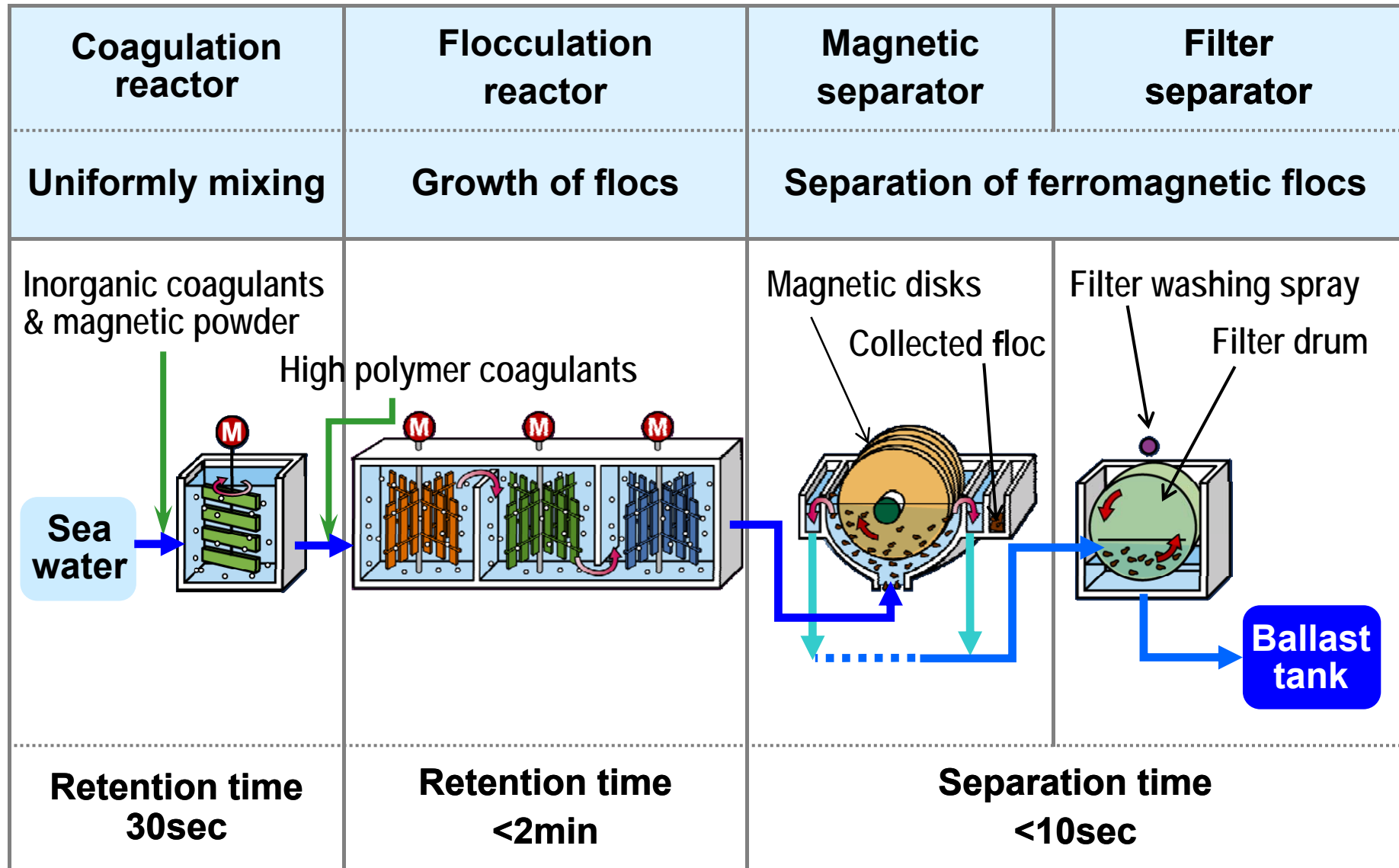
Magnetic separation



Purified water

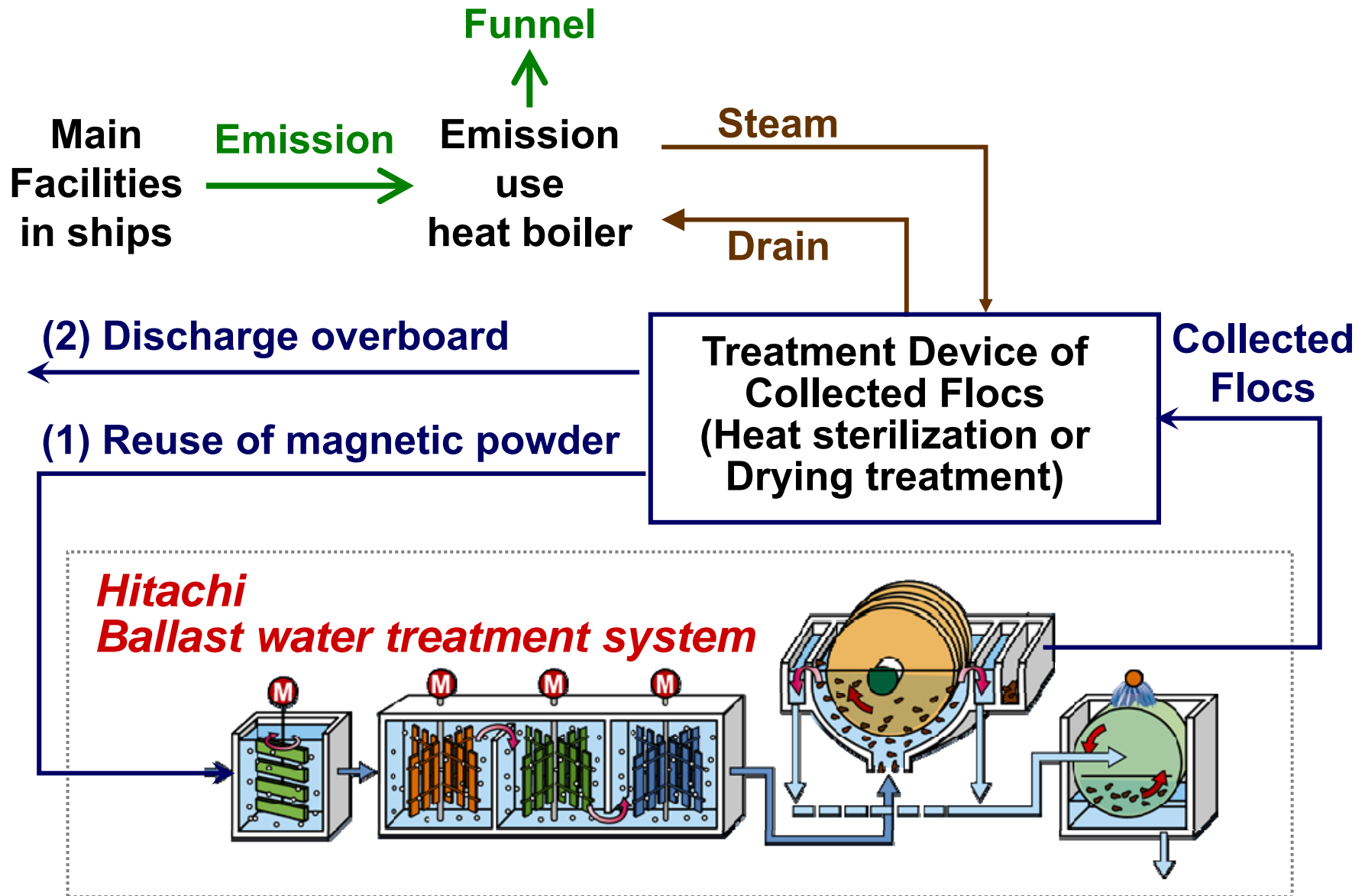
ClearBallast : Process Diagram (Water Treatment)

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ClearBallast : Process Diagram (Collected Flocs Treatment)

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● Clear Treated Water

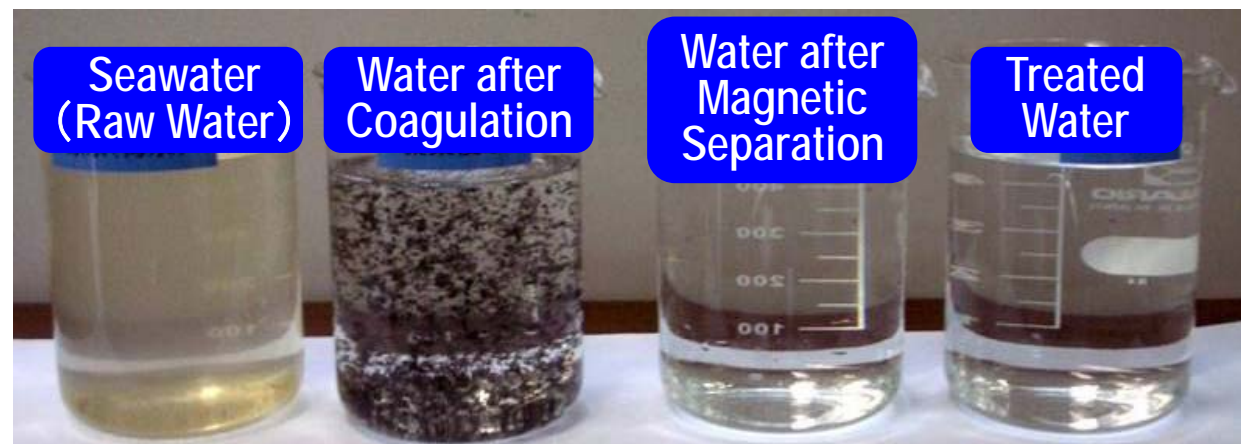
- Stable Removal Performance
(Non Seawater Condition-based (Turbidity, Salinity))
- Effective Application of Treated Water (Preprocess for Desalination)

● Propagation Inhibition of Pathogens and Plankton in Ballast Tank

- Mud with high possibility of organisms propagation are reduced
- Spawn of organisms and mold spore are removed
- Phosphorus as necessary nutrition for organisms growth is removed



Mud



● Safety to Environment

- Eco-toxicity test, which is relevant to G9, shows that non-diluted treated water is safe enough to be discharged into sea

G9 Final Approval was granted to this system

● Safety to Ships

- Treated water has no impact on coating of tanks and piping (1000-hour test of spraying treated water onto test piece shows the safety)

● Others

- Ballast water treatment is operated only during ballasting
- Small electric power is required and it facilitates protection-proof design

This treatment System is safe to
“environment”, “ships” and “humans”

ClearBallast : Land Based Test (1)

ClearBallast

Organism group	Influent water	Treated water after 5 days storage	In control after 5 days storage
Organisms > 50µm (individuals/m ³)	5,700,000	<1	7,200,000
	RQ >100,000	RQ<10	RQ>100
Organisms 10 – 50µm (individuals/mL)	15,000	<1	1,100
			RQ>100
E. coli (cfu/100mL)			1,600
			-
Vibrio cholerae (cfu/100mL)			<1
			-
Enterococcus group (cfu/100mL)	<1	<1	<1
	-	RQ<100	-

**All the analysis items
 of treated water
 meet
 D-2 standard.**

RQ: IMO Requirement

- **Inspissations of Sampled Water
(with 50 microns mesh)**



Sampled Control Water
(After inspissations : $1\text{m}^3 \rightarrow 50\text{mL}$)



Sampled Treated Water
(After inspissations : $1\text{m}^3 \rightarrow 50\text{mL}$)

- The employed method removes pollutants in water
- Therefore microscopy and pathogens cultivation tests are easy

- Result of organisms removal performance

Organism group	Sea water (Influent)	Treated ballast water	Untreated ballast water
Organisms > 50µm (individuals/m ³)	31,603 RQ >100	<1 RQ <10	8,392 RQ >10
Organism (individual)			
E. coli (cfu)			
Vibrio cholerae (cfu/100mL)			-
Enterococcus group (cfu/100mL)	<1 -	<1 RQ <100	<1 -

The treatment performance by this system is not influenced by water quality conditions. (e.g. Turbidity, Salinity) D-2 standard.

RQ: IMO Requirement

ClearBallast : System Specifications

ClearBallast

● Specification

Ballast pump scale =System scale (m ³ /h)	Unit type	Device size
200	<ul style="list-style-type: none"> ● ... ● ... ● Magnetic separator ● Filter separator ● Chemical injectors ● Operation control panel 	Container
400		Container × 2
800	<p>200m³/h-13kW</p> <p>400m³/h-23kW</p>	Container × 1
1200		3000 × 3500H
1600		69m ² ✂Foot Print

One of this system features is
Its small consumption of electric power.



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