Technology of Design and Construction for Green AFRAMAX Tanker

绿色阿芙拉精品新船型的设计和建造技术研究

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1. Green Shipbuilding Conception

Three areas to be considered for green ships

• Design and Construction
• Operation
• Scrapping
1. Green Shipbuilding Conception

Following areas to be considered during design

- Emission of NOx and SOx
- Emission of CO₂
- Type approved incinerator
- Reasonable structure design to reduce vibration and noise
- Environment-friendly material
- Treatment of garbage, bilge water and sewage
- Ballast water treatment system
- Environment-friendly painting
- ODME and vapor emission control for tanker
- Low-resistance hullform and energy-saving application
- New technology of energy efficiency and emission reduction
1. Green Shipbuilding Conception

Following areas to be considered during construction

- Material
- Emission of CO$_2$
- Minimize exhaust of sewage
- Dry process
- Piping flushing
- New welding technology
2. General Design
## 2. General Design

### Principal particulars

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (Loa)</td>
<td>abt. 244.60 m</td>
</tr>
<tr>
<td>Breadth</td>
<td>42.00 m</td>
</tr>
<tr>
<td>Depth</td>
<td>22.20 m</td>
</tr>
<tr>
<td>Tiedowns (Ts)</td>
<td>15.50 m</td>
</tr>
<tr>
<td>Deadweight</td>
<td>110,000 t</td>
</tr>
<tr>
<td>C.O.T. capacity</td>
<td>123,500 m³</td>
</tr>
<tr>
<td>Speed</td>
<td>15.6 kn</td>
</tr>
<tr>
<td>Main engine</td>
<td>MAN B&amp;W 6S60ME-C8</td>
</tr>
<tr>
<td></td>
<td>MCR 14,280kW</td>
</tr>
</tbody>
</table>
2. General Design
3. CSR Structure Design
3. CSR Structure design

◆ IACS CSR
◆ SOLAS II-1/3-6.2 Permanent means of access
◆ MARPOL Reg.12A Oil fuel tank protection
◆ MARPOL Reg.22 Pump-room bottom protection
◆ MARPOL Reg.23 Accidental oil outflow performance
4. Ballast Water Treatment System

International Convention for the Control and Management of Ship’s Ballast Water and Sediments

• Adopted February 2004

• Entry into force not yet …

• To date 18 States ratifications representing 15.36% of world merchant shipping tonnage
4. Ballast Water Treatment System
4. Ballast Water Treatment System

The ballast water treatment system have an impact on the arrangement of ER & PR, HFO & COT capacity, diesel generator capacity, endurance etc.
## 5. Decreasing Emission from Ships

### MARPOL Annex VI – NOx Emission Standards

<table>
<thead>
<tr>
<th>Adoption</th>
<th>At MEPC 58 in October 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry into force</td>
<td>1 July 2010</td>
</tr>
<tr>
<td>Tier I</td>
<td>Engines $&gt;130kW$, ships constructed before 1 January 2011</td>
</tr>
<tr>
<td>Tier II</td>
<td>Engines $&gt;130kW$, ships constructed on/after 1 January 2011</td>
</tr>
<tr>
<td>Tier III</td>
<td>Engines on ships constructed on/after 1 January 2016</td>
</tr>
</tbody>
</table>
5. Decreasing Emission from Ships

**MEPC 57 IMO Fuel-sulphur Content**
Equivalent methods may be used as alternative

- **Global:**
  - 2000: 4.5
  - 2015: 3.5
  - 2020: 0.5

- **SECA/ECA:**
  - 2000: 1.5
  - 2015: 1.0
  - 2020: 0.1

![Graph showing硫化物含量变化](image)
5. Decreasing Emission from Ships

EU Directive 2005/33/EC
on or after 1 January 2010
• A 0.1% sulphur limit on fuel used by inland vessels and by seagoing ships at berth in EU ports

California Air Resource Board – Marine Notice 2009-2
on or after 1 January 2012
• MGO (DMA) ≤ 0.1% sulphur content or
• MDO (DMB) ≤ 0.1% sulphur content
5. Decreasing Emission from Ships

• EEDI Guideline was published at MEPC 59 in July 2009

• Baseline and future limits are subject to discussion

- Baseline submitted by Denmark
  \[ Y = 1950.7 \times 110000^{(-0.5337)} = 3.977 \]

- Baseline submitted by China
  \[ Y = 1127.1 \times 110000^{(-0.4832)} = 4.130 \]
5. Decreasing Emission from Ships

Based on Interim Guidelines on the method of calculation of the EEDI for new ships

\[
\left( \prod_{j=1}^{M} f_j \right) \left( \sum_{i=1}^{n_{ME}} \left( P_{AE} \cdot C_{FME(i)} \cdot SFC_{AE(i)} \right) \right) + \left( \prod_{j=1}^{M} f_j \cdot \sum_{i=1}^{n_{PTI}} P_{PTI(i)} \right) - \left( \sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{AEeff(i)} \cdot C_{FME} \cdot SFC_{AE} \right) - \left( \sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{AEeff(i)} \cdot C_{FME} \cdot SFC_{AE} \right)
\]

\[
\cdot f_i \cdot \text{Capacity} \cdot V_{ref} \cdot f_w
\]

\[
\text{★ 110,000DWT Product Oil Tanker EEDI} = 3.732
\]
## 5. Decreasing Emission from Ships

<table>
<thead>
<tr>
<th></th>
<th>Difference (EEDI - baseline)</th>
<th>Difference Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEDI</td>
<td>3.732</td>
<td></td>
</tr>
<tr>
<td>Baseline Denmark</td>
<td>3.977</td>
<td>6.16%</td>
</tr>
<tr>
<td>Baseline China</td>
<td>4.130</td>
<td>9.64%</td>
</tr>
</tbody>
</table>
6. Green Shipbuilding Technology

- Improve painting production design
- Improve piping flushing and protection
Thank you!