



**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..... Evoqua Water Technologies, LLC  
2 Milltown Court, Union, NJ 07083, USA

under type and model designation..... SeaCURE™ Ballast Water Management System,  
Model: SeaCURE-SC-1500/1

and incorporating:

Ballast water management system manufactured by..... Evoqua Water Technologies, LLC

to equipment/assembly drawing No:	<u>BWM-R-E2-1500-A1-G06-02, Rev.A</u>	date..... <u>16 August 2013</u>
	<u>BWM-R-E2-1500-A1-G06-04, Rev.A</u>	date..... <u>16 August 2013</u>
	<u>BWM-R-E2-1500-A1-G06-05, Rev.A</u>	date..... <u>16 August 2013</u>
	<u>SC-M700-A1-G06, Rev.A</u>	date..... <u>15 August 2013</u>
	<u>SC-M900-A1-G06, Rev.A</u>	date..... <u>15 August 2013</u>
	<u>BWM-R-E2-1500-A1-G06-06, Rev.A</u>	date..... <u>16 August 2013</u>

Electrolysis Unit manufactured by ..... Evoqua Water Technologies LLC

to components drawing No..... BWM-R-E2-1500-A1-G06-03, Rev.A date.....16 August 2013

Filtration system manufactured by..... Filtersafe Automatic Screen Filtration

To components drawing No..... BWM-R-E2-1500-A1-G06-01, Rev.A date.....8 March 2013

ORP sensor unit manufactured by.....ABB, Hach or approved others

TRO neutralization unit manufactured by..... Evoqua Water Technologies LLC

Gas Hydrogen (H<sub>2</sub>) sensor unit manufactured by..... Not Required unless by Class

Conductivity sensor unit manufactured by.....Analytical Technology, Inc.

Treatment rated capacity..... up to 1500 m<sup>3</sup>/h

Active Substances (as Total Residual Oxidants) ..... Sodium Hypochlorite, Hypochlorous Acid

Relevant Chemical ..... Bromate, Chlorate, Trihalomethanes, Halogenated Aceto-Nitriles, Halogenated Acetic Acids

Final approval granted by IMO for systems using active substances MEPC 63/2/10 Annex 6, para 7.4 and MEPC 63/23, para 2.7.

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 federal Maritime and Hydrographic Agency, Federal Republic of Germany with Type Approval Certificate No. 0800S41-4443/000/4/Siemens/Evoqua.

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



**Margaret Ansumana**

Deputy Commissioner of Maritime Affairs

Republic of Liberia

Date of issue: 1/October/2017 Place of issue: Vienna, USA

Date of Expiry: 27/October/2020

Enc. This certificate consists of 8 pages, including the appendices and summary of the original test results.

## APPENDIX II

### Limiting Conditions for operation of the BWMS

Treatment rated capacity (TRC).....	up to 1500 m <sup>3</sup> /h
Maximum Allowable Dosage Concentration of TRO (as Cl <sub>2</sub> ).....	6.0 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	≤ 0.2 mg/L
Ballast water salinity range.....	Any
Operation with <25 PSU ballast water.....	Electrolyzer feed water from dedicated seawater tank
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
Maximum Hydrogen gas generation.....	To be not more than 25% of LEL
Differential pressure across the filter.....	should not exceed 0.5 Bar

### Summary of conditions during land and ship-based testing

Ballast water salinity range during shipboard tests (SBT) ...	from 0.4 PSU (fresh water) to 33.9 PSU (high salinity)
Ballast water salinity range during land based tests (LBT) ...	from < 1 PSU (fresh water) to 6-10 PSU (low salinity)
During SBT the water temperature ranged between .....	12.5°C – 15.3°C
Ballast water particulate organic compounds (POC) during SBT.....	9.0 mg/L to 15.1 mg/L
Ballast water total suspended solids (TSS) during SBT.....	21.3 mg/L to 44.3 mg/L
During LBT in low salinity the water temperature ranged between .....	14.1°C – 20.5°C
During LBT in fresh water the water temperature ranged between .....	9°C – 22°C
Ballast water dissolved organic compounds (DOC) during LBT in low salinity.....	2.8 mg/L to 3.8 mg/L
Ballast water dissolved organic compounds (DOC) during LBT in fresh water.....	7.8±0.03 mg/L to 8.9±0.2 mg/L
Ballast water particulate organic compounds (POC) during LBT in low salinity .....	4.8 mg/L to 5.9 mg/L
Ballast water particulate organic compounds (POC) during LBT in fresh water.....	0.0±0.04 mg/L to 0.6±0.6 mg/L
Ballast water total suspended solids (TSS) during LBT in low salinity.....	51 mg/L to 65 mg/L
Ballast water total suspended solids (TSS) during LBT in fresh water.....	34.2±9.4 mg/L to 54.7±3.2 mg/L
Maximum Allowable Dosage Concentration of TRO (as Cl <sub>2</sub> ).....	6.0 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	≤ 0.2 mg/L
Flow rates during land-based testing .....	maximum 340 m <sup>3</sup> /hour
Flow rates during shipboard testing.....	maximum 1500m <sup>3</sup> /hour

**Operating Parameters during land-based and ship-based testing**

Operating TRO dosage.....	Max. 6.0 mg/L
Energy consumption at 300 m <sup>3</sup> /hour.....	10.0 KW/hour*
Current .....	15 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..... SeaCURE™ Ballast Water Management System, Model: SeaCURE-F-1500/1

Manufactured by..... Evoqua Water Technologies, LLC, 2 Milltown Court, Union, NJ 07083, USA

Organization conducting the test..... Great Ships Initiative (GSI) test facility on fresh water Lake Superior in Wisconsin, USA  
Maritime Environmental Resource Center (MERC) in brackish water Chesapeake Bay in Maryland, USA.

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 low (brackish) salinity, six and in fresh water, five independent experiments were carried out. A reference and a treated sample were taken with a minimum of 200 m<sup>3</sup> at each sampling time. Samples were taken as triplicates.

**Low salinity test results (6-10 PSU):**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 µm (/m <sup>3</sup> )	Min. 50,500 Av. 104, 567	≥ 100 000	Min. 35,666 Av. 101,567	> 90	Max. 9 Av. 4.8	< 10
Phyla > 50 µm	>3	≥ 3 different	-	-	-	-
Species > 50 µm	>5	≥ 5 different	-	-	-	-
10-50 µm (/ml)	Min. 1088 Av. 2271	> 1000	Min. 137 Av. 1243	> 90	Max. 6 Av. 1.9	< 10
Phyla 10-50 µm	>3	≥ 3 different	-	-	-	-
Species 10-50 µm	>5	≥ 5 different	-	-	-	-
Hetero. bact./ml	Min. 146 Av. 732.2	≥10 000	Min. 55 Av. 404.5	-	Min. 3.95 Av. 13	-
Escherichia Coli <sup>1</sup> (cfu/100 ml)	Min. 2.2 Av. 8	-	Min. 0 Av. 0.6	-	Min. 0 Av. 7.1	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	< 1
Enterococcus group <sup>2</sup> (cfu/100 ml)	Min. 0 Av. 27.3	-	Min. 2.4 Av. 28.6	-	Min. 0 Av. 33.5	< 100

**Fresh water test results (< 1 PSU):**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 µm (/m <sup>3</sup> )	Min. 287,920 Av. 656, 824	≥ 100 000	Min. 321,058 Av. 463,141	> 90	Max. 7 Av. 4.2	< 10
Phyla > 50 µm	>3	≥ 3 different	-	-	-	-
Species > 50 µm	>5	≥ 5 different	-	-	-	-
10-50 µm (/ml)	Min. 1180 Av. 1580	> 1000	Min. 96 Av. 150	> 90	Max. 6.8 Av. 1.9	< 10
Phyla 10-50 µm	>3	≥ 3 different	-	-	-	-
Species 10-50 µm	>5	≥ 5 different	-	-	-	-
Hetero. bact./ml	Min. 467 Av. 3277	≥10 000	Min. 88 Av. 868	-	Max. 680,000 Av. 415,067	-
Escherichia Coli <sup>1</sup> (cfu/100 ml)	Min. 8 Av. 62	-	Min. <1 Av. 0.4	-	< 1	< 250
Vibrio cholerae (cfu /100 ml)	<1	-	< 1	-	<1	< 1
Enterococcus group <sup>2</sup> (cfu/100 ml)	Min. 86 Av. 394	-	Min. 35 Av. 562	-	Max. 3 Av. 1.2	< 100

**Reference Methods:**

Parameters	Reference Method
>50 µm	Microscopic Examination
10-50 µm	Vital Stain
Hetero. bact.	Procedure for Quantifying Heterotrophic Plate Counts (HPC) Using the Spread Plate Method
Escherichia Coli	Detection and Enumeration of Total Coliforms and <i>E. coli</i> Using IDEXX's Colilert®
Vibrio cholerae	Colony Blot Preparation for the Enumeration of Culturable <i>Vibrio cholerae</i> and Presence of <i>ctxA</i> Gene
Enterococcus group	Detection and Enumeration of <i>Enterococcus</i> using Enterolert™

## Summary of Ship Based Test Results

Organization conducting the test ..... Gollasch Consulting, Hamburg, Germany

Tests were conducted on board the vessel.....M.V. "COSCO Fortune", IMO Nr. 9472127

Time of testing..... October 2012 – May 2013

Maritime Area of testing..... North Sea, Felixstowe, Elbe River, Hamburg

### **Test 1**

<b>Organism Type</b>	<b>Influent Water</b>	<b>IMO req.</b>	<b>Discharge control</b>	<b>IMO req.</b>	<b>Discharge treated</b>	<b>IMO req.</b>
> 50 µm [ individuals/m <sup>3</sup> ]	3796	> 90	609	> 9	Max. 6.5 Av. 3.5	<10
10-50 µm [ individuals/ml ]	455	> 90	83	> 9	0	<10
Escherichia coli (cfu /100 ml)	26	-	5	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	<1
Enterococcus group (cfu/100 ml)	120	-	80	-	0	<100
Temperature [ °C ]	13	-	14	-	13.7	-
Salinity [ PSU ]	33.9	-	33.9	-	33.7	-
POC [ mg/l ]	15.1	-	9.4	-	9.6	-
TSS [ mg/l ]	44.3	-	21.4	-	24	-

### **Test 2**

<b>Organism Type</b>	<b>Influent Water</b>	<b>IMO req.</b>	<b>Discharge control</b>	<b>IMO req.</b>	<b>Discharge treated</b>	<b>IMO req.</b>
> 50 µm ( /m <sup>3</sup> )	17231	> 90	7574	> 9	Max. 9.5 Av.8.8	<10
10-50 µm ( /ml )	5798	> 90	1346	> 9	0	<10
Escherichia coli (cfu /100 ml)	110	-	30	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	<1
Enterococcus group (cfu /100 ml)	-	-	60	-	Max. 30 Av. 20	<100
Temperature ( °C )	12.5	-	13.4	-	13.3	-
Salinity ( PSU)	0.4	-	0.4	-	2.6	-
POC ( mg/l )	11.6	-	4.2	-	4.6	-
TSS [ mg/l ]	30	-	16.6	-	8.2	-

### Test 3

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm ( /m3 )	7553	> 90		> 9	Max. 7.2 Av. 4.7	<10
10-50 µm ( /ml )	58	> 90	48	> 9	0	<10
Escherichia coli (cfu /100 ml)	80	-	11	-	0	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	340	-	130	-	0	<100
Temperature ( °C )	12.6	-	10.8	-	10.8	-
Salinity ( PSU)	32.9	-	33.0	-	32.8	-
POC ( mg/l )	9.6	-	8.6	-	9.8	-
TSS [ mg/l ]	24.2	-	21.4	-	22.4	-

### Test 4

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm ( /m3 )	28059	> 90	5658	> 9	Max. 7.0 Av. 6.2	<10
10-50 µm ( /ml )	1240	> 90	1364	> 9	0	<10
Escherichia coli (cfu /100 ml)	240	-	60	-	Max. 20 Av. 13.3	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	160	-	90	-	Max. 50 Av. 30	<100
Temperature ( °C )	15.3	-	12.9	-	12.7	-
Salinity ( PSU)	0.8	-	1.0	-	2.2	-
POC ( mg/l )	9.0	-	8.9	-	5.5	-
TSS [ mg/l ]	21.3	-	12.3	-	8.5	-

Official Stamp



*M Ansumana*

**Margaret Ansumana**

Deputy Commissioner of Maritime Affairs

Republic of Liberia

Date of issue: 1/October/2017 Place of issue: Vienna, USA





## 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.....Evoqua Water Technologies, Ltd or Affiliates

210 Sixth Avenue, Pittsburgh, PA 15222, USA

under type and model designation.....SeaCURE<sup>®</sup> Ballast Water Management System.

Models:

SC – F – 1600 – 1600/2 \*\*

SC – F – 2000 – 2000/2 \*\*

SC – F – 3000 – 3000/2 \*\*

SC – F – 4000 – 4000/2 \*\*

SC – F – 5000 – 5000/2 \*\*

SC – F – 6000 – 6000/2 \*\*

\*\* indicates there are additional options to each of these models including but the base model is the same. and incorporating:

Ballast water management system manufactured by.....Evoqua Water Technologies Ltd or Affiliates

to equipment/assembly drawing No:

Model	Electrochlorination Unit Drawing No.	Date
SC – 1600/2	6D-40070 Rev D - ECU 3S-3L-5T GA	22/11/2016
	6D-40358 Rev A - SeaCURE Electrolyser GA	08/01/2018
	6D-40293 Rev B - Degas Tank 1.0D GA	24/11/2017
SC – 2000/2	6D-40070 Rev D - ECU 3S-3L-5T GA	22/11/2016
	6D-40358 Rev A - SeaCURE Electrolyser GA	08/01/2018
	6D-40293 Rev B - Degas Tank 1.0D GA	24/11/2017
SC – 3000/2	6D-40070 Rev D - ECU 3S-3L-5T GA	22/11/2016
	6D-40358 Rev A - SeaCURE Electrolyser GA	08/01/2018
	6D-40116 Rev C - Degas Tank 1.2D GA	11/08/2017
SC – 4000/2	6D-40070 Rev D - ECU 3S-3L-5T GA	22/11/2016
	6D-40358 Rev A - SeaCURE Electrolyser GA	08/01/2018
	6D-40116 Rev C - Degas Tank 1.2D GA	11/08/2017
SC – 5000/2	6D-40070 Rev D - ECU 3S-3L-5T GA	22/11/2016
	6D-40358 Rev A - SeaCURE Electrolyser GA	08/01/2018
	6D-40116 Rev C - Degas Tank 1.2D GA	11/08/2017
SC – 6000/2	6D-40070 Rev D - ECU 3S-3L-5T GA	22/11/2016
	6D-40358 Rev A - SeaCURE Electrolyser GA	08/01/2018
	6D-40116 Rev C - Degas Tank 1.2D GA	11/08/2017

Filtration system manufactured by..... Filtersafe Automatic Screen Filtration

To components drawing No..... See Appendix 1

ORP sensor unit manufactured by.....ABB, Hach or approved others

TRO neutralization unit manufactured by.....Evoqua Water Technologies Ltd or Affiliates

Gas Hydrogen (H<sub>2</sub>) sensor unit manufactured by..... Not Required unless by Class

Conductivity sensor unit manufactured by.....Analytical Technology, Inc.

Treatment rated capacity..... up to 6000 m<sup>3</sup>/h

Active Substances (as Total Residual Oxidants) ..... Sodium Hypochlorite, Hypochlorous Acid

Relevant Chemical ..... Bromate, Chlorate, Trihalomethanes, Halogenated Aceto-Nitriles, Halogenated Acetic Acids

Final approval granted by IMO for systems using active substances MEPC 63/2/10 Annex 6, para 7.4 and MEPC 63/23, para 2.7.

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 federal Maritime and Hydrographic Agency, Federal Republic of Germany with Type Approval Certificate No. 0800S41-4443/000/4/Siemens/Evoqua.

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

Official Stamp



*M. Ansumana*  
**Margaret Ansumana**

Deputy Commissioner of Maritime Affairs  
 Republic of Liberia

Date of issue: 11/July/2018 Place of issue: Dulles, USA

Date Reissued: 25/February/2019 Place of reissue: Dulles, USA

Date of Expiry: 27/October/2020

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

**APPENDIX I**

Filter unit drawing number	Date	SeaCURE Model					
		SC – 1600/2	SC – 2000/2	SC – 3000/2	SC – 4000/2	SC – 5000/2	SC – 6000/2
6D-40023	01/11/2016	■	■	■	■	■	■
6D-40024	01/11/2016	■	■	■	■	■	■
6D-40025	01/11/2016	■	■	■	■	■	■
6D-40026	01/11/2016	■	■	■	■	■	■
6D-40027	01/11/2016	■	■	■	■	■	■
6D-40028	01/11/2016	■	■	■	■	■	■
6D-40029	01/11/2016	■	■	■	■	■	■
6D-40030	01/11/2016	■	■	■	■	■	■
6D-40031	01/11/2016	■	■	■	■	■	■
6D-40032	01/11/2016	■	■	■	■	■	■
6D-40033	01/11/2016	×	×				
6D-40034	01/11/2016	×	×				
6D-40035	01/11/2016		×	×			
6D-40036	01/11/2016		×	×			
6D-40037	01/11/2016			×	×	×	
6D-40038	01/11/2016			×	×	×	
6D-40039	01/11/2016				×	×	×
6D-40040	01/11/2016				×	×	×
6D-40041	01/11/2016					×	×
6D-40042	01/11/2016					×	×
6D-40043	01/11/2016						×
6D-40044	01/11/2016						×

Key:	APT Filter	■
	Main Filter[s]	×

## APPENDIX II

### Limiting Conditions for operation of the BWMS

Treatment rated capacity (TRC).....	up to 6000 m <sup>3</sup> /h
Maximum Allowable Dosage Concentration of TRO (as Cl <sub>2</sub> ).....	6.0 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	≤ 0.2 mg/L
Ballast water salinity range.....	Any
Operation with <25 PSU ballast water.....	Electrolyzer feed water from dedicated seawater tank
Minimum holding time with neutralization.....	< 1 day
Minimum holding time without neutralization .....	5 days
Approved for use in explosive atmosphere .....	Yes
Refer to drawing # 6D-40250 Rev B for installation in explosive atmosphere	
Installation on open deck .....	No
Maximum Hydrogen gas generation.....	To be not more than 25% of LEL
Differential pressure across the filter.....	should not exceed 0.5 Bar

### Summary of conditions during land and ship-based testing

Ballast water salinity range during shipboard tests (SBT) ...	from 0.4 PSU (fresh water) to 33.9 PSU (high salinity)
Ballast water salinity range during land based tests (LBT) ...	from < 1 PSU (fresh water) to 6-10 PSU (low salinity)
During SBT the water temperature ranged between .....	12.5°C – 15.3°C
Ballast water particulate organic compounds (POC) during SBT.....	9.0 mg/L to 15.1 mg/L
Ballast water total suspended solids (TSS) during SBT.....	21.3 mg/L to 44.3 mg/L
During LBT in low salinity the water temperature ranged between .....	14.1°C – 20.5°C
During LBT in fresh water the water temperature ranged between .....	9°C – 22°C
Ballast water dissolved organic compounds (DOC) during LBT in low salinity.....	2.8 mg/L to 3.8 mg/L
Ballast water dissolved organic compounds (DOC) during LBT in fresh water.....	7.8±0.03 mg/L to 8.9±0.2 mg/L
Ballast water particulate organic compounds (POC) during LBT in low salinity .....	4.8 mg/L to 5.9 mg/L
Ballast water particulate organic compounds (POC) during LBT in fresh water.....	0.0±0.04 mg/L to 0.6±0.6 mg/L
Ballast water total suspended solids (TSS) during LBT in low salinity.....	51 mg/L to 65 mg/L
Ballast water total suspended solids (TSS) during LBT in fresh water.....	34.2±9.4 mg/L to 54.7±3.2 mg/L
Maximum Allowable Dosage Concentration of TRO (as Cl <sub>2</sub> ).....	6.0 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	≤ 0.2 mg/L
Flow rates during land-based testing .....	maximum 340 m <sup>3</sup> /hour
Flow rates during shipboard testing.....	maximum 1500m <sup>3</sup> /hour

(The SeaCURE<sup>R</sup> Ballast Water Management System has basic electrolyzers with with nominal sodium hypochlorite production rates of 1.5 kg/h or 3 kg/h. The total TRC of the SeaCURE<sup>R</sup> Ballast Water Management System can be increased by modular installation of the basic electrolyzers according to BWM.2/Circ.8. and evidenced by using mathematical modelling and/or calculations.

The removal of the dedicated ambient feed for the marine growth prevention system, the redesign of the electrochlorination cell, the change to the installation of the ORP analyzer, the modifications to the control enclosures, and the redesign of the dosing lines do not affect the validity of previous testing undertaken with the base model SC-F-1500/1.

**Operating Parameters during land-based and ship-based testing**

Operating TRO dosage.....	Max. 6.0 mg/L
Energy consumption at 300 m <sup>3</sup> /hour.....	10.0 KW/hour*
Current .....	15 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..... SeaCURE<sup>®</sup> Ballast Water Management System,  
Model: SeaCURE-F-1500/1

Manufactured by...Evoqua Water Technologies, L.Ld or Affiliates, 210 Sixth Avenue, Pittsburgh, PA 15222, USA

Organization conducting the test..... Great Ships Initiative (GSI) test facility on fresh water  
Lake Superior in Wisconsin, USA  
Maritime Environmental Resource Center (MERC) in  
brackish water Chesapeake Bay in Maryland, USA.

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 low (brackish) salinity, six and in fresh water, five independent experiments were carried out. A reference and a treated sample were taken with a minimum of 200 m<sup>3</sup> at each sampling time. Samples were taken as triplicates.

**Low salinity test results (6-10 PSU):**

<b>Organism Type</b>	<b>Influent Water</b>	<b>IMO req.</b>	<b>Discharge control</b>	<b>IMO req.</b>	<b>Discharge treated</b>	<b>IMO req.</b>
>50 um ( /m <sup>3</sup> )	Min. 50,500 Av. 104, 567	≥ 100 000	Min. 35,666 Av. 101,567	> 90	Max. 9 Av. 4.8	< 10
Phyla > 50 um	>3	≥ 3 different	-	-	-	-
Species > 50 μm	>5	≥ 5 different	-	-	-	-
10-50 μm ( /ml)	Min. 1088 Av. 2271	> 1000	Min. 137 Av. 1243	> 90	Max. 6 Av. 1.9	< 10
Phyla 10-50 μm	>3	≥ 3 different	-	-	-	-
Species 10-50 μm	>5	≥ 5 different	-	-	-	-
Hetero. bact./ml	Min. 146 Av. 732.2	≥10 000	Min. 55 Av. 404.5	-	Min. 3.95 Av. 13	-
Escherichia Coli <sup>1</sup> (cfu/100 ml)	Min. 2.2 Av. 8	-	Min. 0 Av. 0.6	-	Min. 0 Av. 7.1	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	< 1
Enterococcus group <sup>2</sup> (cfu/100 ml)	Min. 0 Av. 27.3	-	Min. 2.4 Av. 28.6	-	Min. 0 Av. 33.5	< 100

**Fresh water test results (< 1 PSU):**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 µm (/m <sup>3</sup> )	Min. 287,920 Av. 656, 824	≥ 100 000	Min. 321,058 Av. 463,141	> 90	Max. 7 Av. 4.2	< 10
Phyla > 50 µm	>3	≥ 3 different	-	-	-	-
Species > 50 µm	>5	≥ 5 different	-	-	-	-
10-50 µm (/ml)	Min. 1180 Av. 1580	> 1000	Min. 96 Av. 150	> 90	Max. 6.8 Av. 1.9	< 10
Phyla 10-50 µm	>3	≥ 3 different	-	-	-	-
Species 10-50 µm	>5	≥ 5 different	-	-	-	-
Hetero. bact./ml	Min. 467 Av. 3277	≥10 000	Min. 88 Av. 868	-	Max. 680,000 Av. 415,067	-
Escherichia Coli <sup>1</sup> (cfu/100 ml)	Min. 8 Av. 62	-	Min. <1 Av. 0.4	-	< 1	< 250
Vibrio cholerae (cfu /100 ml)	<1	-	< 1	-	<1	< 1
Enterococcus group <sup>2</sup> (cfu/100 ml)	Min. 86 Av. 394	-	Min. 35 Av. 562	-	Max. 3 Av. 1.2	< 100

**Reference Methods:**

Parameters	Reference Method
>50 µm	Microscopic Examination
10-50 µm	Vital Stain
Hetero. bact.	Procedure for Quantifying Heterotrophic Plate Counts (HPC) Using the Spread Plate Method
Escherichia Coli	Detection and Enumeration of Total Coliforms and <i>E. coli</i> Using IDEXX's Colilert®
Vibrio cholerae	Colony Blot Preparation for the Enumeration of Culturable <i>Vibrio cholerae</i> and Presence of <i>ctxA</i> Gene
Enterococcus group	Detection and Enumeration of <i>Enterococcus</i> using Enterolert™

**Summary of Ship Based Test Results**

Organization conducting the test ..... Gollasch Consulting, Hamburg, Germany

Tests were conducted on board the vessel.....M.V. "COSCO Fortune", IMO Nr. 9472127

Time of testing..... October 2012 – May 2013

Maritime Area of testing..... North Sea, Felixstowe, Elbe River, Hamburg

**Test 1**

<b>Organism Type</b>	<b>Influent Water</b>	<b>IMO req.</b>	<b>Discharge control</b>	<b>IMO req.</b>	<b>Discharge treated</b>	<b>IMO req.</b>
> 50 µm [ individuals/m3 ]	3796	> 90	609	> 9	Max. 6.5 Av. 3.5	<10
10-50 µm [ individuals/ml ]	455	> 90	83	> 9	0	<10
Escherichia coli (cfu /100 ml)	26	-	5	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	<1
Enterococcus group (cfu/100 ml)	120	-	80	-	0	<100
Temperature [ °C ]	13	-	14	-	13.7	-
Salinity [ PSU ]	33.9	-	33.9	-	33.7	-
POC [ mg/l ]	15.1	-	9.4	-	9.6	-
TSS [ mg/l ]	44.3	-	21.4	-	24	-

**Test 2**

<b>Organism Type</b>	<b>Influent Water</b>	<b>IMO req.</b>	<b>Discharge control</b>	<b>IMO req.</b>	<b>Discharge treated</b>	<b>IMO req.</b>
> 50 µm ( /m3 )	17231	> 90	7574	> 9	Max. 9.5 Av.8.8	<10
10-50 µm ( /ml )	5798	> 90	1346	> 9	0	<10
Escherichia coli (cfu /100 ml)	110	-	30	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	<1
Enterococcus group (cfu /100 ml)	-	-	60	-	Max. 30 Av. 20	<100
Temperature ( °C )	12.5	-	13.4	-	13.3	-
Salinity ( PSU)	0.4	-	0.4	-	2.6	-
POC ( mg/l )	11.6	-	4.2	-	4.6	-
TSS [ mg/l ]	30	-	16.6	-	8.2	-



**Test 3**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm ( /m3 )	7553	> 90		> 9	Max. 7.2 Av. 4.7	<10
10-50 µm ( /ml )	58	> 90	48	> 9	0	<10
Escherichia coli (cfu /100 ml)	80	-	11	-	0	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	340	-	130	-	0	<100
Temperature ( °C )	12.6	-	10.8	-	10.8	-
Salinity ( PSU)	32.9	-	33.0	-	32.8	-
POC ( mg/l )	9.6	-	8.6	-	9.8	-
TSS [ mg/l ]	24.2	-	21.4	-	22.4	-

**Test 4**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm ( /m3 )	28059	> 90	5658	> 9	Max. 7.0 Av. 6.2	<10
10-50 µm ( /ml )	1240	> 90	1364	> 9	0	<10
Escherichia coli (cfu /100 ml)	240	-	60	-	Max. 20 Av. 13.3	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	160	-	90	-	Max. 50 Av. 30	<100
Temperature ( °C )	15.3	-	12.9	-	12.7	-
Salinity ( PSU)	0.8	-	1.0	-	2.2	-
POC ( mg/l )	9.0	-	8.9	-	5.5	-
TSS [ mg/l ]	21.3	-	12.3	-	8.5	-

Official Stamp



*M. Ansumana*

**Margaret Ansumana**

Deputy Commissioner of Maritime Affairs  
Republic of Liberia

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