Danish Shipowner’s Association 16 June 2009

Ballast Water Treatment Systems
Case studies

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Karsten Elland
Søren Schnack
AGENDA

- Short Presentation of SEAHORSE 35
- Case Studies of Water Ballast Treatment Systems:
  - Venturi Oxygen
  - SEDNA from Hamann AG
  - PureBallast from Alfa Laval
  - Hyde Guardian from Hyde Marine
  - EcoChlor from EcoChlor Inc
- Cost and Energy Comparison
- Discussion and Questions
Grontmij | Carl Bro

Grontmij | Carl Bro is part of Grontmij, one of Europe’s largest consultancy companies.

Grontmij was founded in 1915.

In 2006 Carl Bro became part of Grontmij.

Over 8,000 professionals in Europe.

Consultancy and Engineering.

25,000 Projects yearly.

Turnover € 773 million.

6 Main market sectors.
Market Sectors

Main Market Sectors

- Building
- Transportation
- Environment
- Water
- Energy
- Industry (Marine)
Maritime services in Grontmij | Carl Bro

- Grontmij | Carl Bro are experts in maritime advice, including creating efficient, safe and environmentally friendly transport at sea.

- Our customers are shipyards, ship owners and public institutions. We work nationally as well as internationally with an office in Shanghai.

- Grontmij | Carl Bro’s Marine Department offer following services:
  - Ship design
  - Maritime Management Services
  - Ship Inspection
  - Specialized Services
GREEN SHIP of the FUTURE (GSF):

• Danish Maritime Network works to reduce emission from ships
  
  30% reduction of CO$_2$
  90% reduction of SO$_x$
  90% reduction of NO$_x$

• GSF will present two demonstrator vessels at the BRIGHT GREEN Exhibition in connection with the COP15 Climate Conference held in Copenhagen December 2009
Conceptual Green Ship Designs

8,500 TEU Containership
Design based on OSS/APMM A-Class design
(PM: OSS)

35,000 DWT Bulk Carrier
Design based on Grontmij | Carl Bro SEAHORSE 35 design
(PM: GMCB)
SEAHORSE 35
SEAHORSE 35

Main Particulars:

- Length OA: 180 m
- Breadth: 30 m
- Depth: 14.7 m
- Scntl draft: 10.1 m
- DWT: 35,000 t
- Cargo vol: 46,800 m³
- Speed: 14.0 knots

DnV +1A1 BULK CARRIER ES(D), CSR, BC-A(CH 2 and 4 maybe empty), GRAB (20), HA(+), ESP, EO, TMON, FUEL (380cSt, 991kg/m³, -15 Deg), BWM-E(s,f), COAT-PSPC(B), ICE-1C
Arrangement of Fuel Oil Tanks
SEAHORSE 35

Water Ballast Exchange System - WBM-E(s,f)
The selection proces

- The selection of the potential systems for SEAHORSE 35:
  - Different principles
  - Approved systems
Chosen suppliers

- Venturi Oxygen Stripping®, NEI Treatment systems, LLC
- SEDNA®, Hamann AG
- PureBallast, Alfa Laval AB
- Hyde Guardian™, Hyde Marine (Lamor Group)
- Ecochlor, Ecochlor Inc.
Assumptions

- **Cost and energy calculations:**
  - Ballast pump capacity: 2 x 800 m³/h
  - Light ballast capacity: 12,900 m³
  - Heavy ballast capacity: 23,000 m³
  - 10 annual voyages (ballast and loaded)
  - 9 light ballast voyages + 1 heavy ballast voyage
  - Operational days: 200 at sea and 160 in harbour
  - Steel work: 4 USD/kg
  - Pipe work: 6 USD/kg
  - Bunker price for LSHFO: 400 USD/tonnes
  - USD / EUR exchange rate: 1,40
  - Total M/E & D/G annual fuel oil cons. (incl. WB exchange): USD 2,300,000
  - Total D/G annual fuel oil cons. (incl. WB exchange): USD 300,000
Venturi Oxygen Stripping®, NEI Treatment systems, LLC

Basic technology:
- De-oxygenation during ballasting
- Inerting of ballast tanks

- Key components:
  - Stripping gas generator
  - Venturi injectors
  - Combustion blowers
  - Scrubber/cool. water pumps
  - P/V valve
  - P/V breaker
  - Overfilling valves at WB tanks
  - Control cabinets
Venturi Oxygen Stripping®, NEI Treatment systems, LLC
VENTURI OXYGEN STRIPPING®, NEI Treatment systems, LLC

CAPITAL EXPENCES:

- Purchase cost (given by supplier): USD 640.000
- Installation cost (estimated by GMCB): USD 130.000
- Total: USD 770.000
## ANNUAL OPERATIONAL EXPENCES:

- **Additional fuel cost (Estimated by GMCB):** USD 15,000  
  Additional in percentage of total vessel / D/G FO costs: 0,7% / 5%  
  - Used fuel for inert gas generation  
  - Additional el. power consumption

- **Utilities & Service cost (estimated by GMCB):** USD 10,000

- **Total:** USD 25,000
SEDNA®, Hamann AG

• Basic technology:
  – 2-stage filtration
    • hydro cyclone
    • filter
  – Injection of chemical Peraclean® Ocean

• Key components:
  – Hydro cyclone
  – Filter
  – Active substance tank/module
  – Mixing section
  – Control cabinets
CAPITAL EXPENCES:

- Purchase cost (given by supplier): USD 1.670.000
- Installation cost (estimated by GMCB): USD 270.000
- Total: USD 1.940.000
SEDNA®,
Hamann AG

ANNUAL OPERATIONAL EXPENCES:

• Additional fuel cost (Estimated by GMCB): USD 4,000
  Additional in percentage of total vessel / D/G FO costs: 0,2% / 1,3%
  – Additional el. power consumption

• Utilities & Service cost (estimated by GMCB): USD 35,000

• Total: USD 39,000
PureBallast
Alfa Laval AB

• Basic technology:
  – Filtration
  – Disinfection (UV-generated "free radicals")

• Key components:
  – Filter
  – UV reactor chambers with catalyst (titanium dioxide)
  – Power panels for reactors
  – Lamp cleaning unit
  – Flowmeter
  – Control cabinets
PureBallast
Alfa Laval AB

2 x 3 modules
PureBallast
Alfa Laval AB
CAPITAL EXPENSES:

- Purchase cost (given by supplier): USD 1.180.000
- Installation cost (estimated by GMCB): USD 60.000
- Total: USD 1.240.000
## PureBallast
### Alfa Laval AB

### ANNUAL OPERATIONAL EXPENCES:

- **Additional fuel cost (Estimated by GMCB):**
  - USD 6,000
  - Additional in percentage of total vessel / A/E FO costs: 0.3% / 2%
    - Additional el. power consumption:

- **Utilities & Service cost (estimated by GMCB):**
  - USD 16,000

- **Total:**
  - USD 22,000
Hyde Guardian™, Hyde Marine (Lamor Group)

- Basic technology:
  - Filtration
  - UV treatment

- Key components:
  - Filter
  - UV treatment chamber
  - Booster pump
  - Control cabinet
  - Power panel
Hyde Guardian™,
Hyde Marine (Lamor Group)

Booster pump for back flushing
Hyde Guardian™, Hyde Marine (Lamor Group)

CAPITAL EXPENCES:

• Purchase cost (given by supplier): USD 1.240.000

• Installation cost (estimated by GMCB): USD 140.000

• Total: USD 1.380.000
Hyde Guardian™,
Hyde Marine (Lamor Group)

ANNUAL OPERATIONAL EXPENCES:

- Additional fuel cost (Estimated by GMCB): USD 2,000
  Additional in percentage of total vessel / D/G FO costs: 0,1% / 0,7%
    - Additional el. power consumption:

- Utilities & Service cost (estimated by GMCB): USD 3,000

- Total: USD 5,000
**Ecochlor**
**Ecochlor Inc.**

- **Basic technology:**
  - Filtration
  - Injection of chemicals - chlorine dioxide

- **Key components:**
  - Filter
  - Injection spool piece with ultrasonic flow meter
  - Chemical storage and mixing unit
  - Small SW booster pump
  - Control cabinet
Ecochlor
Ecochlor Inc.

Chlorine dioxide solution injection spool piece
Ecochlor
Ecochlor Inc.

Chlorine dioxide solution injection spool piece
Ecochlor
Ecochlor Inc.

CAPITAL EXPENCES:

- **Purchase cost (given by supplier):** USD 680.000
  - Ecochlor 1600LT
    - Chemical storage and mixing unit
    - Two fine filters
    - Two injection spool pieces / flow meters

- **Installation cost (estimated by GMCB):** USD 40.000
  - Steel bulkheads for Ecochlor unit compartment
  - Pipe work
  - Cabling
  - Ventilation of compartment

- **Total:** USD 720.000
ANNUAL OPERATIONAL EXPENCES:

- Additional fuel cost (Estimated by GMCB): USD 1,000
  Additional in percentage of total vessel / D/G FO costs: 0,05% / 0,3%
  - Additional electrical power consumption

- Utilities & Service cost (estimated by GMCB): USD 17,000

- Total: USD 18,000
### Cost and energy comparison

#### CAPITAL EXPENCES (USD)

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<tr>
<th></th>
<th>NEI VOS</th>
<th>SEDNA® Hamann AG</th>
<th>PureBallast Alfa Laval AB</th>
<th>Guardian™ Hyde Marine</th>
<th>Ecochlor Ecochlor Inc.</th>
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Cost and energy comparison

### ANNUAL OPERATIONAL EXPENCES (USD)

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<td>22.000</td>
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## Cost and energy comparison

### ANNUAL OUTLET

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<td>47</td>
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<td>21</td>
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Discussion and questions

- Active substances versus CO₂
- Space requirement and arrangement
- Re-evaluation of ballast pump capacity
- Stripping
- D/G electrical power versus operation (WB rate/crane operation)
- Availability of water ballast treatment systems
- IMO versus national requirements (Brazil, California, etc)
Thank you
### Application dates [subject ratification of convention]

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