



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..... Ecochlor Inc, 14 Nason Street, Suite 309, Maynard, MA 01754, USA

under type and model designation..... Ecochlor® Ballast Water Treatment System, Series 100
and incorporating:

Ballast water management system manufactured by..... Ecochlor Inc.

to equipment/assembly drawing No..... ES04100H02 date..... 06 January 2011

Disinfection Unit manufactured by..... Ecochlor Inc.

to components drawing No..... ES04100H03 date..... 14 April 2011

Filter Unit manufactured by..... Ecochlor Inc.

To components drawing No...BS400H-16-12F / BS400V-14-12 date..... 06.2010 / 08.2010

Treatment rated capacity..... up to 1300 m³/h

Active Substance..... Chlorine Dioxide (ClO₂)

A copy of this Type Approval Certificate should be carried on board a vessel 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 of the Federal Republic of Germany with Type Approval Certificate No.....

BSH/18228/Ecochlor Series100-I/S41 2011.

Limiting Conditions imposed are described in the appendix to this document.

Official Stamp

Margaret Ansumana
Deputy Commissioner of Maritime Affairs
Republic of Liberia
Date of issue: 26th June, 2012 Place of issue: Vienna, USA
Date of Expiry: 25th June 2017

Enc. This certificate consists of 6 pages, including the appendix and summary of the original test results

APPENDIX I

Ballast Water Temperature Range..... 0°C – 50°C

Maximum dosage of the active substance Chlorine Dioxide **per liter** of ballast water.....5 mg

Minimum holding time..... 48 hours

Maximum Allowable Discharge Concentration (MADC) of Chlorine Dioxide..... <= 0.2 mg/L

Prior to discharge, the Chlorine Dioxide concentration is to be determined in accordance with the Lissamine Green Method B (LGB) [for details see manufacturer's manual]. Should the chlorine dioxide concentration exceed 0.2 mg/L, the treated ballast water must not be discharged.

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..Ecochlor® Ballast Water Treatment System, Series 100

Manufactured by..... Ecochlor Inc, 14 Nason Street, Suite 309, Maynard, MA 01754, USA

Organization conducting the test..... NIOZ; Royal Netherlands Institute for Sea Research, Texel, The Netherlands

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, six 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.

The water temperature ranged between 16.7°C and 18.8° C (low salinity) and between 14.3°C and 17.5°C (high salinity) over the period of land based tests. The physicochemical parameters for the water to be treated were adhered to as stipulated in G8.

High salinity test results (31.9 PSU):

before treatment at intake at discharge after treatment

| | Average | Min | Max | Average | Min | Max |
|---|----------|----------|----------|----------|----------|----------|
| Total bacteria (counts/mL) | 3.79E+06 | 1.25E+06 | 5.42E+06 | 4.90E+06 | 4.80E+05 | 8.24E+06 |
| Escherichia coli (cfu/100mL) | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Enterococci (cfu/100mL) | 5.0 | < 1 | 17 | < 1 | < 1 | < 1 |
| Organisms < 10um (viable cells/mL) | 2264 | 1004 | 4556 | < 0.1 | < 0.1 | < 0.1 |
| Organisms > = 10 < 50um (viable cells/mL) | 1628 | 730 | 3207 | < 0.1 | < 0.1 | < 0.1 |
| Organisms > = 50 um(viable organisms/m3) | 1.78E+05 | 5.15E+04 | 4.11E+05 | 0.9 | 0 | 3.7 |

Reference at discharge

| | Average | Min | Max |
|---|----------|----------|----------|
| Total bacteria (counts/mL) | 2.15E+06 | 3.30E+05 | 5.37E+06 |
| Escherichia coli (cfu/100mL) | < 0.1 | < 0.1 | < 0.1 |
| Enterococci (cfu/100mL) | < 1 | < 1 | 1 |
| Organisms < 10um (viable cells/mL) | 290 | 173 | 632 |
| Organisms > =10 < 50 um (viable cells/mL) | 140 | 121 | 151 |
| Organisms > = 50 um(viable organisms/m3) | 1.54E+04 | 0.25E+04 | 2.76E+04 |

Low salinity test results (23.1 PSU):

before treatment at intake at discharge after treatment

| | Average | Min | Max | Average | Min | Max |
|---|----------|----------|----------|----------|----------|----------|
| Total bacteria (counts/mL) | 6.47E+06 | 3.66E+06 | 9.02E+06 | 4.74E+06 | 2.54E+05 | 7.86E+06 |
| Escherichia coli (cfu/100mL) | 0.5 | < 0.1 | 1.4 | < 0.1 | < 0.1 | < 0.1 |
| Enterococci (cfu/100mL) | 9.3 | < 1 | 27 | < 1 | < 1 | < 1 |
| Organisms < 10um (viable cells/mL) | 8945 | 3278 | 15096 | < 0.1 | < 0.1 | < 0.1 |
| Organisms > = 10 < 50um (viable cells/mL) | 1326 | 719 | 1746 | < 0.1 | < 0.1 | < 0.1 |
| Organisms > = 50 um(viable organisms/m3) | 1.76E+05 | 3.57E+04 | 3.61E+05 | 0 | 0 | 0 |

reference at discharge

| | Average | Min | Max |
|---|----------|----------|----------|
| Heterotrophic bacteria (cfu/mL) | 2.18E+06 | 4.10E+05 | 4.25E+06 |
| Escherichia coli (cfu/100mL) | 1.89E+06 | 8.67E+05 | 2.90E+06 |
| Enterococci (cfu/100mL) | < 0.1 | < 0.1 | < 0.1 |
| Organisms < 10um (viable cells/mL) | < 1 | < 1 | 1 |
| Organisms > =10 < 50 um (viable cells/mL) | 712 | 393 | 1195 |
| Organisms > = 50 um(viable organisms/m3) | 157 | 130 | 175 |

Reference Methods:

| Parameters | Reference Method |
|--|--|
| Total bacteria (counts/mL) | Measurement by flow cytometry after dyeing the DNA (see Veldhuis & Kraay 2000) |
| Escherichia coli (cfu/100mL) | NEN-EN-ISO 9308-1 |
| Enterococci (cfu/100 mL) | NEN-EN ISO 7899-2 |
| Organisms < 10um (viable cells/mL) | Casotti, R., S. Mazza, C. Brunet, V. Vantrepotte, A. Ianora & A. Miralto (2005) Growth inhibition and toxicity of the diaform aldehyde 2-trans, 4-trans-decadienal on <i>Thalassiosira weissflogii</i> (baciillariophyceae). <i>J. Phycol.</i> 41:7-20 |
| Organisms >=10 < 50 um (viable cells/mL) | Veldhuis MJW, Kraay GW, Timmermans KR (2001) Cell death in phytoplankton: correlation between changes in membrane permeability, photosynthetic activity, pigmentation and growth. <i>Eur. J. Phycol.</i> 36:167-177 |
| Organisms >= 50 um (viable organisms/m3) | Veldhuis, M.J.W., F. Fuhr, J.P. Boon, C.T. Hallers-Tjabbers. 2006. Treatment of ballast water: how to test a system with a modular concept? <i>Environ. Technol.</i> , 27: 909-921 |

Physicochemical parameters: before treatment at intake at discharge after treatment

| | Average | Min | Max | Average | Min | Max |
|--|---------|------|-------|---------|------|------|
| Salinity (PSU) | 17.7 | 13.8 | 25 | 19.7 | 14.7 | 24.8 |
| Total suspended solids-TSS (mg/L) | 115.5 | 17.8 | 176.9 | 22.6 | 13.9 | 46.6 |
| Particulate organic carbon- POC (mg/L) | 19.8 | 3.7 | 32.4 | 6.7 | 3.6 | 9.2 |

reference at discharge

| | Average | Min | Max |
|--|---------|------|------|
| Salinity (PSU) | 18.3 | 14.6 | 25.3 |
| Total suspended solids-TSS (mg/L) | 28.4 | 7.8 | 9.6 |
| Particulate organic matter- POC (mg/L) | 8.5 | 7.8 | 9.6 |

During the shipboard tests the water temperature ranged between 11°C – 19°C

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 Deputy Commissioner of Maritime Affairs
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