



THE REPUBLIC OF LIBERIA
LIBERIA MARITIME AUTHORITY

TYPE APPROVAL CERTIFICATE OF BALLAST WATER MANAGEMENT SYSTEM

This is to certify that the ballast water management system listed below has been examined and tested in accordance with the requirements of the specifications contained in the Guidelines contained in IMO resolution MEPC.174 (58) adopted on 10 October 2008. This certificate is valid only for the ballast water management system referred to below.

Ballast water management system supplied by..... Qingdao Headway Technology Co., Ltd
 Qingdao Shandong Province, China
 under type and model designation..... OceanGuard® Ballast Water Management System,
Model: HMT-50 ~ HMT-4000

and incorporating:

Ballast water management system manufactured by..... Qingdao Headway Technology Co., Ltd
 to equipment/assembly drawing No..... See Appendix 1 date.....See Appendix 1

Electrocatalysis Ultra Treatment Unit manufactured by..... Qingdao Headway Technology Co., Ltd
 to components drawing No..... See Appendix 1 date.....See Appendix 1

Filtration system manufactured by..... Qingdao Headway Technology Co., Lt
 To components drawing No..... See Appendix 1 date..... See Appendix 1

Filtration system manufactured by..... BOLL& KIRCH Filterbau GmbH
 Filtration system manufactured by..... Filtersafe Automatic Screen Filtration

TRO sensor unit manufactured by..... HF Scientific, Inc.
 To components drawing No..... See Appendix 1 date..... See Appendix 1

TRO neutralization unit manufactured by..... Qingdao Headway Technology Co., Ltd
 To components drawing No..... See Appendix 1 date..... See Appendix 1

Treatment rated capacity..... 50 ~4000 m³/h

Active Substances (as Total Residual Oxidants) Hydroxyl Radical, Sodium Hypochlorite,
 Hypochlorous Acid, Hydrogen Peroxide

Relevant Chemical Bromate, Chlorate, Halogenated Aliphatic and Aromatic Compounds
 including THMs, halogenated Aceto-Nitriles, Halogenated Acetic Acids,
 Halogenated Phenol, Carbon Monoxide, Methane

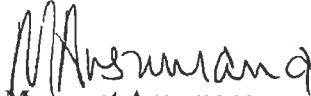
Final approval granted by IMO for systems using active substances....MEPC 61/2/21 Annex 5, para 7.4 and MEPC 61/24, para 2.

A copy of this Type Approval Certificate should be carried on board vessels fitted with this ballast water management system at all times. A reference to the test protocol and a copy of the test results should be available for inspection on board the vessel. This Type Approval Certificate is issued based on approval by the Norwegian Maritime Administration with Type Approval Certificate No. P-15081.

Limiting Conditions imposed and operating parameters are described in the Appendix 2 to this document.

Official Stamp




Margaret Ansumana

Deputy Commissioner of Maritime Affairs
Republic of Liberia

Date of issue: 31/January/2015 Place of issue: Vienna, USA

Date of Expiry: 30/January/2020

Enc. This certificate consists of 9 pages, including the appendices and summary of the original test results.

APPENDIX I

No.	Drawing Name	Drawing No.	Quantity	Rev	Date
1	Principle Drawing of BWMS	HMT-BWMS-YL-A	1	A1.4	2012/05/16
2	BWMS Principle Drawing of Ballasting	HMT-BWMS-YL-B	1	A1.4	2012/05/16
3	BWMS Principle Drawing of Deballasting	HMT-BWMS-YL-D	1	A1.4	2012/05/16
4	BWMS Principle Drawing of Emergency Ballasting	HMT-BWMS-YL-EB	1	A1.4	2012/05/16
5	BMWS Principle Drawing of Emergency Deballasting	HMT-BWMS-YL-ED	1	A1.4	2012/05/16
6	Type List of BWMS	HMT-BWMS-02	1	A1.3	2011/04/14
7	Electric Principle Drawing of BWMS	HMT-BWMS-EL01-01/02	2	A1.3	2011/04/14
8	Electric Drawing of BWMS	HMT-BWMS-EL02-01 ~ 13	13	A1.3	2011/04/14
9	EUT Unit (HMT-50E)				
(1)	EUT Assembly	HMT-50E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-50E-A-II	1	A2.1	2014/04/16
(3)	EUT Assembly	HMT-50E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-50E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-50E-DJ-II	1	A2.1	2014/04/16
10	EUT Unit (HMT-100E)				
(1)	EUT Assembly	HMT-100E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-100E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-100E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-100E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-100E-DJ-II	1	A2.1	2014/04/16
11	EUT Unit (HMT-200E)				
(1)	EUT Assembly	HMT-200E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-200E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-200E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-200E-DJ- I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-200E-DJ-II	1	A2.1	2014/04/16
12	EUT Unit (HMT-300E)				
(1)	EUT Assembly	HMT-300E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-300E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-300E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-300E-DJ- I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-300E-DJ-II	1	A2.1	2014/04/16
13	EUT Unit (HMT-450E)				
(1)	EUT Assembly	HMT-450E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-450E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-450E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-450E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-450E-DJ-II	1	A2.1	2014/04/16
14	EUT Unit (HMT-600E)				
(1)	EUT Assembly	HMT-600E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-600E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-600E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-600E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-600E-DJ-II	1	A2.1	2014/04/16
15	EUT Unit (HMT-800E)				

(1)	EUT Assembly	HMT-800E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-800E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-800E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-800E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-800E-DJ-II	1	A2.1	2014/04/16
16	EUT Unit (HMT-1000E)				
(1)	EUT Assembly	HMT-1000E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-1000E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-1000E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-1000E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-1000E-DJ-II	1	A2.1	2014/04/16
17	EUT Unit (HMT-1200E)				
(1)	EUT Assembly	HMT-1200E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-1200E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-1200E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-1200E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-1200E-DJ-II	1	A2.1	2014/04/16
18	EUT Unit (HMT-1500E)				
(1)	EUT Assembly	HMT-1500E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-1500E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-1500E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-1500E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-1500E-DJ-II	1	A2.1	2014/04/16
19	EUT Unit (HMT-2000E)				
(1)	EUT Assembly	HMT-2000E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-2000E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-2000E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-2000E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-2000E-DJ-II	1	A2.1	2014/04/16
20	EUT Unit (HMT-2500E)				
(1)	EUT Assembly	HMT-2500E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-2500E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-2500E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-2500E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-2500E-DJ-II	1	A2.1	2014/04/16
21	EUT Unit (HMT-3000E)				
(1)	EUT Assembly	HMT-3000E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-3000E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-3000E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-3000E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-3000E-DJ-II	1	A2.1	2014/04/16
22	EUT Unit (HMT-4000E)				
(1)	EUT Assembly	HMT-4000E-A-I	1	A2.1	2014/04/16
(2)	EUT Assembly	HMT-4000E-A-II	1	A2.1	2014/04/16
(3)	EUT Shell	HMT-4000E-KT	1	A2.1	2014/04/16
(4)	Catalytic Group	HMT-4000E-DJ-I	1	A2.1	2014/04/16
(5)	Catalytic Group	HMT-4000E-DJ-II	1	A2.1	2014/04/16
23	Filter Outline Diagram	HMT-F-001	1	A1.3	2011/04/19
24	Control Unit Outline Diagram of Filter	HMT-F-002	1	A1.3	2011/04/19
25	Electric Drawing of Filter Control Box	HMT-F-EL01/EL02	2	A1.3	2011/04/22

26	Panel Layout of Filter Control Box	HMT-F-EL04-01/02	2	A1.3	2011/04/22
27	Internal Component Layout of Filter Control Box	HMT-F-EL04-03	1	A1.3	2011/04/22
28	Dimension Drawing of EUT Power	HMT-PE-01	1	A1.3	2011/04/22
29	Schematic Diagram of EUT Power	HMT-PE-EL01	1	A1.3	2011/04/22
30	Electric Diagram of EUT Power	HMT-PE-EL02	1	A1.3	2011/04/22
31	Component Specification of EUT Power (HMT-50/100/200/300PE)	HMT-PE-EL03-1	1	A1.3	2011/04/22
32	Component Specification of EUT Power (HMT-450/600/800PE)	HMT-PE-EL03-2	1	A1.3	2011/04/22
33	Component Specification of EUT Power (HMT-1000/1200/1500PE)	HMT-PE-EL03-3	1	A1.3	2011/04/22
34	Component Specification of EUT Power (HMT-2000/2500/3000PE)	HMT-PE-EL03-4	1	A1.3	2011/04/22
35	EUT Power (UL) Working Principle	HMT-PE-EL04	1	A1.3	2011/01/22
36	EUT Power (UL) Diagram of the Circuit	HMT-PE-EL05	1	A1.3	2011/04/22
37	EUT Power (UL) Component Specification Table	HMT-PE-EL06	1	A1.3	2011/04/22
38	Dimension Drawing of Control Unit	HMT-CL-09	1	A1.3	2011/05/17
39	Electric Drawing of Control Unit	HMT-CL-EL01-1 ~ 6	6	A1.3	2011/05/19
40	Panel Layout of Control Unit	HMT-CL-EL03	1	A1.3	2011/05/17
41	Internal Layout of Control Unit	HMT-CL-EL04	1	A1.3	2011/05/17
42	Component List of Control Unit	HMT-CL-EL05	1	A1.3	2011/05/17
43	Power Distribution Unit (HMT-50~300PDU)				
(1)	Dimensions of Power Distribution Unit (HMT-50/100/200/300PDU)	HMT-50/100/200/300PDU-01	1	A1.4	2012/07/18
(2)	SCH of Power Distribution Unit (HMT-300PDU)	HMT-300PDU-EL01-01	1	A1.4	2012/07/18
(3)	SCH of Power Distribution Unit (HMT-50/100/200/300PDU)	HMT-50/100/200/300PDU-EL01-02	1	A1.4	2012/07/18
(4)	SCH of Power Distribution Unit (HMT-50/100/200/300PDU)	HMT-50/100/200/300PDU-EL01-03	1	A1.3	2012/07/18
(5)	SCH of Power Distribution Unit (HMT-50/100/200/300PDU)	HMT-50/100/200/300PDU-EL01-04	1	A1.4	2012/07/18
(6)	Layout of Power Distribution Unit (HMT-50/100/200/300PDU)	HMT-50/100/200/300PDU-EL02	1	A1.4	2012/07/18
(7)	Component Lists of Power Distribution Unit (HMT-50/100/200/300PDU)	HMT-50/100/200/300PDU-EL04	1	A1.4	2012/07/18
44	Power Distribution Unit (HMT-450~600PDU)				
(1)	Dimensions of Power Distribution Unit (HMT-	HMT-450/600PDU-01	1	A1.4	2012/07/18

	450/600PDU)				
(2)	Component Lists of Power Distribution Unit (HMT-450/600PDU)	HMT-450/600PDU-EL04	1	A1.4	2012/07/18
(3)	SCH of Power Distribution Unit (HMT-450/600PDU)	HMT-450/600PDU-EL01-02	1	A1.4	2012/07/18
(4)	SCH of Power Distribution Unit (HMT-450/600PDU)	HMT-450/600PDU-EL01-003	1	A1.4	2012/07/18
(5)	SCH of Power Distribution Unit (HMT-450/600PDU)	HMT-450/600PDU-EL01-004	1	A1.4	2012/07/18
(6)	Layout of Power Distribution Unit (HMT-450/600PDU)	HMT-450/600PDU-EL02	1	A1.4	2012/07/18
(7)	Component Lists of Power Distribution Unit (HMT-500/600PDU)	HMT-500/600PDU-EL04	1	A1.4	2012/07/18
45	Power Distribution Unit (HMT-800~1500PDU)				
(1)	Dimensions of Power Distribution Unit (HMT-800/1000/1200/1500PDU)	HMT-800/1000/1200/1500PDU-01	1	A1.4	2012/07/18
(2)	SCH of Power Distribution Unit (HMT-800/1000/1200/1500PDU)	HMT-800/1000/1200/1500PDU-EL01-01	1	A1.4	2012/07/18
(3)	SCH of Power Distribution Unit (HMT-800/1000/1200/1500PDU)	HMT-800/1000/1200/1500PDU-EL01-02	1	A1.4	2012/07/18
(4)	SCH of Power Distribution Unit (HMT-800/1000/1200/1500PDU)	HMT-800/1000/1200/1500PDU-EL01-03	1	A1.4	2012/07/18
(5)	SCH of Power Distribution Unit (HMT-800/1000/1200/1500PDU)	HMT-800/1000/1200/1500PDU-EL01-04	1	A1.4	2012/07/18
(6)	Layout of Power Distribution Unit (HMT-800/1000/1200/1500PDU)	HMT-800/1000/1200/1500PDU-EL02	1	A1.4	2012/07/18
(7)	Component Lists of Power Distribution Unit (HMT-800/1000/1200/1500PDU)	HMT-800/1000/1200/1500PDU-EL04	1	A1.4	2012/07/18
46	Power Distribution Unit (HMT-2000~3000PDU)				
(1)	Dimensions of Power Distribution Unit (HMT-2000/2500/3000PDU)	HMT-2000/2500/3000PDU-01	1	A1.4	2012/07/18
(2)	SCH of Power Distribution Unit (HMT-2000/2500/3000PDU)	HMT-2000/2500/3000PDU-EL01-01	1	A1.4	2012/07/18
(3)	SCH of Power Distribution Unit (HMT-2000/2500/3000PDU)	HMT-2000/2500/3000PDU-EL01-02	1	A1.4	2012/07/18
(4)	SCH of Power Distribution Unit (HMT-2000/2500/3000PDU)	HMT-2000/2500/3000PDU-EL01-03	1	A1.4	2012/07/18
(5)	SCH of Power Distribution Unit (HMT-2000/2500/3000PDU)	HMT-2000/2500/3000PDU-EL01-04	1	A1.4	2012/07/18
(6)	Layout of Power Distribution Unit (HMT-2000/2500/3000PDU)	HMT-2000/2500/3000PDU-EL02	1	A1.4	2012/07/18
(7)	Component Lists of Power Distribution Unit (HMT-2000/2500/3000PDU)	HMT-2000/2500/3000PDU-EL04	1	A1.4	2012/07/18
47	Power Distribution Unit (HMT-4000PDU)				
(1)	Dimensions of Power	HMT-4000PDU-01	1	A1.4	2012/07/18

	Distribution Unit (HMT-4000PDU)				
(2)	SCH of Power Distribution Unit (HMT-4000PDU)	HMT-4000PDU-EL01-01	1	A1.4	2012/07/18
(3)	SCH of Power Distribution Unit (HMT-4000PDU)	HMT-4000PDU-EL01-02	1	A1.4	2012/07/18
(4)	SCH of Power Distribution Unit (HMT-4000PDU)	HMT-4000PDU-EL01-03	1	A1.4	2012/07/18
(5)	SCH of Power Distribution Unit (HMT-4000PDU)	HMT-4000PDU-EL01-04	1	A1.4	2012/07/18
(6)	Layout of Power Distribution Unit (HMT-4000PDU)	HMT-4000PDU-EL02	1	A1.4	2012/07/18
(7)	Component Lists of Power Distribution Unit (HMT-4000PDU)	HMT-4000PDU-EL04	1	A1.4	2012/07/18
48	Flow Meter	HMT-FM-01 ~ 02	2	A1.3	2011/04/22
49	Protection Box of Monitoring Unit	HMT-TRO-01	1	A1.3	2011/06/04
50	Fixed Drawing of Monitoring Unit	HMT-TRO-10	1	A1.3	2011/06/04
51	Pump of Monitoring Unit	HMT-TRO-P	1	A1.3	2011/06/04
52	20L Neutralization Unit	HMT-20N-01	1	A1.3	2013/02/19
53	60L Neutralization Unit	HMT-60N-01	1	A1.3	2013/02/19
54	100L Neutralization Unit	HMT-100N-01	1	A1.3	2013/02/19
55	300L Neutralization Unit	HMT-300N-01	1	A1.3	2013/02/19
56	600L Neutralization Unit	HMT-600N-01	1	A1.3	2013/02/19
57	Electric Diagram of Neutralization Unit	HMT-N-EL01	1	A1.3	2012/03/07
Total			163		

APPENDIX II

Limiting Conditions for operation of the BWMS

Treatment rated capacity (TRC).....	50 m ³ /h ~ 4,000 m ³ /h
Maximum Allowable Dosage Concentration of TRO (as Cl ₂).....	2.5 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	≤ 0.2 mg/L
Ballast water salinity range.....	≥ 1 PSU
Ballast water temperature range	Not tested in cold water less than 1°C
Minimum holding time with neutralization.....	< 1 day
Minimum holding time without neutralization	5 days
Approved for use in explosive atmosphere	No
Installation on open deck	No
Differential pressure across the filter.....	should not exceed 2.0 Bar

Summary of conditions during land and ship-based testing

Ballast water salinity range during land based test	21 to 33PSU
Ballast water salinity range during ship board tests.....	28 to 31PSU
During the shipboard tests the water temperature ranged between.....	3 to 30°C
During the land based tests the water temperature ranged between.....	6 to 19°C
Ballast water dissolved organic compounds (DOC).....	1 to 8 mg/L
Ballast water particulate organic compounds (POC).....	0 to 9 mg/L
Ballast water total suspended solids (TSS).....	11 to 86 mg/L
Maximum Allowable Dosage Concentration of TRO (as Cl ₂).....	2.5 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	≤ 0.2 mg/L
Flow rates during land-based testing	maximum 340 m ³ /hour
Flow rates during shipboard testing.....	maximum 310m ³ /hour

(Treatment rated capacity based upon mathematical modeling of area of filter from 100 m³/hour to 5,000 m³/hour and catalysis material from 50 m³/hour to 4,000 m³/hour)

Corrosion Tests

1. Monitoring programme to be installed to provide for long term inspection of ballast systems using OceanGuard treatment to ensure that no common obvious or extensive corrosion failures occur as a result of using OceanGuard ballast water treatment system.
2. Longer term studies on both uniform and localized corrosion rate determination of corrosion of carbon steel to be performed at the TRO level in ballast water applied by the treatment system.

Operating Parameters during land-based and ship-based testing

Operating TRO dosage.....	Max. 2.5 mg/L
Energy consumption at 300 m ³ /hour.....	14.5 KW/hour*
Current	301 Amperes*

*Remark: The value is the averaged value and is not used for determining whether the system is operated properly or not.

The system is to be operated according to the manual provided by the manufacturer.

A plate or durable label containing the manufacturer’s name, the type, the serial number, the date of manufacture and the treatment rated capacity must be attached to each system.

Summary of Land Based Test Results

For Ballast Water Management System, Type.....

Qingdao Headway Technology Co., Ltd,
HMT-50~HMT-4000

Manufactured by..... Qingdao Headway Technology Co., Ltd, Qingdao Shandong Province,
China

Organization conducting the test..... Norwegian Institute for Water Research, Oslo, Norway

The test results of the tested Ballast Water Management System are valid for the System that is given type approval with this document.

Notes:

At high salinity, five and at low salinity, seven independent experiments were carried out. A reference and a treated sample were taken with a minimum of 200 m³ at each sampling time. Samples were taken as triplicates.

High salinity test results (> 32 PSU):

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 um (/m ³)	187392	≥ 100 000	80813	> 90	0.7	< 10
Phyla > 50 um	>3	≥ 3 different	-	-	-	-
Species > 50 μm	>5	≥ 5 different	-	-	-	-
10-50 μm (/ml)	1241	> 1000	1969	> 90	0	< 10
Phyla 10-50 μm	>3	≥ 3 different	-	-	-	-
Species 10-50 μm	>5	≥ 5 different	-	-	-	-
Hetero. bact./ml	>2.7x10 ⁴	≥10 000	2.3x10 ⁵	-	2.3x10 ⁴	-
Escherichia Coli ¹ (cfu/100 ml)	-	-	-	-	<1	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	<1	< 1
Enterococcus group ² (cfu/100 ml)	-	-	78.8	-	0.4	< 100
Temperature ° C	23.6	-	10.7	-	10.8	-
Salinity (PSU)	10.1	>32	32.3	-	32.3	-
POC (mg/L)	32.3	> 1	-	-	-	-
DOC (mg/L)	2.5	> 1	-	-	-	-
TSS (mg/L)	2.5	> 1	-	-	-	-

Low salinity test results (3-32 PSU):

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 μm (/m ³)	180831	$\geq 100\ 000$	37554	> 90	3.5	< 10
Phyla > 50 μm	>3	≥ 3 different	-	-	-	-
Species > 50 μm	>5	≥ 5 different	-	-	-	-
10-50 μm (/ml)	1910	> 1000	1423	> 90	1.4	< 10
Phyla 10-50 μm	>3	≥ 3 different	-	-	-	-
Species 10-50 μm	>5	≥ 5 different	-	-	-	-
Hetero. bact./ml	$>3.7 \times 10^4$	$\geq 10\ 000$	5.0×10^5	-	6.4×10^5	-
Escherichia Coli ¹ (cfu/100 ml)	-	-	-	-	<1	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	<1	< 1
Enterococcus group ² (cfu/100 ml)	16.8	-	12.5	-	9.3	< 100
Temperature °C	14.1	-	13.7	-	13.7	-
Salinity (PSU)	21.7	3-32	21.7	-	21.7	-
POC (mg/L)	7.7	> 5	-	-	-	-
DOC (mg/L)	6.5	> 5	-	-	-	-
TSS (mg/L)	72.5	> 50	-	-	-	-

Reference Methods:

Parameters	Reference Method
>50 μm	OECD Test Guideline for Testing of Chemical 202.
10-50 μm	Serial Dilution Method and CFDA Method
Hetero. bact.	Norwegian Standard NS-EN 6222
Escherichia Coli	ISO 9308-3
Vibrio cholerae	TCBS plating method
Enterococcus group	ISO7899-2

Summary of Ship Based Test Results

Organization conducting the test..... Ocean Monitoring and Inspection Center, Ocean University of China

Tests were conducted on board the vessel.....“M/V SITC Yokohama”, IMO Nr. 9308041

Time of testing..... 11.18.2009 – 1.19.2011

Maritime Area of testing..... Hong Kong/Busan/Shinsundae/Shanghai/Xiamen

Test 1

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm [individuals/m3]	3214	> 90	3038	> 9	0	<10
10-50 µm [individuals/ml]	322	> 90	326	> 9	2.4/L	<10
Escherichia coli (cfu /100 ml)	0	-	0	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	<1
Enterococcus group (cfu/100 ml)	42.3	-	284.3	-	0.7	<100
Temperature [°C]	25.0	-	26.8	-	26.9	-
	30.2	-	30.2	-	30.2	-
Salinity [PSU]	0.61	-	0.96	-	0.93	-
POC [mg/l]	31.8	-	13.8	-	25.5	-
TSS [mg/l]						

Test 2

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	606	> 90	507	> 9	0	<10
10-50 µm (/ml)	389	> 90	438	> 9	3.0/L	<10
Escherichia coli (cfu /100 ml)	0	-	0	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	<1
Enterococcus group (cfu /100 ml)	154.3	-	125.3	-	0	<100
Temperature (°C)	29.3	-	26.9	-	27.0	-
Salinity (PSU)	27.9	-	27.6	-	27.6	-
POC (mg/l)	0.79	-	1.26	-	0.81	-
TSS [mg/l]	26.0	-	27.3	-	8.7	-

Test 3

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	703	> 90	652	> 9	0	<10
10-50 µm (/ml)	350	> 90	365	> 9	2.1/L	<10
Escherichia coli (cfu /100 ml)	0	-	0	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	<1
Enterococcus group (cfu /100 ml)	86.8	-	171.0	-	0	<100
Temperature (°C)	21.2	-	19.6	-	19.4	-
Salinity (PSU)	25.5	-	25.6	-	25.5	-
POC (mg/l)	0.86	-	0.93	-	0.78	-
TSS [mg/l]	53.1	-	34.0	-	20.0	-



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