Ballast Water Management Systems for Tankers

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Overview

- Ballast Water Management System (BWMS) Approvals
- Statistics on BWMS
- Processes used for Ballast Water Treatment
- Important Issues for Tankers
- Comparison of BWMS
- Options for Tankers
- Limitations of Systems

BWMS Approvals

BWMS	No. of Systems
Available or In-Development	70+
MEPC.174(58) Type Approval Certificate	~36*
Type Approved BWMS – Explosion Proof	3
IMO Final Approval	9
IMO Basic Approval	16
USCG Type Approval	0
USCG Alternate Management System (AMS)	10 BWMS by 9 manufacturers

* The number reflects verified approvals for a BWMS manufacturer – not the number of specific models approved and excludes 1 system removed from the market

USCG Accepted AMS

BWMS	Model
BalClor™ **Manufactured by SunRui Marine Environment Engineering Company**	BC-300, -500, -1000, -1500, -2000, -2500, -3000, -3500, -4000, -5000, -6000, and -7000
BALPURE® **Manufactured by Severn Trent De Nora, LLC**	Models BP-500, -675, -1000, -2000, -2650, -3000, -4000, and -5000
CleanBallast® **Manufactured by RWO GmbH – Marine Water Technology, Veolia Water Solutions & Technologies**	CleanBallast®-150, -200, -250, -300, -350, -400, -450, -500, -500-1, -750, -1000, -1250, -1500, -1750, -2000, -2250, -2500, -2750, -3000, -3250, -3500, and -3750
Ecochlor® **Manufactured by Ecochlor,Inc.**	Series 75, 100, 150, 200, 250, and 300
GloEn-Patrol™ **Manufactured by PANASIA Co., Ltd.**	P-50, -150, -250, -300, -350, -500, -700, -750, -800, -900, -1000, -1200, -1500, -2000, -2500, -3000,
Hyde GUARDIAN™ **Manufactured by Hyde Marine Inc.**	HG-60, -100, -150, -200,-250, -300, -400, -450, -500, -600, -700, -800, -900, -1000, -1250, -1350, -1400, -1488, -1600, -2000, -2500, -2975, -4000, -5000, and -6000
NK-O3 BlueBallast® **Manufactured by NK Company, Ltd.**	NK-O3-010, -015, -030, -040, -050, -075, -100, -150, -200, -250, -300, and -400
OceanGuard™ **Manufactured by Qingdao Headway Technology Co., Ltd.**	OceanGuard™
PureBallast **Manufactured by Alfa Laval Tumba AB**	Models 250 to 2500 and Models 2.0 and 2.0Ex

BWMS Statistics

Category	All Type Approved BWMS	USCG AMS
No. of BWMS Requiring Treatment during Intake & De-Ballasting	32	8
No. of BWMS using Active Substances	22	8
No. of BWMS Requiring Storage of Chemicals	16	4
No. of BWMS Requiring Storage of Waste Products	1	0
Minimum Capacity (m^3/hr)	0	30
Maximum Capacity (m^3/hr)*	16,200	16,200

*Maximum capacity only includes specific models listed in documentation.

Processes Used for Treatment

- Separation Technology
  - Natural physical differences in organisms
  - Chemically “induced” differences (i.e., coagulation, flocculation)
- Disinfection Technology
  - Killing organisms; or
  - Altering organisms such that they cannot reproduce or are no longer viable

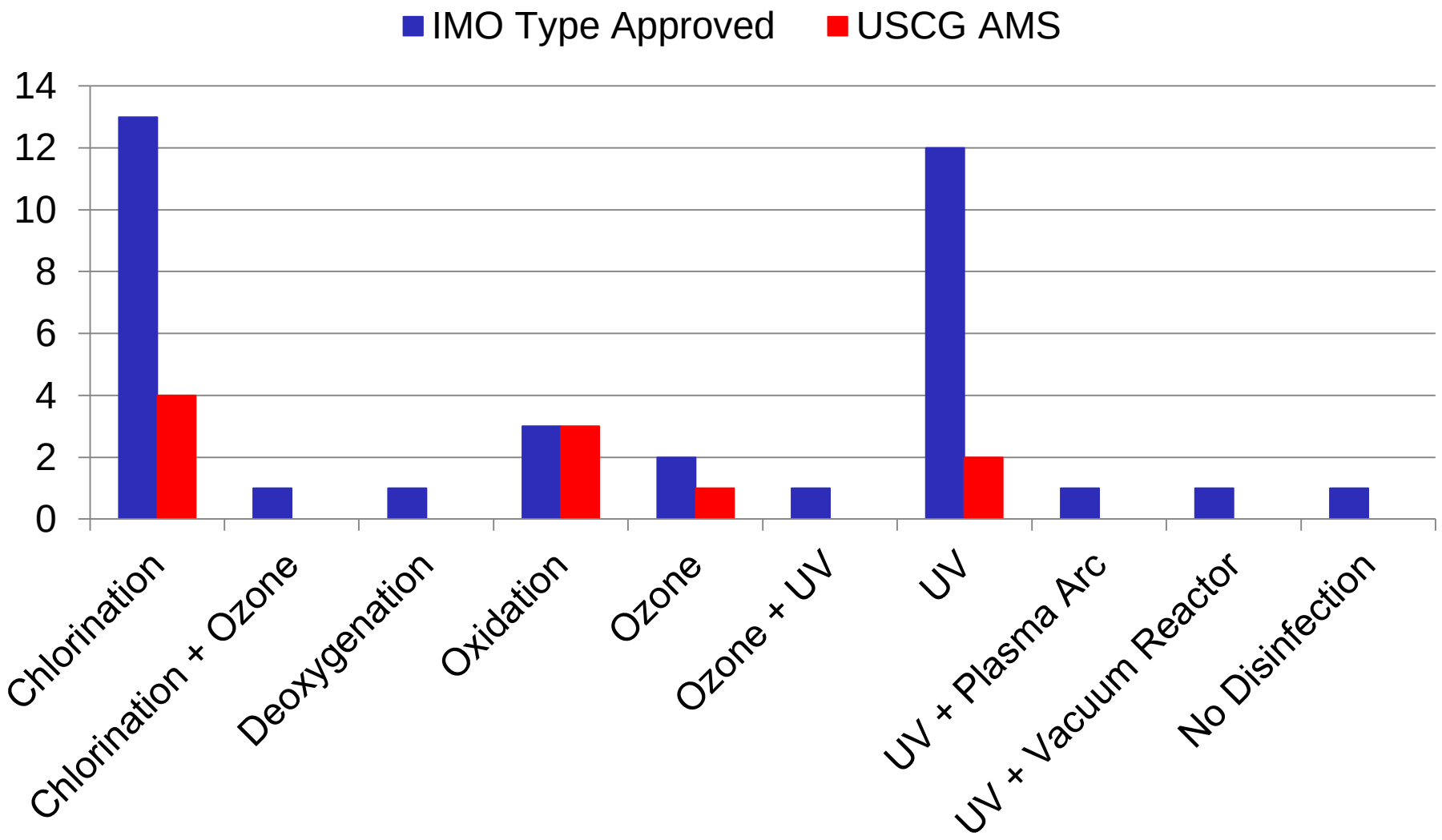
BWMS: Without Filtration

- Four IMO Type Approved Systems do not use any type of separation technology
- Treatment technologies included:
  - Electrolytic Chlorination
  - Ozone
  - Deoxygenation
  - Vacuum Reactor + UV

Filtration: Items to be Investigated

- Clogging
- Reliability of the mechanical components
- Restriction for piping system
- Reliability for corrosion
- Measure for water-hammer
- Damage by physical substances in the piping
- Spare parts for moving components
- Required backpressure for backflow washing

Disinfection Technologies on BWMS



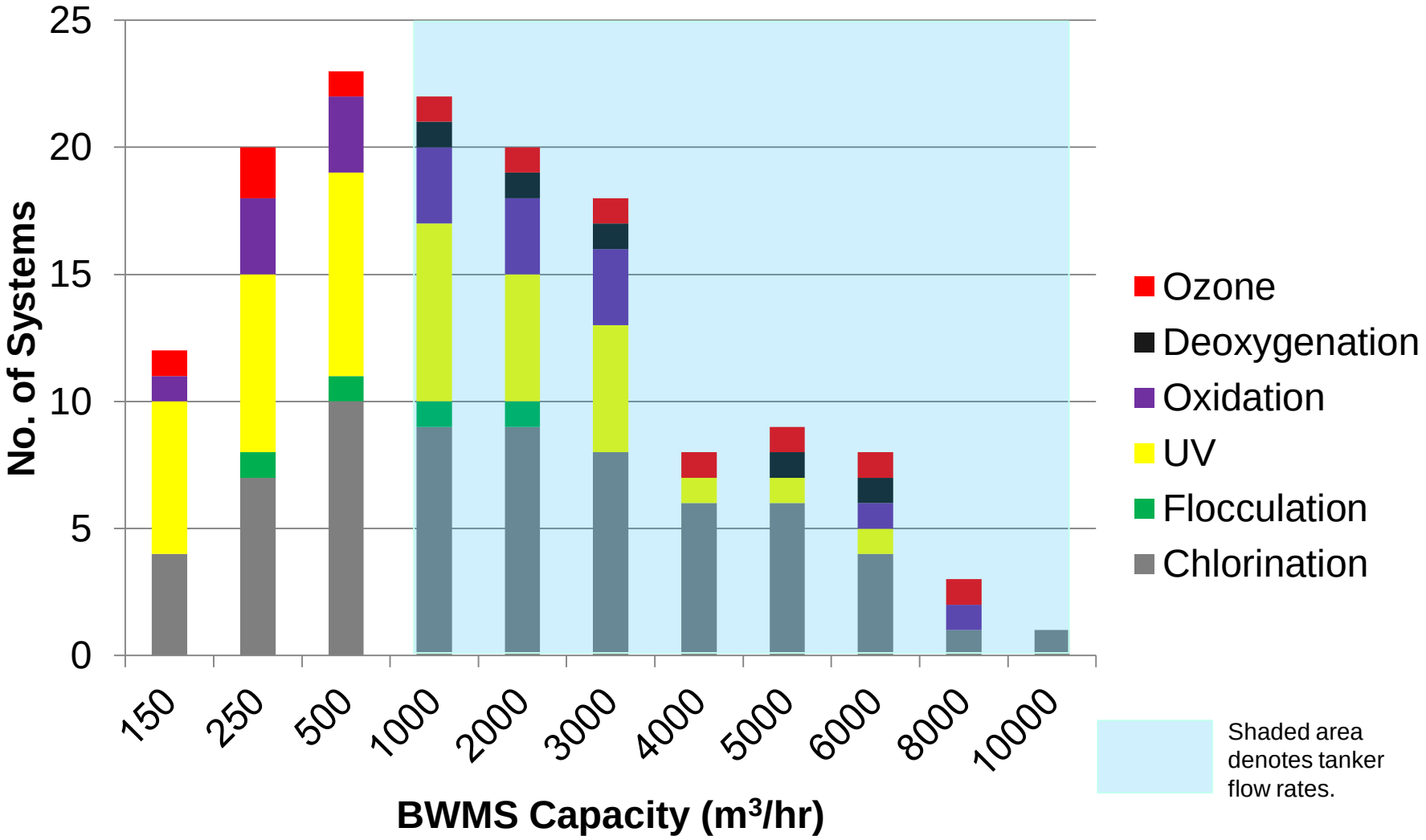
Disinfection Technologies

Type	Issues to be Investigated
Electrolysis/ Electrochlorination	• Exhaust of hydrogen/chlorine gas generated by electrolysis • Maintenance and replacement of electrodes • Salinity levels in ballast water for proper BWMS operation • Corrosion of ballast water tank and ballast pumping • Neutralizing when deballasting
Chemical Application	• Chemicals – supplies, storage (i.e., tanks, ventilation, temperature) • Means for transfer of chemicals • Leakage detection and containment • Corrosion of ballast water tank and ballast pumping • Neutralizing when deballasting
UV	• Gravity deballasting is not applicable. • Maintenance and replacement of UV lamps • Possible damage by “water hammer”
Deoxygenation	• Restrictions due to inerting of ballast water tank and ballast water piping • Extended treatment times
Ozone	• Detection of ozone leaks • Corrosion of ballast water tank and ballast piping • Neutralizing when deballasting

Important Issues for Selecting a BWMS on Tankers

- Ballast Water Pumping Rate
- Cost of BWMS
  - Capital Cost and Operating and Maintenance Costs
- Installation Locations
  - Hazardous or Non-Hazardous Issues

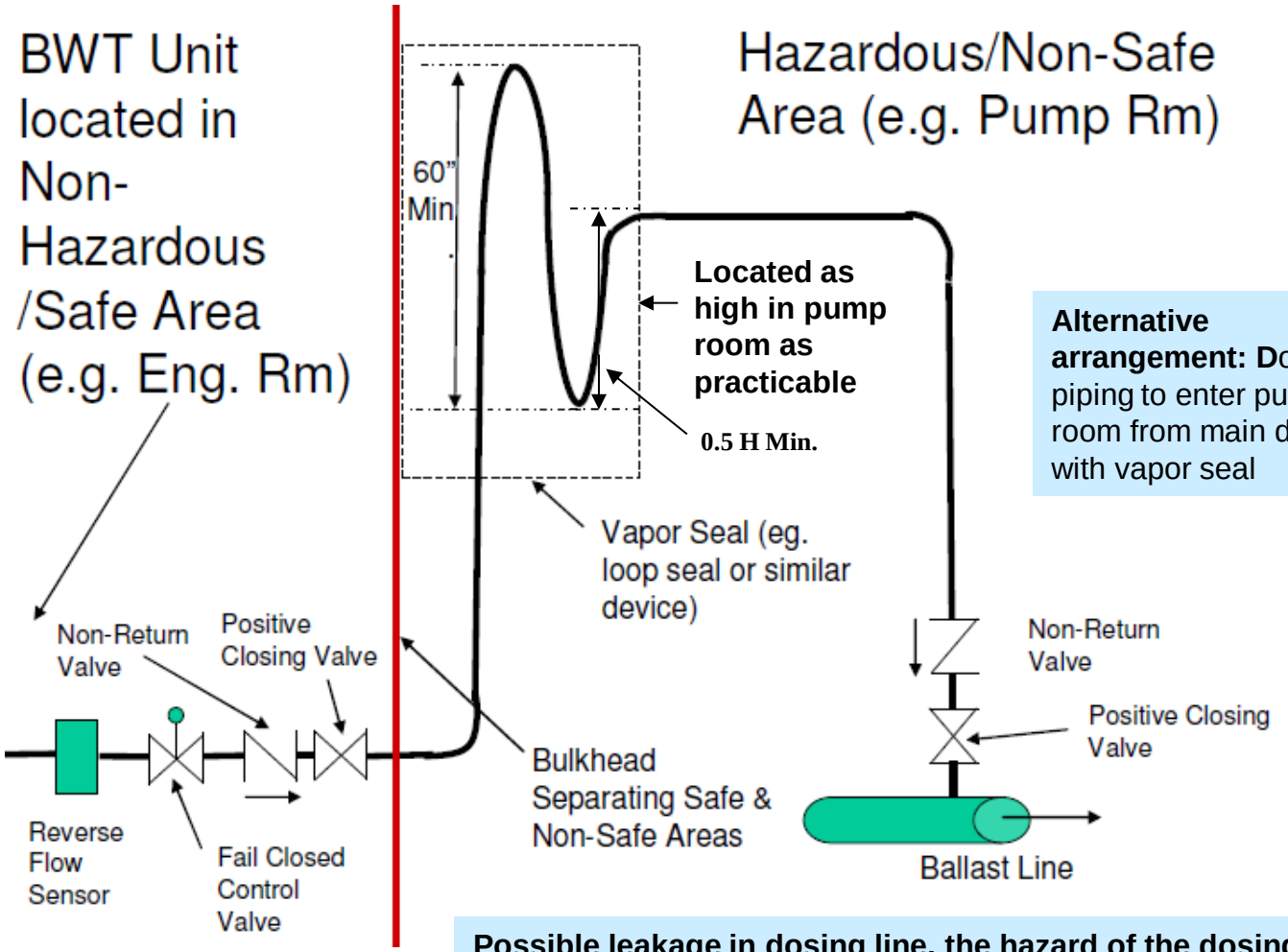
IMO Type Approved BWMS Model Capacities



Options for Installations in Hazardous Areas

- Alternative Arrangements
- Explosion Proof Systems

Arrangements for Chemical Dosing Systems



With alarm and shut down arrangement

Alternative arrangement: Dosing piping to enter pump room from main deck with vapor seal

Possible leakage in dosing line, the hazard of the dosing agent, and appropriate mitigating measures should be addressed.

Explosion Proof Type Approved BWMS

- Explosion-Proof version tested for Type Approval
  - Components have been specifically engineered to meet the requirements of explosion proof equipment.
- BWMS with Explosion Proof Type Approval:
  - AquaStar™ Manufactured by AQUA Eng. Co., Ltd.
    - INTAKE - FILTRATION, ELECTROLYTIC DISINFECTION;
    - DE-BALLASTING – NEUTRALIZATION
  - Electro-Cleen™ Manufactured by Techcross Inc.
    - INTAKE – ELECTROLYTIC DISINFECTION;
    - DE-BALLASTING – NEUTRALIZATION with SODIUM THIOSULFATE
  - PureBallast 2.0 EX – Manufactured by Alfa Laval Tumba AB
    - INTAKE - FILTRATION AND ADVANCED OXIDATION TECHNOLOGY (AOT) (Ultraviolet Treatment in combination with TiO_2 catalyst);
    - DEBALLASTING – AOT

BWMS Installed on Tankers

BWMS	Treatment	Unit Flow Rates
AquaStar™	INTAKE - FILTRATION, ELECTROLYTIC DISINFECTION; DE-BALLASTING – NEUTRALIZATION	200 – 5,000 m^3/h
BALPURE®	INTAKE - FILTRATION, ELECTROLYTIC DISINFECTION, CYCLONE-TYPE DEGAS SEPARATOR; DE-BALLASTING – NEUTRALIZATION with SODIUM BISULFITE	500 – 5,000 m^3/h
CleanBallast®	INTAKE - FILTRATION; EctoSys® ELECTROLYSIS DISINFECTION; DE-BALLASTING - EctoSys® ELECTROLYSIS DISINFECTION, OPTIONAL NEUTRALIZATION with SODIUM THIOSULFATE	150 – 3,750 m^3/h
Electro-Cleen™	INTAKE – ELECTROLYTIC DISINFECTION; DE-BALLASTING – NEUTRALIZATION with SODIUM THIOSULFATE	150 – 8,000 m^3/h
OceanSaver® Ballast Water Treatment System	INTAKE - FILTRATION AND ELECTROLYTIC DISINFECTION WITH OPTIONAL NITROGEN SATURATION (I.E., DEOXYGENATION); DE-BALLASTING - NEUTRALIZATION WITH SODIUM THIOSULFATE	250 – 1,000 m^3/h
Purimar™	INTAKE - FILTRATION, ELECTROLYTIC DISINFECTION; DEBALLASTING – NEUTRALIZATION with SODIUM THIOSULFATE	200 – 6,500 m^3/h

BWMS Installed on Tankers

BWMS	Treatment	Unit Flow Rates
Hyde GUARDIAN™	IN-TAKE - FILTRATION AND UV DISINFECTION; DE-BALLASTING – UV DISINFECTION	60 – 6,000 m^3/h
KBAL Ballast Water Management System	INTAKE - PRESSURE VACUUM REACTOR, UV DISINFECTION; DE-BALLASTING - PRESSURE VACUUM REACTOR, UV DISINFECTION	50 – 3,000 m^3/h
N.E.I. VOS™	INTAKE - VOS STRIPPING GAS GENERATOR (SGG) PROVIDES LOW OXYGEN INERT GAS, VENTURI INJECTORS (INERT GAS MIXED WITH BALLAST WATER), CAVITATION; DE-BALLASTING - OXYGENATION OF BALLAST THRU VENTURI INJECTORS, TANKS FILLED WITH INERT GAS	100 – 6,500 m^3/h
NK-O3 BlueBallast® System	INTAKE - OZONE INJECTION; DE-BALLASTING - NEUTRALIZATION WITH SODIUM THIOSULFATE	250 – 8,000 m^3/h
OceanGuard™	INTAKE - FILTRATION, ADVANCED ELECTROCATALYSIS ENHANCED OXIDATION WITH ULTRASONIC TECHNOLOGY	30 – 10,000 m^3/h
PureBallast	INTAKE - FILTRATION AND ADVANCED OXIDATION TECHNOLOGY (AOT) (Ultraviolet Treatment in combination with TiO_2 catalyst); DEBALLASTING – AOT	250 – 3,000 m^3/h

Technical Specifications of BWMS

BWMS	Unit Flow Rates	Footprint (m^2)	Power (kW)	Weight (kg)
AquaStar™	200 – 5,000 m^3/h	1.9 – 5.3	28 – 400	1760 – 13600
BALPURE®	500 – 5,000 m^3/h	7.2 – 18.4	20 - 157	No Values
CleanBallast®	150 – 3,750 m^3/h	5.5 – 51.6	No Value Reported	1605 – 11300
Electro-Cleen™	150 – 8,000 m^3/h	6.53 – 25.2	7.1 – 542	1013 – 9669
Hyde GUARDIAN™	60 – 6,000 m^3/h	2.1 – 16.3	10 – 114	441 – 5700
N.E.I. VOS™	100 – 6,500 m^3/h	3 – 14.2	29 – 226	1915 - 7827
KBAL Ballast Water Management System	50 – 3,000 m^3/h	No Value Reported	No Value Reported	No Value Reported
NK-O3 BlueBallast® System	250 – 8,000 m^3/h	4.2 – 36.8	36.2 – 613.8	2636 - 26,461
OceanGuard™	30 – 10,000 m^3/h	0.14 – 2.6	2 – 150	No Value Reported
OceanSaver® Ballast Water Treatment System	250 – 1,000 m^3/h	No Value Reported	No Value Reported	No Value Reported
PureBallast	250 – 3,000 m^3/h	2.4 – 4.1	No Value Reported	1296 – 2936
Purimar™	200 – 6,500 m^3/h	6 – 30.2	26 - 224	No Value Reported

BWMS with Positive Side Effects

- Minimize Power Requirements
  - Power requirements depend on water quality
    - Electrolytic Chlorination systems require less power in high salinity water than low salinity water
    - UV system require less power in waters with low turbidity
- Corrosion
  - One system creates an inert atmosphere in the ballast tank to decrease corrosion in tanks but this system requires 96 hour ballast water holding time for compliance with the D-2 standard
  - Chlorination and Oxidation systems may increase corrosion

Limitations: Final Approval & Type Approval

- Specific limitations listed in IMO Final Approval and Type Approval Certificates
  - Salinity
  - Temperature
  - UV intensity
  - Dosage
  - Holding time
- Need consistency in level of detail in Type Approval certificates


Certificate Number: 11-BK774755/1-PDA
07/MAR/2013

Confirmation of Product Type Approval

Please refer to the "Service Restrictions" shown below to determine if Unit Certification is required for this product.
This certificate reflects the information on the product in the ABS Records as of the date and time the certificate is printed.

Pursuant to the Rules of the American Bureau of Shipping (ABS), the manufacturer of the below listed product held a valid Manufacturing Assessment (MA) with expiration date of 14/JUL/2016. The continued validity of the Manufacturing Assessment is dependent on completion of satisfactory audits as required by the ABS Rules.
And; a Product Design Assessment (PDA) valid until 29/JUL/2017 subject to continued compliance with the Rules or standards used in the evaluation of the product.

The above entitle the product to be called Product Type Approved.

The Product Design Assessment is valid for products intended for use on ABS classed vessels, MODUs or facilities which are in existence or under contract for construction on the date of the ABS Rules used to evaluate the Product.

ABS makes no representations regarding Type Approval of the Product for use on vessels, MODUs or facilities built after the date of the ABS Rules used for this evaluation.

Due to wide variety of specifications used in the products ABS has evaluated for Type Approval, it is part of our contract that; whether the standard is an ABS Rule or a non-ABS Rule, the Client has full responsibility for continued compliance with the standard.

Model Name(s): ECS-300A / Ex-ECS-300A / ECS-600A / Ex-EC

Product Name: Ballast Water Treatment

Presented to:
TECHCROSS
25-1, GWANAM-RI
INJOO-MYEON
ASAN
Korea, Republic of

Type Approval Limitations for BWMS with Chlorination

Treatment Concentration (mg/L)	Limitations	Notes
10 mg/L Total Residual Oxidants (TRO)	1 PSU, Less than 40 °C	Additional protection needed if installed on deck and exposed to heavy seas.
2.5 mg/L TRO	None	
20.0 mg/L TRO	None	Discharge TRO = 0.03 mg/L
10 mg/L TRO	3 PSU, Minimum Temperature 5 °C	
Intake - 2.5 mg/L TRO; Deballasting - 0.15 mg/L TRO	None	
2.0 mg/L TRO	None	
10 mg/L TRO	10 PSU	
15.0 mg/L TRO	15 - 35 °C	
3.0 mg/L TRO	None	
9.5 mg/L TRO; (TA states 7.4 mg/L TRO)	3 PSU or High Salinity Source Needed	Discharge Concentration = 0.1 mg/l
9 mg/L TRO	15 PSU	
5 mg/L $Cl0_2$	0 - 50 °C	Minimum Holding Time: 48 hours

Type Approval Limitations for BWMS with UV

Limitations
5 - 45 °C 45% (10 mm) minimum UV transmittance at 254 nm
0-50 °C UV-Intensity Minimum Level: 100 mJ/cm^2
Wavelength - 254 nm Minimum Radiation Dosage of: 83% for 250 m^3/h model, 85% for 50 m^3/h model, and 93% for 1500 m^3/h model.
Additional protection needed if installed on deck and exposed to heavy seas.
UV Intensity Meter: 10.39 - 150 W/m^2; Intensity below 10.39 implies ballast water not treated in accordance with TA certificate
UV Intensity Meter Acceptable Range: 100 - 2500 W/m^2; Intensity below 100 implies ballast water not treated in accordance with TA certificate
Pressure: 10 bar

Final Points

- Various options for tankers
- Need to evaluate available spaces for installation options
- Comparison of various items (i.e., specifications, limitations, costs, side effects) necessary when evaluating systems
- Important to review data and ask vendors questions

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