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..... Optimarin AS, Sandnes, Norway

under type and model designation..... Optimarin Ballast System (OBS) and OBS Ex/Model 50-3000

and incorporating:

Ballast water management system manufactured by..... Optimarin AS

to equipment/assembly drawing No..... 102-129 Item 1 Appendix 1and 201- 217 Item 2 Appendix 2

UV Chamber manufactured by..... CIG Piping Technology

to components drawing No..... 138506 and 145334 (Ex system)

Filtration system manufactured by..... Bollfilter

To components drawing No..... Item 1, Appendix A 07-08

Filtration system manufactured by..... Filtersafe

To components drawing No..... Item 1, Appendix A, 09

Filtration system manufactured by ..... Filtrex

To components drawing No..... Item 1, Appendix A, 10

UV Intensity sensor manufactured by ..... IL Metronic

Treatment rated capacity..... 50 - 3000 m^3/h

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 Norwegian Maritime Directorate with Type Approval Certificate No. TAP000006X/Rev.1

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

Official Stamp

Margaret Ansumana
Deputy Commissioner of Maritime Affairs
Republic of Liberia
Date of issue: 19 March 2018 Place of issue: Vienna, USA
Date of Expiry: 27 October 2020

Enc. This certificate consists of 8 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)..... 3000 m^3/h (Working range 20Ma = 2300W/m^2)

Measured Minimum UV Intensity .....100 W/m^2
(Corresponding to a minimum UV transmittance of 50%)

Salinity range..... No limitations

Temperature..... -2°C to 37 °C

Max system operating pressure..... 10 bar

Minimum holding time..... No Limitation

Total Residual Oxidant Level ..... Not Applicable

Approved for use in explosive atmosphere ..... Yes

Conditions for use in explosive atmosphere ..... According to ATEX and IECEx Certificate

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 20.7 PSU (low salinity) to 32.9 PSU (high salinity)

Ballast water salinity range during ship board tests.....Tested in water salinity ranging from 9 PSU (low salinity) to 26 PSU (high salinity)

During the shipboard tests the water temperature ranged between..... 3°C – 8°C

During the land based tests the water temperature ranged between..... 4°C – 18°C

Ballast water dissolved organic compounds (DOC)..... 5.3 mg/L to 6.1 mg/L

Ballast water particulate organic compounds (POC)..... 6.5 mg/L to 8.7 mg/L

Ballast water total suspended solids (TSS) during land-based testing..... 57 mg/L to 68.4 mg/L

Ballast water total suspended solids (TSS) during ship-based testing..... 0 mg/L to 24 mg/L

Means to account for changes in UV-transmittance..... UV intensity sensor mounted MPUV chamber UV Intensity warning at 100W/m^2

Information on reduced flow rates ..... Flow rates are controlled by changes in intensity value
Flow set point is constant controlled by Flow Control Valve

Total Residual Oxidant Level ..... Not Applicable

Maximum treatment rated capacity (TRC)..... 3000 m^3/h

Flow rates during land-based testing averaged..... 334 m^3/h

Flow rates during shipboard testing averaged..... 334 m^3/h

(Maximum treatment rated capacity based upon mathematical modeling of UV Reactor from 300 m^3/h to 3000 m^3/h using guidance in BWM.2/Circ.33)

Operating Parameters during ship-based testing

Operating UV Intensity at ..... 0 -2100 W/cm^2

Energy consumption at 250 m^3/hour..... Max. 60 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

For Ballast Water Management System, Type..... Optimarin Ballast System (OBS) and OBS Ex/Model 50-3000

Manufactured by..... Optimarin AS, Sandnes, Norway

Organization conducting the test..... Norwegian Institute for Water Research

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, seven and at low salinity, five 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)	Min. 71,229 ± 14144 Max. 248,000 ± 35848	≥ 100 000	Min. 7245 ± 2408 Max. 59 278 ± 11 484	> 100	0	< 10
Phyla > 50 um	Min. 4	≥ 3 different	-	-		-
Species > 50 µm	Min. 6	≥ 5 different	-	-		-
10-50 µm (/ml)	Min. 1556 ± 412 Max. 5,705 ± 1036	> 1000	Min. 1357 ± 91 Max. 5324 ± 158	> 100	Min. 0 Max. 0.7 ± 0.6	< 10
Phyla 10-50 µm	Min. 3	≥ 3 different	-	-		
Species 10-50 µm	Min. 7	≥ 5 different	-	-		
Hetero. Bact./ml	Min. 1.7 ± 0.5 x 10^4 Max. 1.8 ± 0.2 x 10^5	≥10 000	Average 176,945 Min. 140,167	-	Min. 1.2 ± 0.5 x 10^1 Max. 1.5 ± 0.3 x 10^2	-
Escherichia Coli (cfu/100 ml)	Min. 0 Max. 3.7 ± 0.6 x 10^0	-	Min. 0 Max. 0.7 ± 0.6 x 10^0	-	0	<250
Vibrio cholerae (cfu /100 ml)	-	-	Min. 4.4 ± 0.3 x 10^3 Max. 2.9 ± 2.6 x 10^4	-	<1	< 1
Enterococcus group (cfu/100 ml)	Min. 0 Max. 1.3 ± 1.2 x 10^0	-	Min. 0 Max. 2.0 ± 1.0 x 10^0	-	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)	Min. 232,708 ± 29,189 Max. 265,083 ± 17,924	≥ 100,000	Min. 14 852 ± 1587 Max. 66 093 ± 2360	> 100	Min. 0 Max 1.3 ± 0.6	< 10
Phyla > 50 um	Min.	≥ 3 different	Average 6,25 Min. 5	-	-	-
Species > 50 µm	Min. 5	≥ 5 different	Average 18 Min. 15	-	-	-
10-50 µm (/ml)	Min. 1927 ± 182 Max. 2800 ± 494	Min.	Min. 1279 ± 104 Max. 2964 ± 226	> 100	Min. 3.3 ± 0.6 Max. 7.7 ± 0.6	< 10
Phyla 10-50 µm	Min. 3	≥ 3 different	Average 3,5 Min. 3	-	-	-
Species 10-50 µm	Min. 5	≥ 5 different	Average 11.5 Min. 8	-	-	-
Hetero. bact./ml	Min. 1.8 ± 0.2 x 10^4 Max. 1.2 ± 0.006 x 10^5	≥10,000	Min. 3.6 ± 1.5 x 10^4 Max. 1.4 ± 0.8 x 10^6	-	Min 3.9 ± 1.9 x 10^0 Max. 2.0 ± 0.9 x 10^3	-
Escherichia Coli (cfu/100 ml) [/100 ml]	Min. 1.7 ± 0.6 x 10^0 Max. 3.3 ± 2.1 x 10^1	-	Min. 0 Max. 2.3 ± 2.1 x 10^0	-	0	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	< 1
Enterococcus group (cfu/100 ml)	Min. 0.3 ± 0.6 x 10^0 Max. 3.3 ± 1.2 x 10^0	-	Min. 0 Max. 0.3 ± 0.6 x 10^0	-	0	< 100

Reference Methods:

Parameters	Reference Method
Heterotrophic Bacteria (counts/mL)	Norwegian Standard NS-EN 6222/NS 4791
Escherichia coli (cfu/100mL)	NS 4792 or NS-EN ISO 9308-3
Enterococci (cfu/100 mL)	Norwegian Standard NS-EN ISO 7899-2
Vibrio cholerae (cfu /100 ml)	NMKL method No. 156, 2. ed 1997, "sykdomsfremkallende Vibrio-arter. Påvisning og bestemmelse I levnedsmidler"
Organisms >=10 < 50 um (viable cells/mL)	Ganassin *et al.* (2000)
Organisms >= 50 um (viable organisms/m3)	OECD Test Guideline (1985)

Summary of Ship Based Test Results

Organization conducting the test ... . Analytech Danmark/Eurofins Danmark/NIVA, Oslo

Tests were conducted on board the vessel..... "KCL Banshee", IMO Nr. 8221363

Time of testing..... ..... 10 August 2008– 20 June 2009

Maritime Area of testing..... Bremerhaven, Gothenburg, North Sea

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	Min. 10284±6261 Max. 96529±42838	> 90	Min. 4558±3321 Max. 84242±38845	> 9	Min. 0.8±1.6 Max. 22.4±26.8	<10
10-50 µm (/ml)	Min. 42±11 Max. 1052±98	> 90	Min. 15±3 Max. 773±54	>9	Min. 0 Max. 3.9±3	<10
Escherichia coli (cfu /100 ml)	Min. 0 Max. 49.7 ± 15.0	-	Min. 0 Max. 28.0 ± 5.6	-	0	<250
Vibrio cholerae (cfu /100 ml)	Min. 25 ± 19 Max. 1100 ± 760	-	Min. 3.3 ± 1.0 Max. 1200 ± 240	-	< 1	<1
Enterococcus group (cfu /100 ml)	Min. 0 Max. 21.0 ± 10.4	-	Min. 0 Max. 24.0 ± 5.0	-	0	<100

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