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..... Shanghai Cyeco Environmental Technology Co., Ltd.

under type and model designation..... Cyeco- B1000

and incorporating:

Ballast water management system manufactured by..... Shanghai Cyeco Environmental Technology Co., Ltd.

to equipment/assembly drawing No.... Cyeco/TD04-40; Cyeco/TD04-41; Cyeco/TD04-45 date.... 12 June 2012

UV-Reactor manufactured by ..... Shanghai Cyeco Environmental Technology Co., Ltd.

to components drawing No..... Cyeco/TD04-41B03502-A/1 date..... 12 June 2012

Filtration system manufactured by..... Shanghai Cyeco Environmental Technology Co., Ltd.

To components drawing No..... Cyeco/TD04-41B02502-A/1 date..... 12 June 2012

Treatment rated capacity..... 1000 m3/hour

Active Substance..... N/A Relevant Chemical..... N/A

Whole Effluent Toxicity (WET) tests carried out in accordance with Resolution MEPC. 169(57) with negligible effect.

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 China Maritime Safety Administration with Type Approval Certificate No. SH16T00044.

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

Official Stamp

DEPUTY COMMISSIONER OF MARITIME AFFAIRS OF LIBERIA

Margaret Ansumana
Deputy Commissioner of Maritime Affairs
Republic of Liberia
Date of issue: 24 July 2017 Place of issue: Vienna, USA
Date of Expiry: 27 October 2020

Enc. This certificate consists of 7 pages, including the appendix and summary of the original test results

APPENDIX I

Limiting Conditions for operation of the BWMS

Maximum treatment rated capacity (TRC) (per installed UV-Reactor)..... 1000 m^3/h

Measured Minimum UV Intensity ..... 906 W/m^2

(Corresponding to a minimum UV transmittance of 60%)

Salinity range..... Brackish and Marine Water

Temperature..... minimum 0°C

Max system operating pressure..... 8 bar

Minimum holding time..... Not Applicable

Maximum Allowable Discharge Concentration (MADC) of (OH) radical..... Not limited

Total Residual Oxidant Level ..... Not Applicable

Approved for use in explosive atmosphere ..... No

Installation on open deck ..... No

Summary of conditions during land and ship-based testing

Ballast water salinity range during land based tests.....Tested in water salinity ranging from 21.7 PSU (low salinity) to 32.6 PSU (high salinity)

During the land based tests the water temperature ranged between..... 22.2°C – 25.9°C

Ballast water dissolved organic compounds (DOC)..... 6.65 mg/L (low salinity) to 2.84 mg/L (high salinity)

Ballast water particulate organic compounds (POC)..... 5.41 mg/L (low salinity) to 1.63 mg/L (high salinity)

Ballast water total suspended solids (TSS)..... 55.47 mg/L (low salinity) to 20.43 mg/L (high salinity)

Ballast water salinity range during ship board tests.....Tested in water salinity ranging from 30.0 PSU (low salinity) to 34.3 PSU (high salinity)

During the shipboard tests the water temperature ranged between..... 15.0°C – 24.2°C

Ballast water dissolved organic compounds (DOC)..... 0.57 mg/l to 1.24 mg/L

Ballast water particulate organic compounds (POC)..... 1.31 mg/L to 2.84 mg/L

Ballast water total suspended solids (TSS)..... 3.0 mg/L to 20 mg/L

Minimum holding time..... Not Applicable

Maximum Allowable Discharge Concentration (MADC) of (OH) radical..... Not limited

((OH) radical dissipates immediately upon leaving the AOT Reactor.)

Minimum UV transmittance 84%

Minimum UV measured Intensity ..... 1268 W/m^2 (1000 m^3/h)

Means to account for changes in UV-transmittance..... UV intensity sensor mounted in MPUV chamber

Information on reduced flow rates ..... Flow rates are controlled by changes in intensity value

Total Residual Oxidant Level ..... Not Applicable

Maximum treatment rated capacity (TRC)..... 1000 m^3/h

Flow rates during land-based testing averaged..... 250 m^3/h

Flow rates during shipboard testing averaged..... 1000 m^3/h

(Maximum treatment rated capacity based upon mathematical modeling of AOT Reactor dose from 300 m^3/h to 1000 m^3/h)

Operating Parameters during ship-based testing

Operating UV Intensity at ..... 906 – 1510 W/cm^2 (60% UVT –99% UVT)

Energy consumption at 1,000 m^3/hour..... 16-85 KW

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 (Most Probable Number (MPN) methodology)

For Ballast Water Management System, Type..... Cyeco B-1000

Manufactured by..... Shanghai Cyeco Environmental Technology Co., Ltd.

Organization conducting the test..... Centre of Marine Environmental Measurements, First Institute of Oceanography (FIO), State Oceanic Administration (SOA), Qingdao, China.

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 (5) and at low salinity, five (5) independent experiments were carried out. A reference and a treated sample were taken with a minimum of 200 m^3 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)	Average 250,000 Min. 101,000	≥ 100 000	Average 58,800 Min. 22,700	> 100	0	< 10
Phyla > 50 um	Min. 3	≥ 3 different	3	-	-	-
Species > 50 µm	Min. 5	≥ 5 different	6	-	-	-
10-50 µm (/ml)	Average 1,190 Min. 1,140	> 1000	Average 130.1 Min. 109.02	> 100	Average 0.001 Max. 0.005	< 10
Phyla 10-50 µm	Min. 3	≥ 3 different	3	-	-	-
Species 10-50 µm	Min. 5	≥ 5 different	5	-	-	-
Hetero. Bact./ml	Average 3,500,000 Min. 1,970,000	≥10 000	Average 429,000 Min. 197,000	-	Average 216 Max. 273	-
Escherichia Coli (cfu/100 ml)	Average 378 Min. 293	-	Average 361 Min. 137	-	0	<250
Vibrio cholerae (cfu /100 ml)	Average 15,900 Min. 2,800	-	Average 5,450 Min. 2,730	-	0	< 1
Enterococcus group (cfu/100 ml)	Average 488 Min. 87	-	Average 222 Min. 73	-	0	< 100

Low salinity test results (3-32 PSU):

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 um (/m^3)	Average 729,000 Min.104,000	≥ 100,000	Average 192,000 Min. 7,500	> 100	0	< 10
Phyla > 50 um	Min. 3	≥ 3 different	-	-	-	-
Species > 50 µm	Min. 5	≥ 5 different	-	-	-	-
10-50 µm (/ml)	Average 1,270 Min 1041	> 1000	Average 182 Min. 159	> 100	0	< 10
Phyla 10-50 µm	Min. 3	≥ 3 different	-	-	-	-
Species 10-50 µm	Min. 5	≥ 5 different	-	-	-	-
Hetero. bact./ml	Average 3,470,000 Min. 1,330,000	≥10,000	Average 1,570,000 Min. 493,000	-	Average 127 Max. 320	-
Escherichia Coli (cfu/100 ml) [/100 ml]	Average 3,330 Min. 483	-	Average 10,700 Min. 240	-	0	< 250
Vibrio cholerae (cfu /100 ml)	Average 159,000 Min. 48,000	-	Average 120,000 Min. 15,300	-	0	< 1
Enterococcus group (cfu/100 ml)	Average 4,130 Min. 3,300	-	Average 3,260 Min. 86	-	0	< 100

Reference Methods:

Parameters	Reference Method
Heterotrophic Bacteria (counts/mL)	GB17378-2007
Escherichia coli (cfu/100mL)	GB17378-2007
Enterococci (cfu/100 mL)	ISO4833-2003
Vibrio cholerae (cfu /100 ml)	GB17378-2007
Organisms >=10 < 50 um (viable cells/mL)	Hallegraeff, G. M., Anderson, D. M., Cembella, A. D., & Enevoldsen, H. O. (2003). Manual on harmful marine microalgae.
Organisms >= 50 um (viable organisms/m3)	GB/T12763-2007

Summary of Ship Based Test Results (Most Probable Number (MPN) methodology)

Organization conducting the test..... Centre of Marine Environmental Measurements, First Institute of Oceanography (FIO), State Oceanic Administration (SOA).

Tests were conducted on board the vessel..... "JULI", IMO Nr. 9648568

Time of testing..... 10 May, 2013 – 11 August, 2013

Maritime Area of testing..... East China Sea, South China Sea

Test 1

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	7200	> 90	3275	> 9	0.3	<10
10-50 µm (/ml)	605	> 90	102	>9	0.13	<10
Escherichia coli (cfu /100 ml)	-	-	-	-	-	<250
Vibrio cholerae (cfu /100 ml)	2240	-	-	-	7	<1
Enterococcus group (cfu /100 ml)	133	-	-	-	0	<100

Test 2

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	22883	>90	4589	>9	0.3	<10
10-50 µm (/ml)	252	> 90	57	>9	0	<10
Escherichia coli (cfu /100 ml)	180	-	-	-	31.1	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	27	-	-	-	0	<100

Test 3

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	5833	>90	2050	>9	0	<10
10-50 µm (/ml)	102	> 90	45	>9	0.07	<10
Escherichia coli (cfu /100 ml)	170	-	-	-	6.7	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	37	-	-	-	0	<100

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