

The advanced ballast water treatment solution

CleanBallast[®]

RWO



The IMO Convention

- In 2004 the IMO decided for onboard ballast water treatment.
- Timeframe for implementation: between **2010*) and 2016**, depending on time of **keel laying** and ballast **tank capacity**.

States	% Tonnage	Parties to the convention
Needed: 30	Needed: 35%	Albania, Antigua & Barbuda, Barbados, Brazil, Canada, Cook Islands, Croatia, Egypt, France, Kenya, Kiribati, Korea, Liberia, Maldives, Marshall Islands, Mexico, Netherlands, Nigeria, Norway, Saint Kitts and Nevis, Sierra Leone, South Africa, Spain, Sweden, Syrian Arab Republic, Tuvalu
Currently: 26	Currently: 24.4%	

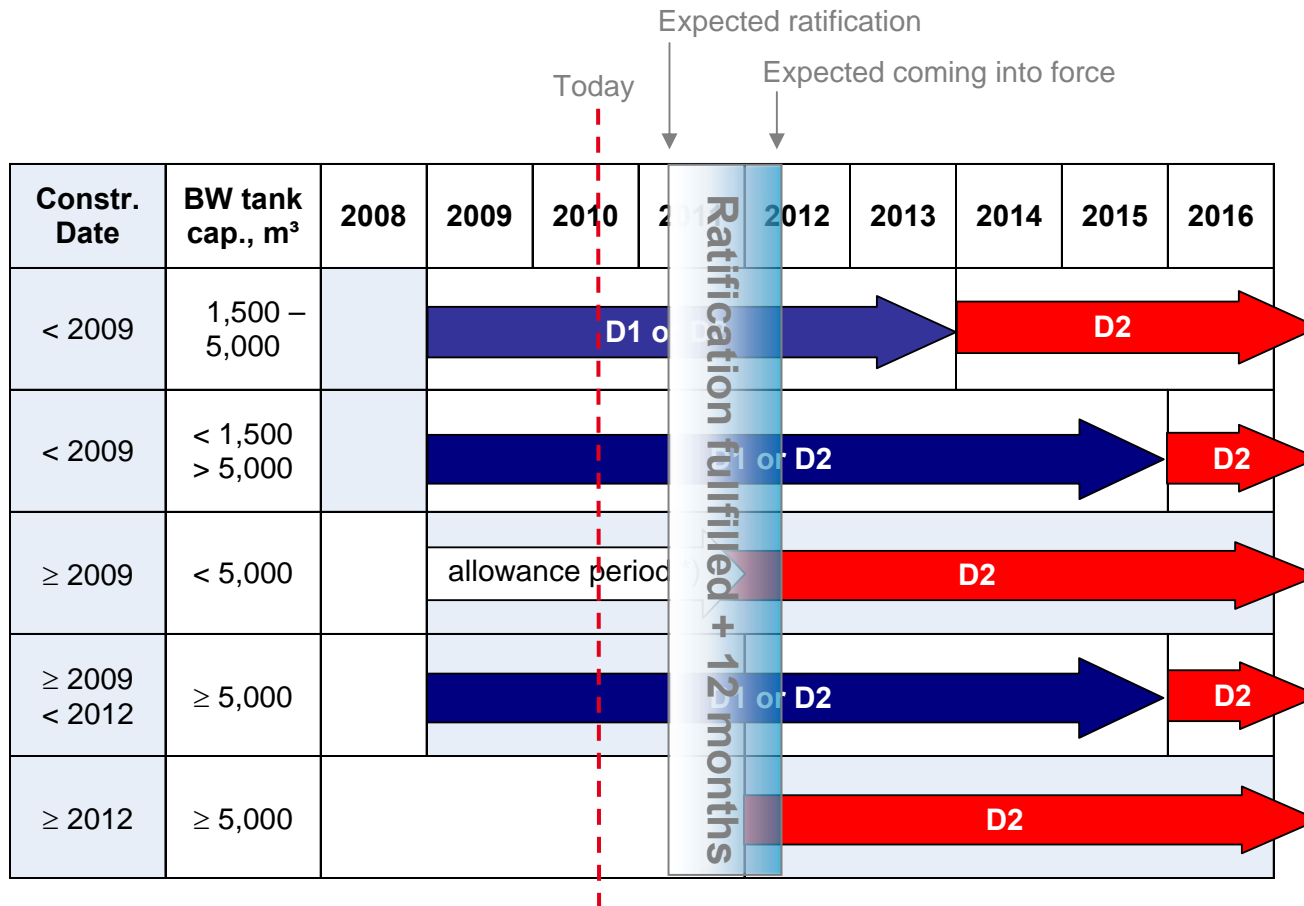
Discharge Standards



Technical description	Viable Organisms (> 50 µm in minimum size)	Viable Organisms (> 10µm and ≤ 50µm in minimum size)	Very Small Organisms (≤ 10µm in minimum size)	Bacteria		
				Toxigenic Vibrio cholera (O1 & O139)	Eschericia coli	Intestinal Enterococci
IMO and USCG-Phase 1	< 10 per m ³	< 10 per ml	N/A	< 1 cfu per 100 ml	< 250 cfu per 100 ml	< 100 cfu per 100 ml
USCG-Phase 2	< 1 per 100 m ³	< 1 per 100 ml	< 1,000 bacterial cells AND < 10,000 viruses per 100 ml	< 1 cfu per 100 ml	< 126 cfu per 100 ml	< 33 cfu per 100 ml
California Standard	No detectable living organisms	< 0.01 living organisms per ml	< 1,000 bacterial cells AND < 10,000 viruses per 100 ml	< 1 cfu per 100 ml	< 126 cfu per 100 ml	< 33 cfu per 100 ml

under review

Implementation Agenda of the IMO Convention



*) IMO resolution at the 25th IMO Assembly: vessels constructed in 2009 will be allowed to go until their second survey before they have to fit approved systems, providing they are fitted by 31.12.2011.

Ballast water treatment



RWO



„We are very satisfied with the performance of the CleanBallast systems, which already today enable us to perform ballasting and de-ballasting operations in accordance with the D2 standard of the IMO.“

*Niels Stollberg
President and CEO Beluga Shipping GmbH*



Advanced Solution

- Started with R&D in **2003**
- Compared and tested **various process technologies**
- Designed for and tested in **real life conditions**
 - fast and reliable ballast water production
 - no additional waiting time or harbour costs
- **Highest reduction** of sediment load
 - no loss of cargo weight
 - no expensive tank cleaning
 - economic benefit on fuel consumption
- **Low pressure** loss
 - no or only lowest additional CapEx for ballast water pump; low OpEx
- **Lowest power** consumption
 - no additional CapEx for periphery equipment (e.g. additional power generator)
 - low OpEx



Advanced Solution

- **No** increase in corrosion or material damage
- **Simple, safe, efficient** and **reliable**
- **Modular** design, applications 100 – 7,000 m³/hr
- For **newbuildings** and **retrofits**
- Optimized at **high TSS load**
- **Low** system pressure loss **< 1.3** bar (0.7 - 1.3)
- **Low** power consumption **0.008 – 0.1 kWh/m³** (not only saving energy but also costs on pollutant emissions!)
- RWO is a water & wastewater technology supplier for **maritime industry** since over **30 years**
- **Global** availability of service



System Testing

- RWO site chosen to ensure tests were conducted in **'real life'** conditions
- Realistic high sediment load **> 250 mg/l** TSS
- **Different locations** in river, brackish and seawater
- Long-term land based testing with over **10,000** hours of operation



Advanced Solution



2 stage ballast water treatment

- Ballast water uptake

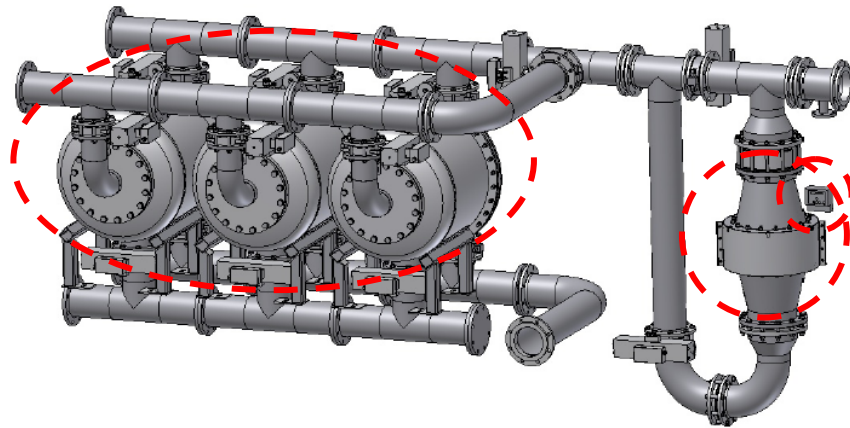
Advanced mechanical
DiskFilter separation

+

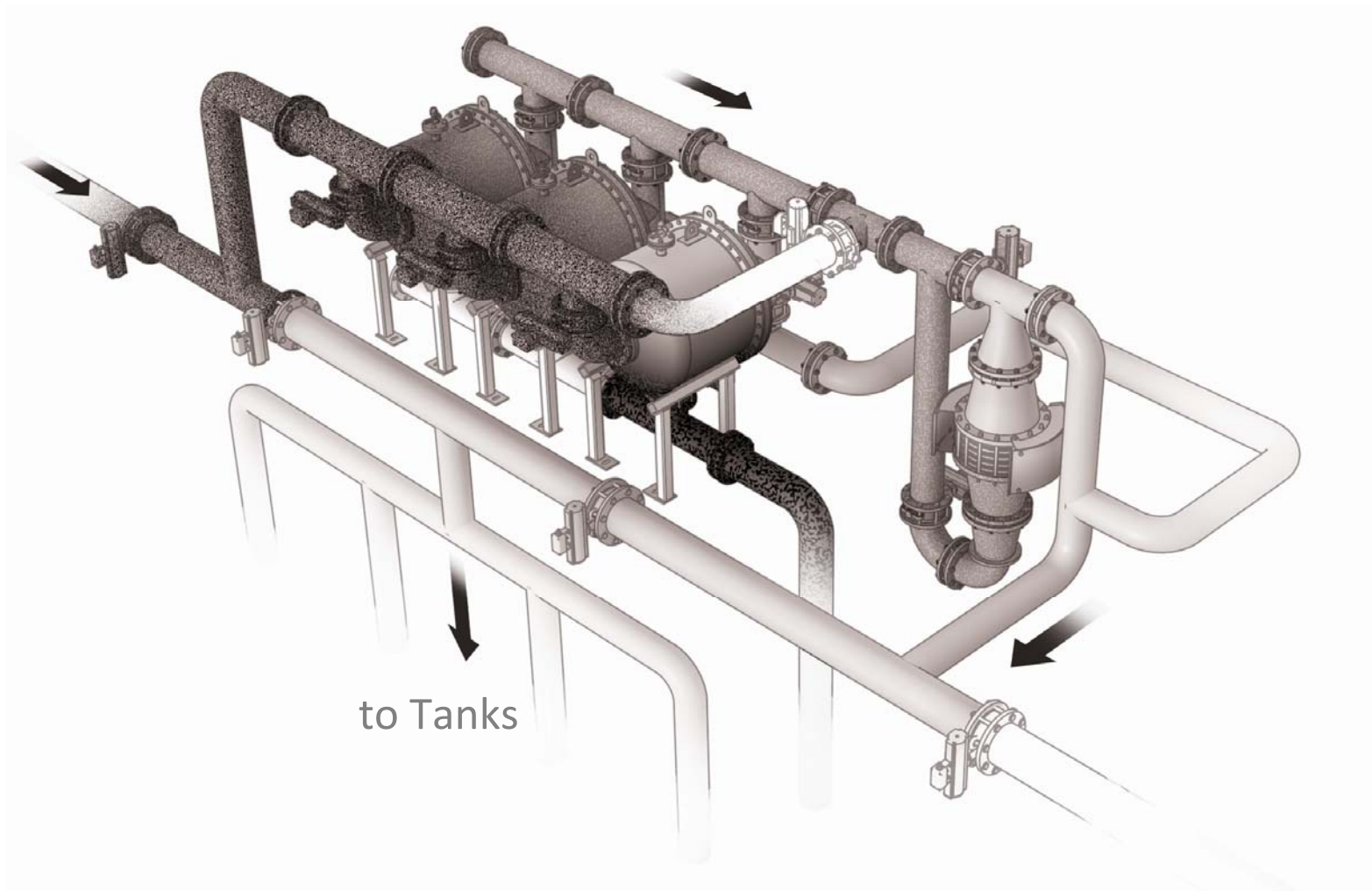
EctoSys[®] disinfection,
max. 2 mg/l TRO

- Ballast water discharge

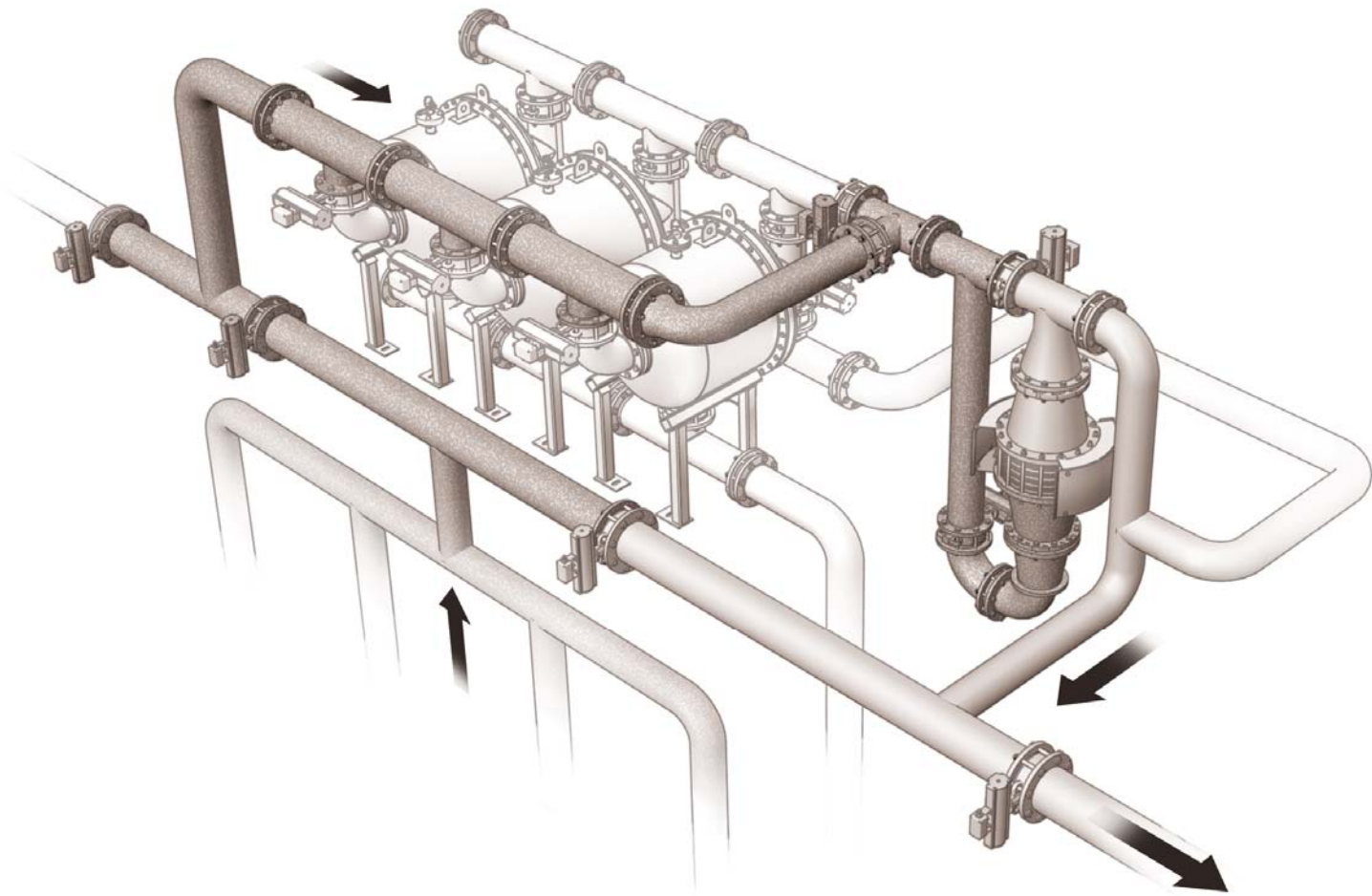
EctoSys[®] disinfection monitored by
algae monitor + if necessary neutralisation



CleanBallast - Ballasting



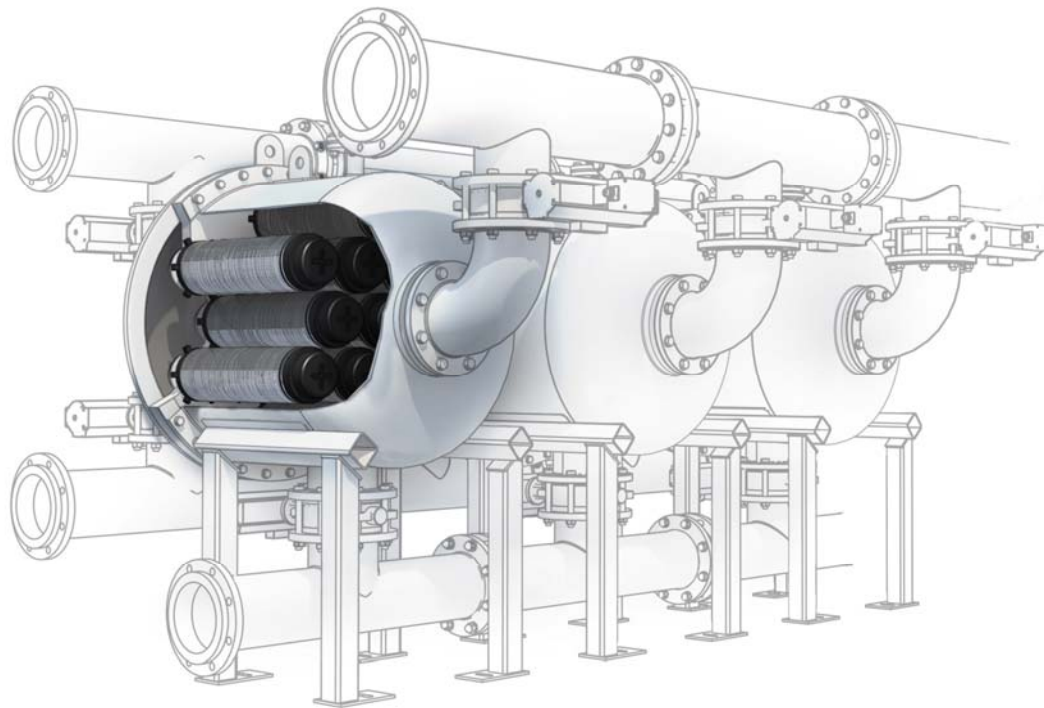
CleanBallast – De-Ballasting



Overboard

Advanced mechanical separation

► The DiskFilter solution



Why Sediment Removal?

- **IMO Regulation** B-5 Sediment Management for ships
- **No loss** of cargo weight
- **Avoidance** of expansive tank cleanings (solid waste considered as **hazardous**)
- Economic **benefit on fuel consumption** (calculations indicate upto 3% savings)



DiskFilter Characteristics

- **Modular** system
- Highly **effective** and **proven** DiskFilter technology (Arkal inside)
- **Automatic** backwashing; no flow interruption
- **Low** pressure loss (0.2 – 0.8 bar)
- **High** ballast water production even at high sediment loads



DiskFilter



Based on **proven** filtration principles



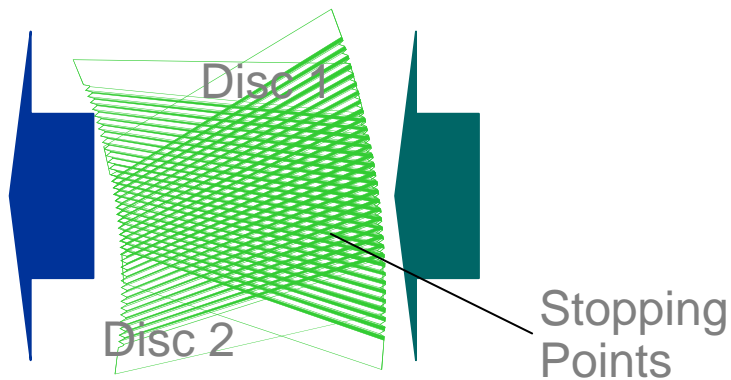
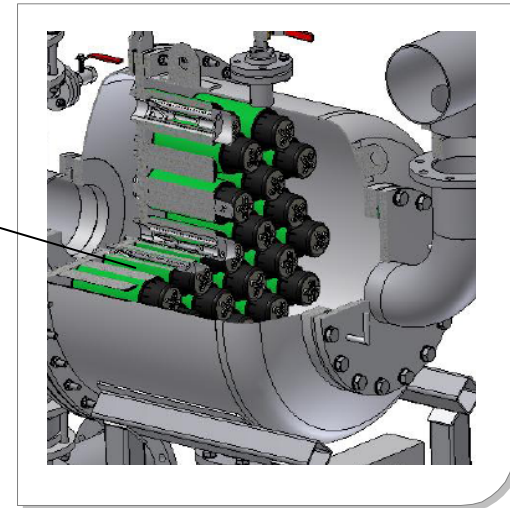
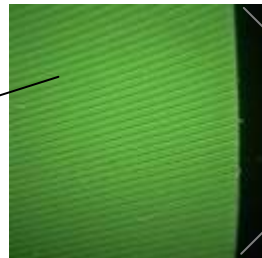
DiskFilter Principle



Advantages of **in-depth filtration!**

Grooves

Filter Fineness:
55 μm



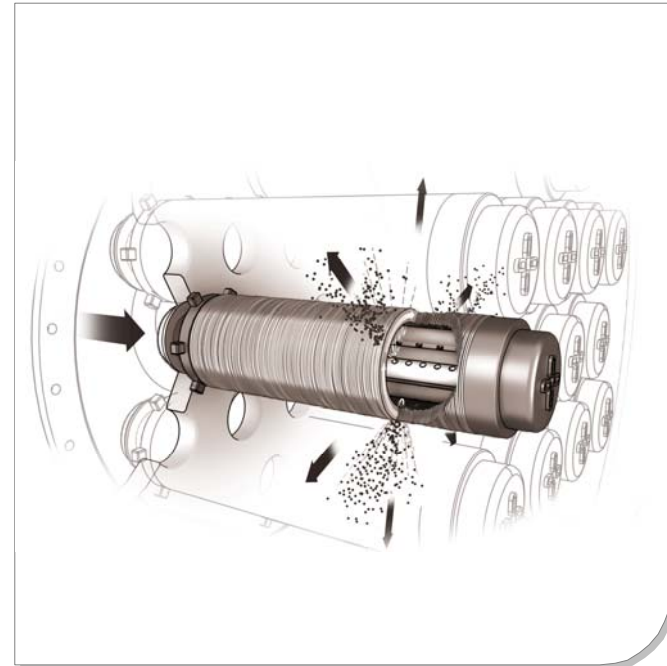
DiskFilter Principle



Filtration mode



Backflush mode

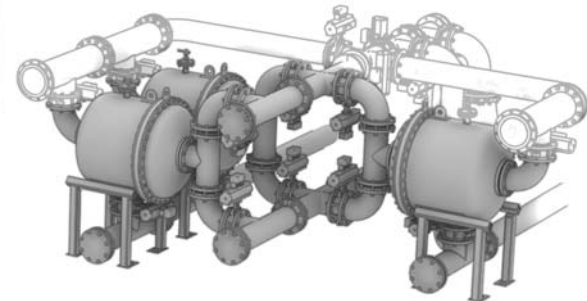
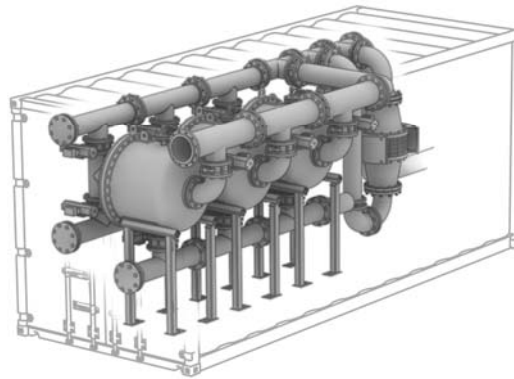
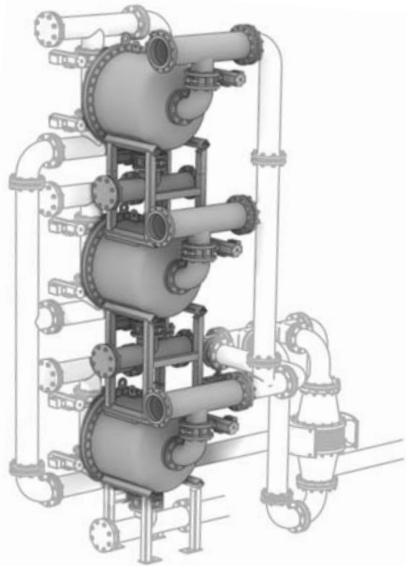
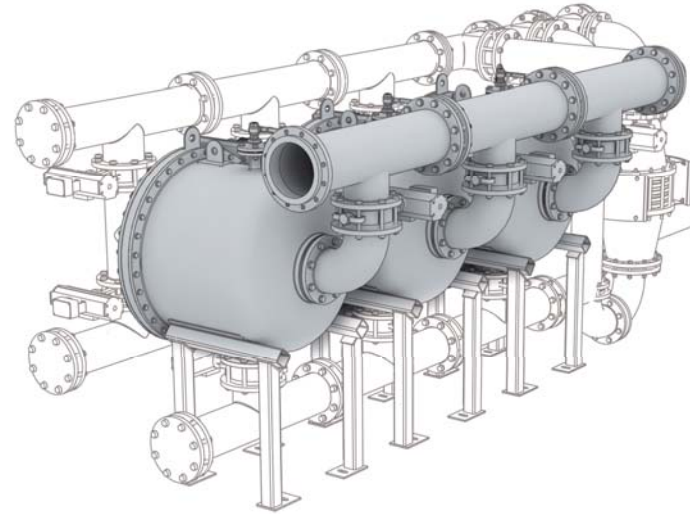


Modular System



One system, many possibilities

- Flexibility
- Best use of available footprint
- Easy for retrofitting



Advanced electrolysis Disinfection



• The EctoSys[®] solution



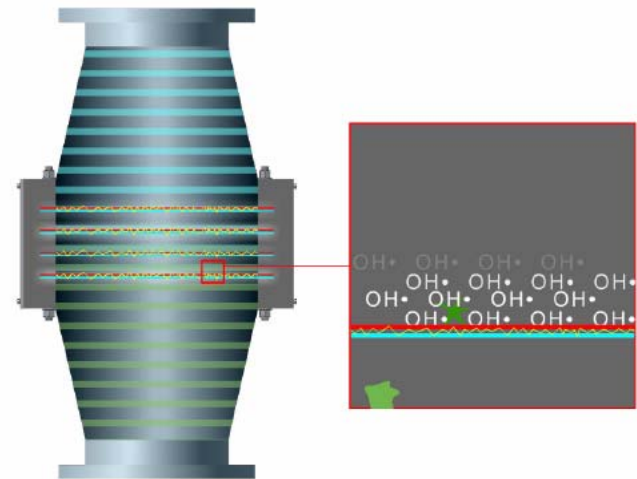
EctoSys[®] - Advantages

- Requires electrical power only; **low power consumption** 0.008 – 0.1 kWh/m³
- No chemicals for operation of disinfection
- **Minimum** footprint < 1 m² (500 m³/h)
- **No** waiting time
- **Safe** for crew and vessel
- **No** increase of corrosion
- Significant **higher** efficiency than UV-system
- **Low** pressure loss (~ 0.5 bar)
- Works also in **river water**



EctoSys[®] - Disinfection

- Only **H₂O** and electrical **current** necessary
- Production of **OH** radicals
- OH• are extremely **reactive**; having highest oxidation potential
 - River / Fresh water: only OH•
 - Brackish / Seawater: mixed disinfectants, chlorine and OH•



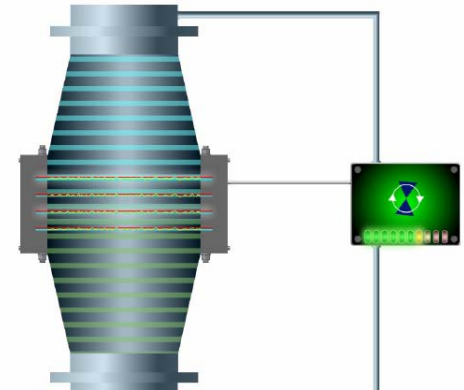
EctoSys[®] - Oxidation



Disinfectant	Reaction	Oxidation potential (Volt)
OH-radicals	$\text{OH} + \text{H}^+ + \text{e}^- = \text{H}_2\text{O}$	2.80
Ozone	$\text{O}_3 + 2\text{H}^+ + 2\text{e}^- = \text{H}_2\text{O} + \text{O}_2$	2.07
Hydrogen peroxide	$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- = 2 \text{H}_2\text{O}$	1.77
Chlorine dioxide	$\text{ClO}_2 + \text{e}^- = \text{Cl}^- + \text{O}_2$	1.50
Chlorine	$\text{Cl}_2 + 2\text{e}^- = 2 \text{Cl}^-$	1.36

Algae Monitor

- New monitoring instrument
- Measurement of viable phyto-plankton in effluent
- Minimization of **disinfectant concentration** at ballast water discharge
- Minimization of **power consumption**



CleanBallast



► Key Features



Key Features

- **Simple, safe, efficient** and **reliable**
- **Modular** design, 100 – 7,000 m³/hr
- Designed for and tested in **real-life**
- For **newbuildings** and **retrofits**
- Optimized at **high TSS load**
- **Low** system pressure loss **< 1.3** bar (0.7 - 1.3)
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(not only saving energy but also costs on pollutant emissions!)



Key Features

- **Simple** start / stop at any time
- Easily adaptable to **each kind** of vessel
- **Self cleaning** filter without flow interruption
- **Fast** ballast water production at high sediment load
- **Flexible** and **highly efficient** disinfection
- High level of **automation**; configured for local and/or remote operation
- **No** increase in corrosion
- **Explosion proof** system under development



Orders



At present **orders** under execution for over **40 units**



Status of Certification



Necessary Steps

*Actual status related
to CleanBallast*

Basic approval of active substance	Successfully concluded
Land based test	Successfully concluded
Final approval of active substance	Successfully concluded
Shipboard test	Successfully concluded ! - Feb 2010



Type approval certificate
(**August 2010**, i.e. well ahead before IMO
BW-convention will come into force)

Thank you for your attention



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