



**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..... Alfa Laval Tumba AB, Hans Stahles vag7, Tumba, Sweden

under type and model designation..... PureBallast 3.0/3.0Ex, PureBallast 3.1/3.1Ex  
and incorporating:

Ballast water management system manufactured by..... Alfa Laval AB  
to equipment/assembly drawing No..... See Appendix I, Table 2

UV-Reactor manufactured by..... Wallenius Water AB  
to components drawing No..... See Appendix I, Table 3

Filtration system manufactured by..... Hydac  
To components drawing No..... See Appendix I, Table 4

Filtration system manufactured by..... Boll & Kirch  
To components drawing No..... See Appendix I, Table 5

Filtration system manufactured by..... Filtrex  
To components drawing No..... See Appendix I, Table 6

Treatment rated capacity..... See Appendix I, Table 1

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. TAP0000010.

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



*Margaret Ansumana*

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Deputy Commissioner of Maritime Affairs

Republic of Liberia

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Date of Expiry: 31 December 2019

Encl. This Certificate consists of 12 pages, including the appendix and summary of the original test results

## APPENDIX I

**Table 1**

Systems flow Designation	TRC [m <sup>3</sup> /h] <sup>1</sup>	UV – Reactor size <sup>2</sup>	Filter type Design pressure* Differential pressure for Backwash to be initiated**		
			Hydac 6 Bar* 0,85 Bar**	Boll & Kirch 6 or 10 Bar* 0,38 Bar**	Filtrex 6 or 10 Bar* 0,5 Bar**
87	17-87	1 x 170	-	-	ACB-906-100
135	17-135	1 x 170	-	-	ACB-910-150
170	17-170	1 x 170	-	-	ACB-915-150
250	30- 250	1 x 300	RF 10-20	-	ACB-935-200
300	30- 300	1 x 300	RF 10-25	6.18.3 419	ACB-945-200
500	60-500	1 x 600 or 2x300	RF 10-25	-	ACB-955-250
600	60-600	1 x 600 or 2x300	RF 10-30	6.18.3 600	ACB-985-300
750	100-750	1 x 1000	RF 10-30	-	ACB-985-300
1000	100-000	1 x 1000	RF 10-35	6.18.3 750	ACB-999-350
1200	120-1200	2 x 600	RF 10-40	6.18.3 750	2x ACB-985-300 <sup>3</sup>
1500	200-1500	2 x 1000	RF 10-40	-	2x ACB-985-300 <sup>3</sup>
1750	200-1750	2 x 1000	-	6.18.3 900	-
2000	200-2000	2 x 1000	RF 10-50	6.18.3 1000	2 x ACB-999-350 <sup>3</sup>
3000	200-3000	3 x 1000	RF 10-60	6.18.3 1100	3 x-ACB-999-350 <sup>3</sup>

1) TRC is defined as net flow out of the treatment system, a net flow exceeding the given value implies that the ballast water is not treated in accordance with this certificate.

2) During ballast water discharge, the size and number of UV reactors limits the systems TRC.

3) Parallel installation of the Filtrex filter must follow specifications given in AW15-027 Flow distribution calculation parallel filters.

**Table 2 System layout**

Description	Dwg Nr.	Rev.	Dated	Ex version		
				Dwg Nr.	Rev.	Dated
Generic flow chart	9011279	0	2013-12-19	9011280	0	2013-12-19
Flow chart for UV-Reactor size 170	9015279	2	2015-06-10	-	-	-

**Table 3 UV Reactors**

Type (size)	Dwg Nr.	Rev.	Dated	Ex version		
				Dwg Nr.	Rev.	Dated
AOT reactor dim drw. (170 m <sup>3</sup> /h)	9015167	0	2014-09-08	-	-	-
AOT reactor dim drw. (300 m <sup>3</sup> /h)	9003515	4	2014-12-04	9017160	2	2014-07-08
AOT reactor dim drw. (600 m <sup>3</sup> /h)	9010717	2	2013-12-19	9011007	1	2014-07-08
AOT reactor dim drw. (1000) m <sup>3</sup> /h)	9003516	4	2015-06-10	9017161	2	2014-07-08

**Table 4 Hydac filters**

Type (size)	Dwg Nr.	Rev.	Dated	Ex version		
				Dwg Nr.	Rev.	Dated
RF10-20 (flow 250 m <sup>3</sup> /h)	9015050	0	2014-08-27	9015070	1	2014-08-27
RF10-25 (flow 300, 500 m <sup>3</sup> /h)	9015051	0	2014-08-27	9015071	1	2014-08-27
RF10-30 (flow 600, 750 m <sup>3</sup> /h)	9015052	0	2014-08-27	9015072	1	2014-08-27
RF10-35 (max flow 1000 m <sup>3</sup> /h)	9015053	1	2014-08-27	9015073	1	2014-08-27
RF10-40 (max flow 1500 m <sup>3</sup> /h)	9015054	1	2014-12-19	9015074	1	2014-09-03
RF10-50 (max flow 2000 m <sup>3</sup> /h)	9015055	1	2014-08-27	9015075	1	2014-09-03
RF10-60 (max flow 3000 m <sup>3</sup> /h)	9015056	0	2014-08-27	9015076	1	2014-09-03

**Table 5 Boll & Kirch filters****Ex version**

Type (size)	Dwg Nr.	Rev.	Dated	Dwg Nr.	Rev.	Dated
6.18.3.419 (flow 250, 300 m <sup>3</sup> /h)	9010360	0	2013-12-06	9010360	0	2013-12-06
6.18.3.600 (flow 500, 600 m <sup>3</sup> /h)	9010362	0	2013-12-06	9010362	0	2013-12-06
6.18.3.750 (flow 750, 10000 m <sup>3</sup> /h)	9010363	0	2013-12-06	9010363	0	2013-12-06
6.18.3.900 (flow 1500 m <sup>3</sup> /h)	9010364	0	2013-12-13	9010364	0	2013-12-13
6.18.3.1000 (flow 2000 m <sup>3</sup> /h)	9010365	0	2013-12-13	9010365	0	2013-12-06
6.18.3.1000 (flow 3000 m <sup>3</sup> /h)	9010366	0	2013-12-13	9010366	0	2013-12-06

**Table 6 Filtrex filters****Ex version**

Description	Dwg Nr.	Rev.	Dated	Dwg Nr.	Rev.	Dated
ACB-906-100 (flow 87 m <sup>3</sup> /h)	9011987	0	2014-10-24	-	-	-
ACB-910-150 (flow 135 m <sup>3</sup> /h)	9011988	0	2014-10-24	-	-	-
ACB-915-150 (flow 170 m <sup>3</sup> /h)	9011989	0	2014-10-24	-	-	-
ACB-935-200 (flow 250 m <sup>3</sup> /h)	9011981	0	2014-06-23	9011991	2	2015-04-28
ACB-945-200 (flow 300 m <sup>3</sup> /h)	9011982	0	2014-06-23	9011992	2	2015-04-28
ACB-955-250 (flow 500 m <sup>3</sup> /h)	9011983	2	2014-11-17	9011993	3	2015-04-28
ACB-985-300 (flow 600, 750 m <sup>3</sup> /h)	9011984	0	2014-06-23	9011994	2	2015-04-28
ACB-999-350 (flow 1000 m <sup>3</sup> /h)	9011985	0	2014-06-23	9011995	2	2015-04-28

## APPENDIX II

### Limiting Conditions for operation of the BWMS

Maximum treatment rated capacity (TRC) (per installed UV-Reactor).....	170, 300, 600 or 1000 m <sup>3</sup> /h
Measured Minimum UV Intensity (Hydac filter).....	312 W/ m <sup>2</sup> (170, 300, 600 m <sup>3</sup> /h); 380 W/m <sup>2</sup> (1000 m <sup>3</sup> /h)
(Corresponding to a minimum UV transmittance of 50%)	
Measured Minimum UV Intensity (Filtrex filter).....	210 W/ m <sup>2</sup> (170, 300, 600 m <sup>3</sup> /h); 252 W/m <sup>2</sup> (1000 m <sup>3</sup> /h)
(Corresponding to a minimum UV transmittance of 42%)	
Salinity range.....	Brackish and Marine Water (Boll&Kirch & Hydac filter)
.....	Fresh, Brackish and Marine (Filtrex Filter)
Temperature.....	minimum 0°C
Max system operating pressure.....	6 bar with Hydac Filter, 6 or 9 with Boll&Krich & Filtrex Filter
Minimum holding time.....	Not Applicable
Maximum holding time.....	Not Applicable (UV treatment upon discharge)
Maximum Allowable Discharge Concentration (MADC) of (OH) radical.....	Not limited
Total Residual Oxidant Level .....	Not Applicable
Approved for use in explosive atmosphere .....	Yes (if Conditions for use in explosive atmosphere are fulfilled)
Conditions for use in explosive atmosphere:	
1. Water temperature sensor installed and operated to shut down at 60°C;	
2. Intrinsically safe wiring provided;	
3. Electrical bonding must be provided;	
4. Pumps, UV vessel and all valves, sensors, switches, solenoids are designed for installation in hazardous location;	
5. Booster pump supplied with an explosion electric or hydraulic motor	
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 0.4 PSU (fresh water) to 36.0 PSU (high salinity)
Ballast water salinity range during ship board tests.....	Tested in water salinity ranging from 17.0 PSU (low salinity) to 36.0 PSU (high salinity)
During the shipboard tests the water temperature ranged between.....	4.8°C – 13.0°C
During the land based tests the water temperature ranged between.....	1.4°C – 18.0°C
Ballast water dissolved organic compounds (DOC).....	9.5 mg/L (low salinity) to 7.2 mg/L (high salinity)
Ballast water particulate organic compounds (POC).....	6.76 mg/L (low salinity) to 7.7 mg/L (high salinity)
Ballast water total suspended solids (TSS).....	57.2 mg/L (low salinity) to 49.0 mg/L (high salinity)
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 .....	42% (with Filtrex filter) or 50% (with Hydac or Boll&Kirch filter)
Minimum UV measured Intensity .....	(Hydac filter)....312 W/ m <sup>2</sup> (300, 600 m <sup>3</sup> /h); 380 W/m <sup>2</sup> (1000 m <sup>3</sup> /h)
	(Filtrex filter)....210 W/ m <sup>2</sup> (300, 600 m <sup>3</sup> /h); 252 W/m <sup>2</sup> (1000 m <sup>3</sup> /h)
Means to account for changes in UV-transmittance.....	UV intensity sensor mounted in AOT reactor
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).....	300 - 1000 m <sup>3</sup> /h
Flow rates during land-based testing averaged.....	300 m <sup>3</sup> /h
Flow rates during shipboard testing averaged.....	1,000 m <sup>3</sup> /h
(Maximum treatment rated capacity based upon mathematical modeling of AOT Reactor dose from 170 m <sup>3</sup> /h to 1000 m <sup>3</sup> /h)	

**Operating Parameters during ship-based testing**

Operating UV Intensity at ..... 497-2100 W/cm<sup>2</sup> (60% UVT – 97% UVT)  
Energy consumption at 1,000 m<sup>3</sup>/hour..... 96-55 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..... PureBallast 3.0/3.0Ex, PureBallast 3.1/3.1Ex

Manufactured by..... Alfa Laval Tumba AB, Hans Stahles VAG7, Tumba, Sweden

Organization conducting the test..... DHI Environmental Laboratory, Denmark

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, seven 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.

The water temperature averaged 12.0°C over the period of land based tests.

**High salinity test results (> 32 PSU):**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 um ( /m <sup>3</sup> )	Average 208,730 Min. 168,553	≥ 100 000	Average 36,142 Min. 13,283	> 100	Average 0.6 Max. 1.0	< 10
Phyla > 50 um	Average 6.0 Min. 5	≥ 3 different	Average 6.0 Min. 5	-		-
Species > 50 um	Average 17.0 Min. 12	≥ 5 different	Average 17.0 Min. 12	-		-
10-50 um ( /ml)	Average 6,078 Min. 3,133	> 1000	Average 978 Min. 317	> 100	Average 0.3 Min. 0.7	< 10
Phyla 10-50 um	Average 3.3 Min. 3	≥ 3 different	Average 3.3 Min. 3	-		
Species 10-50 um	Average 15.3 Min. 11	≥ 5 different	Average 15.3 Min. 11	-		
Hetero. Bact./ml	Average 365,483 Min. 115,400	≥10 000	Average 176,945 Min. 140,167	-	-	-
Escherichia Coli (cfu/100 ml)	Average <10	-	-	-	Average <10 Max. <10	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	< 1
Enterococcus group (cfu/100 ml)	Average 1,476	-	-	-	Average 3 Max. 15	< 100
Temperature ° C	Average 9.6	-	-	-	27.0	-
Salinity (PSU)	Average 34.0	>32	-	-	-	-
POC (mg/L)	Average 7.7 Min 6.3	> 1	-	-	-	-
DOC (mg/L)	Average 7.2 Min. 6.0	> 1	-	-	-	-
TSS (mg/L)	Average 49.0 Min. 42.0	> 1	-	-	-	-

**Low salinity test results (3-32 PSU):**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 um (/m <sup>3</sup> )	Average 406,874 Min. 243,672	≥ 100,000	Average 85,442 Min. 42,134	> 100	Average 3,7 Max 9.0	< 10
Phyla > 50 um	Average 6,25 Min. 5	≥ 3 different	Average 6,25 Min. 5	-	-	-
Species > 50 μm	Average 18 Min. 15	≥ 5 different	Average 18 Min. 15	-	-	-
10-50 μm (/ml)	Average 14,445 Min 6,667	> 1000	Average 1,524 Min. 1,373	> 100	Average 0.7 Max 3.0	< 10
Phyla 10-50 μm	Average 3,5 Min. 3	≥ 3 different	Average 3,5 Min. 3	-	-	-
Species 10-50 μm	Average 11.5 Min. 8	≥ 5 different	Average 11.5 Min. 8	-	-	-
Hetero. bact./ml	Average 92,453 Min. 52,350	≥10,000	Average 177,042 Min. 107,417	-	-	-
Escherichia Coli (cfu/100 ml)	Average 125	-	-	-	Average <10 Max. <10	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	< 1
Enterococcus group (cfu/100 ml)	Average 333	-	-	-	Average <1 Max. 1.3	< 100
Temperature °C	Average 9.1	-	-	-	-	-
Salinity (PSU)	Average 18.2 Min 17.0 Max. 19.0	3-32	-	-	-	-
POC (mg/L)	Average 7.1 Min. 6.7	> 5	-	-	-	-
DOC (mg/L)	Average 6.9 Min. 5.8	> 5	-	-	-	-
TSS (mg/L)	Average 58.5 Min. 49.0	> 50	-	-	-	-

**Fresh water test results (<3 PSU):**

Only valid for Filtrex ACB filter 20µm

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 µm ( /m <sup>3</sup> )	Average 310,827 Min. 279,837	≥ 100,000	Average 128,792 Min. 97,019	> 100	Average 1.1 Max 2.0	< 10
Phyla > 50 µm	Average 15 Min. 5	≥ 3 different	Average 15 Min. 5	-	-	-
Species > 50 µm	Average 13 Min. 11	≥ 5 different	Average 13 Min. 11	-	-	-
10-50 µm ( /ml)	Average 2,620 Min 1,1933	> 1000	Average 949 Min. 440	> 100	Average 0.5 Max 1.4	< 10
Phyla 10-50 µm	Average 5.8 Min. 5	≥ 3 different	Average 5.8 Min. 5	-	-	-
Species 10-50 µm	Average 35.4 Min. 33	≥ 5 different	Average 35.4 Min. 33	-	-	-
Hetero. bact./ml	Average 26,037 Min. 10,383	≥10,000	Average 46,939 Min. 9,930	-	-	-
Escherichia Coli (cfu/100 ml)	Average 35	-	-	-	Average <1 Max. <1	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	Average Absent Max. Absent	< 1
Enterococcus group (cfu/100 ml)	Average 10	-	-	-	Average <1 Max. 1	< 100
Temperature ° C	Average 9.1	-	-	-	-	-
Salinity (PSU)	Average 0.4 Min 0.4 Max. 0.4	< 3	-	-	-	-
POC (mg/L)	Average 6.76 Min. 6	> 5	-	-	-	-
DOC (mg/L)	Average 9.5 Min. 8	> 5	-	-	-	-
TSS (mg/L)	Average 57.2 Min. 54.0	> 50	-	-	-	-



**Reference Methods:**

Parameters	Reference Method
Heterotrophic Bacteria (counts/mL)	According to DHI SOP 30/1706 (ISO 6222)
Escherichia coli (cfu/100mL)	According to DHI SOP 30/1708 IDEXX Coliert kit
Enterococci (cfu/100 mL)	According to DHI SOP 30/1708 IDEXX Enterolert kit
Vibrio cholerae (cfu /100 ml)	According to DHI SOP 30/1707 (ISO 21872)
Organisms $\geq 10 < 50 \mu\text{m}$ (viable cells/mL)	<p><b>Inverted microscopy (DHI SOP 30/1701).</b> The concentrations of organisms and the presence of taxonomic groups in the inlet water are determined by inverted microscopy. Inverted microscopy is also be used to determine the taxonomic groups of algae that are able to grow under the conditions applied in the algal regrowth assay.</p> <p><b>Vital staining with FDA and CMFDA (DHI SOP 30/1701).</b> FDA and CMFDA are added to a subsample and, after incubation, the subsample is examined by use of a microscope under epifluorescence. Organisms labelled by either FDA or CMFDA are considered viable as described in DHI SOP 30/1701. Only FDA/CMFDA labelled moving organisms are included in the verification of compliance with the pass criterion.</p> <p><b>Algal re-growth assay (DHI SOP 30/1704).</b> Viable algae are quantified by measuring re-growth in a most probable number (MPN) assay. A dilution series is prepared by adding aliquots of subsample to test tubes with liquid medium. The test tubes are incubated for 14 days at ambient temperature. The concentrations of viable algae in the inlet water, control discharge water and treated discharge water are determined by measuring of the fluorescence in the test tubes before and after incubation according to DHI SOP 30/1704. The algal regrowth assay is considered to provide the most reliable results to be used for a performance evaluation of BWMS applying UV treatment as the method is directly linked to algal growth and, thus, indicative of the ability of the organisms to establish and reproduce in the environment. The algal regrowth assay includes planktonic algae without reference to size, and, thus, it is not limited to the <math>\geq 10 \mu\text{m}</math> and <math>&lt; 50 \mu\text{m}</math> size class.</p> <p><b>Algal primary production (DHI SOP 30/1702).</b> The algal primary production is determined by measuring the <math>^{14}\text{C}</math> fixed by photosynthesis. For each field replicate, <math>\text{NaH}^{14}\text{CO}_3</math> (2 <math>\mu\text{Ci}</math>) is added to two subsamples. These subsamples are incubated for approx. 75 min under light from a light panel at ambient temperature. After incubation, the samples are filtered onto Whatman GF/D filters. The filters are transferred to glass vials, and acid is added directly to the filters to release <math>^{14}\text{CO}_2</math>. The <math>^{14}\text{C}</math> activity remaining in the algae on the filters after acidification is quantified by liquid scintillation counting according to DHI SOP 30/1702. The algal primary production assay includes planktonic algae without reference to size, and, thus, it is not limited to the <math>\geq 10 \mu\text{m}</math> and <math>&lt; 50 \mu\text{m}</math> size class.</p>
Organisms $\geq 50 \mu\text{m}$ (viable organisms/m <sup>3</sup> )	The concentration of live organisms $\geq 50 \mu\text{m}$ in minimum dimension is determined by use of a stereo microscope and a counting chamber according to DHI SOP 30/1700. Viable organisms are enumerated by use of standard movement and response stimuli technique. The viable organisms are characterized according to broad taxonomic groups such as crustaceans (e.g. copeopods), molluscs, rotifers, worms, etc.

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

Organization conducting the test..... DHI Environmental Laboratory, Denmark  
 Tests were conducted on board the vessel..... "M/V TURANDOT", IMO Nr. 9070450  
 Time of testing..... December' 2012– October' 2014

Maritime Area of testing..... Bremerhaven, Gothenburg, North Sea & Ulsan, South Korea

**Test 1**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm ( /m3 )	8,490	> 90	9,897	> 9	0	<10
10-50 µm ( /ml )	1,102	> 90	308	>9	2.8	<10
Escherichia coli (cfu /100 ml)	<10	-	<10	-	11	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	<10	-	<10	-	<10	<100
Temperature ( °C )	4.8	-	4.5	-	5.0	-
Salinity ( PSU)	35	-	34	-	35	-
POC ( mg/l )	<0.1	-	<0.1	-	<0.1	-
TSS [ mg/l ]	42.0	-	45.0	-	43.0	-

**Test 2**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm ( /m3 )	2,100	>90	1,125	>9	0	<10
10-50 µm ( /ml )	787	> 90	315	>9	0.8	<10
Escherichia coli (cfu /100 ml)	<10	-	<10	-	<10	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	<10	-	21	-	<10	<100
Temperature ( °C )	6.0	-	6.0	-	6.0	-
Salinity ( PSU)	36	-	35	-	36	-
POC ( mg/l )	0.5	-	<0.1	-	0.3	-
TSS [ mg/l ]	3.8	-	4.9	-	6.5	-

### Test 3

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 $\mu\text{m}$ ( /m3 )	23,603	>90	24,357	>9	1.9	<10
10-50 $\mu\text{m}$ ( /ml )	103	> 90	73	>9	0.7	<10
Escherichia coli (cfu /100 ml)	14	-	<10	-	<10	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	<10	-	17	-	<10	<100
Temperature ( °C )	5	-	5	-	5	-
Salinity ( PSU)	22	-	23	-	23	-
POC ( mg/l )	0.1	-	<0.1	-	<0.1	-
TSS [ mg/l ]	2.7	-	2.9	-	4.1	-


### Test 4

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 $\mu\text{m}$ ( /m3 )	10,665	>90	7,537	>9	7.0	<10
10-50 $\mu\text{m}$ ( /ml )	175	> 90	51	>9	6.4	<10
Escherichia coli (cfu /100 ml)	69	-	39	-	<10	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	32	-	21	-	<10	<100
Temperature ( °C )	13	-	14	-	14	-
Salinity ( PSU)	17	-	18	-	18	-
POC ( mg/l )	0.5	-	0.2	-	0.2	-
	36.0	-	18.0	-	21.0	-

**Test 5**

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm ( /m3 )	20,272	>90	-	>9	4.6	<10
10-50 µm ( /ml )	128	> 90	-	>9	0.2	<10
Escherichia coli (cfu /100 ml)	<10	-	-	-	<10	<250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	<1
Enterococcus group (cfu /100 ml)	<10	-	-	-	<10	<100
Temperature ( °C )	22	-	-	-	23	-
Salinity ( PSU)	34	-	-	-	34	-
POC ( mg/l )	0.3	-	-	-	0.3	-
TSS ( mg/l )	30.0	-	-	-	108	-

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