Introduction to the Design Concept for the LNG fueled Ultra Large Containerships

Teuk-Jin Koh, Mun Namgung, Dong-Kwon Lee

Ship Structure Basic Design Department, Daewoo Shipbuilding & Marine Engineering Co., Ltd
Seoul, Korea

ABSTRACT

One of the possible solutions, LNG propulsion has been widely adopted in order to handle a 0.5% sulphur cap for the ship’s fuel oil in compliance with IMO 2020 other than the SOx scrubber and using the low-sulphur fuel. Recently, the LNG fueled Ultra Large Containerships (ULCs) have been developed in order to meet these needs.

For example, their LNG fuel tanks instead of conventional heavy fuel oil (HFO) tanks could be designed as IMO type B type or Membrane type depending on the Owner’s preference or CAPEX. This paper is basically to introduce the design concept for the LNG fueled ULCs which has been designed and consistently developed by DSME.

In addition, the outstanding engineering technologies for the novel design of the LNG fueled ULCs is to be presented which should be inevitably required to ensure the structural adequacy.

Consequently, the results of the economic efficiency evaluation for the application of each LNG fuel tank type (IMO type B or Membrane type) will be shown on this paper for reference.

KEY WORDS: Sulphur cap; IMO type B; Membrane type; Crack propagation analysis; NOx; SOx; ULCs; MCTIB, Hi-Mn

INTRODUCTION

On 1 January 2020, International Maritime Organization (IMO) will implement a new regulation, a 0.5% global sulphur cap for marine fuels. Accordingly, all commercial ships shall use a marine fuels with a sulphur content of no more than 0.5% against the current limit of 3.5% in an effort to reduce amount of sulphur oxide except for the Emission Control Areas (ECAs) where 0.1% S content since 2015.

To comply with this IMO 2020 requirement except for the marine gas oil (low sulphur distillate fuel), there are multiple options as follows:

1. Heavy fuel oil: 0.1% ultra low sulphur fuel oil (ULSFO) and 0.5% very low Sulphur fuel oil (VLSFO)
2. Exhaust gas cleaning system (scrubber)
3. LNG fuel
4. Alternative fuels: liquefied petroleum gas, methanol, biofuel, compressed natural gas, solar power and fuel cells etc.

Of the mentioned things above, LNG fuel is well known to be the most cost-competitive which is available to clients today. In connection with this, the newbuilding LNG fueled vessels have been steadily increased up to about 440 vessels every year as shown on Fig. 1.

![Fig. 1 LNG fueled vessels (source: DNVGL 2019)](image)

In general, LNG fuel tanks could be IMO type B or Membrane type for ULCs. However, there are advantages and disadvantages for each type. Table 1 shows that IMO type B based on the high manganese steel (Hi-Mn) is more competitive compared to the other types in term of total cost, productivity and structural safety against sloshing.

<table>
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<th>Contents</th>
<th>IMO type B</th>
<th>Membrane Type</th>
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</thead>
<tbody>
<tr>
<td>Hi-Mn</td>
<td>9% Ni</td>
<td>NO 96</td>
</tr>
<tr>
<td>Sloshing</td>
<td>Free</td>
<td>Free</td>
</tr>
<tr>
<td>LF tank material</td>
<td>Competitive</td>
<td>High</td>
</tr>
<tr>
<td>(Price)</td>
<td></td>
<td></td>
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<tr>
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<td>Short time</td>
<td>Middle</td>
</tr>
<tr>
<td>LF tank CAPEX</td>
<td>Competitive</td>
<td>High</td>
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Table 1 Comparison among each type of LNG Fuel Tanks