The Present State of Marine Transports and Environmental Countermeasures in Japan

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Outline of Presentation

Japan consists of some islands girded by the seas and located in the East Asia, and it has little material resources, energy of petroleum etc. and foods. With the growth of manufacturing industry after the mid-twentieth century, our foreign trade has made great development with merchant ships. The bottoms of Japanese foreign cargo ships were about 12% of its world in 2006. On the other hand, Japan is now confronted with the many environmental countermeasures on marine engine systems and marine ships.

In this presentation, I will introduce on the present state of marine transports, marine environmental countermeasures and a proposal for sustainable development in Japan as follows:
Outline of Presentation

1. Introduction
2. The present state of marine transports in Japan
3. The marine environmental countermeasures in Japan
4. A proposal for sustainable development in Japan
5. Conclusions
Marine transport roots with Japan central figure

Marine transportation to link the world closely

(The Japanese Shipowners’ Association, Shipping Now 2007)
Loading ratio of export and import materials with Japanese merchant fleet

Export
- Total: 100%
- Japanese merchant fleet: 36.4%
- Japanese-registered ships: 2.1%

Import
- Total: 100%
- Japanese merchant fleet: 60.7%
- Japanese-registered ships: 5.5%

(Ocean cargo ships over 2000GT)

Bottoms ratios of Japanese merchant fleet in its world


(Ocean cargo ships over 2000GT)
Transition of construction in Japanese merchant fleet

Number of Ships

<table>
<thead>
<tr>
<th>Year</th>
<th>Ships Bottoms</th>
<th>Ships Bottoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>1,983</td>
<td>117</td>
</tr>
<tr>
<td>2002</td>
<td>1,878</td>
<td>110</td>
</tr>
<tr>
<td>2003</td>
<td>1,770</td>
<td>103</td>
</tr>
<tr>
<td>2004</td>
<td>1,797</td>
<td>99</td>
</tr>
<tr>
<td>2005</td>
<td>1,914</td>
<td>95</td>
</tr>
<tr>
<td>2006</td>
<td>2,128</td>
<td>95</td>
</tr>
</tbody>
</table>

Japanese-registered ships

chartered ships

(Ocean Cargo ships over 2000GT)

(MLIT, The Maritime report 2007)
Constructing and completing amount of merchant ships of the world


Others
EU(25 countries)
China
Korea
Japan

70.3MGT
38.0%
28.8%
7.7%
4.0%
21.5%

162.7MGT

anticipation (present of July 2007)
Dismantling trends of merchant ships of the world

NO\textsubscript{x} acceptable value in exhaust gas
(NO\textsubscript{x} Regulation in MEPC 57・58)

17.0 (g/kWh) : n<130 (1/min)
45.0\times10^{-0.2} (g/kWh) : 130\leq n<2000 (1/min)
9.8 (g/kWh) : 2000\leq n (rpm)

Tier 1 from 2000
Tier 2 from 2011
Tier 3 from 2016

reduction
80%
21.8%

(10)

(MAP Report 2007.10. JIME)
Technical developments for NO\textsubscript{x} reduction of marine diesel engines in Japan

**Developmental Target**: 80% NO\textsubscript{x} reduction

Developmental Substances

- After Treatment Equipment of Exhaust Gas
- Save Energy & Space of Engine Room
- Combustion Improvements of Engines

Tier 1

Tier 2
-20%

Tier 3

-80.0%

Actual Ship Experiment

Technical Development

Government-financed Research & Japan Marine Equipment Association (Nippon Foundation’s Subsidy)

(MLIT, Press Release, 2008.4.7)
NO\textsubscript{x} reduction with SCR (Selective Catalytic Reduction) system

**UEC37LA Diesel Engine**

D : 370mm  L : 880mm  
ES : 188rpm  BHP : 1105kW

**An Experimental SCR System**

(1) \((\text{NH}_2)_2\text{CO} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 2\text{NH}_3\)
(2) \(4\text{NO} + 4\text{NH}_3 + \text{O}_2 \rightarrow 4\text{N}_2 + 6\text{H}_2\text{O}\)
(3) \(4\text{NH}_3 \rightarrow 4\text{NO}_2 + 6\text{H}_2\text{O}\)
<table>
<thead>
<tr>
<th>Year</th>
<th>Special Sea Area</th>
<th>General Sea Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>1.5%</td>
<td>4.5%</td>
</tr>
<tr>
<td>2010</td>
<td>1.0%</td>
<td>↓</td>
</tr>
<tr>
<td>2012</td>
<td>↓</td>
<td>3.5%</td>
</tr>
<tr>
<td>2015</td>
<td>0.1%</td>
<td>↓</td>
</tr>
<tr>
<td>2018</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>2020/25</td>
<td>↓</td>
<td>0.5% (*)</td>
</tr>
</tbody>
</table>

(*1) It is decided that the next regulation's inaugural year begins in 2020 or 2025.
(*2) Distilled fuel oil need not be used.

An experimental result with a marine diesel engine: PM (Particulate Matter) increases with sulfur content and the increasing component of it is almost sulfate.

(MLIT, Press Release, 2008.4.7)
Environmental countermeasures of merchant ships

- Improvement of Hull Shape
- Improvement of Propeller & Stern Shape
- Reduction of Ship Weight
- Development of Energy Saving & Low Pollution Type Engine
- Double Hull Structure of Tanker
- Exclusion of Sub-Standard Ships
- Promotion of Ship-Recycle
- Exhaust Gas Regulation on The Ocean
- Using Safety Paint on bottom Surface of ship
- Promotion of Maintenance of Route Environments

Saving Energy

Next Generation's Merchant Transportation

Maintenance of Ocean Environment

(The Japanese Shipowners’ Association, Shipping Now 2007)
Environmental countermeasures of merchant ships

- Double Hull Tanker Under Construction
- Propeller Boss Cap Fins
- Manure Production Equipment by Using Garbage
- Silicon Paint

(The Japanese Ship-owners’ Association, Shipping Now 2006)
Hygienic circulation system of the “Edo” period

Circulation System of the “Edo” Period
(1603~1867)

Artist Hokusai KATSUSHIKA
(1760~1849)

(MOE, A Sound Material-Cycle Society through the Eyes of Hokusai (2008) )
Construction of the low carbon society system

(MOE, A Sound Material-Cycle Society through the Eyes of Hokusai (2008) )
Electric propulsion system with fuel cell

(Wärtsilä Technical Report (2008))
New technical development in Japan

Image Picture of PCC equipped with solar panel

Micro-Bubbling System for the reduction of friction resistance

(Mainichi Newspaper (2008.10.19) by NYK Line)
A proposal for sustainable developments of marine transports by low carbon systems

New Energies • Fuels

Sustainable Developments

Circulation Systems

High Quality Propulsion Systems and Engines
Conclusions

Japan is a very compact and high efficiency society compared with another country as same as marine ship and marine engine systems. Therefore, I am sure that the marine ship and marine engines are able to develop sustainably with new fuels, circulation systems and low carbon engine systems.
Thank you for your attention