1. General

1.1 Shipbuilding

1.1.1 The trends of the industry\(^1\) ;

In March, 2011, the East Japan was hit by tremendously big earthquake and the vast area of Tohoku District suffered from the disastrous damages, and also, in Kanto District the atomic power plant of Tokyo Electric Power Company suffered destructive damage which has caused the unprecedented and serious problem of shortage of electric power. Under the circumstances, not only shipping and shipbuilding industries but also whole Japan has faced two big difficult problems, that is, the restoration from disaster and possible chronic shortage of electric power, which will have to be solved over long time period in future.

The strong exchange rate of Yen has been still continuing and the annual average exchange rate renewed the record of 2010 when the annual exchange rate of Yen had become the eighties against a Dollar for the first time in history, and the annual exchange rate of Yen hit temporarily the new record level of 75 Yen.

1.1.2 The trends of the actual orders awarded to the shipbuilders and the new ships placed into commission\(^1\) ;

The new ships ordered to the shipbuilders in the world within 2011 (from January to December) were 1,944 ships or 53,343 thousand gross tons, and the amount of orders reduced by 35.3% from the previous year in terms of gross tonnage. Looking at the share of orders of each country in terms of gross tons, the shares of each country are 14.5% of Japan, 47.2% of Korea, 29.0% of China and 3.0% of Europe (the member countries of CESA), and so, Korea recaptured the first place of the world.

On the other hand, the amount of completion of new ships in the world was 3,608 ships or 101,501 thousand gross tons, that is the record-breaking high figure exceeding same 100 million gross tons as marked in the previous year. This is the increase of 5.3% in gross tons against the previous year, and the shares of each country are 19.1% of Japan, 35.1% of Korea, 38.9% of China and 2.4% of Europe (the member countries of CESA), and China has maintained the first place in the rank of the world consecutively after the previous year.

1.1.3 Trends of international rules and regulations\(^1\) ;

With reference to the international rule and regulation, the proposal of the partial revision of the International Convention for the Prevention of Pollution from Ships was adopted in the International Maritime Organization (IMO) in July and the control of CO\(_2\) exhaust has been introduced. To put it concretely, the introduction etc. of Energy Efficiency Design Index (EEDI) to the new ships will be obligated from January, 2013.

1.1.4 Topics in the shipbuilding and shipping industries;

In 2011, the main topics were about eco-ship (ecological ship) and LNG tankers and LNG-fuelled ship. Referring to the press release of each news agency, the author would like to introduce the followings.

1.1.4.1 Next generation type LNG carrier [Sayaendoh] (MHI)\(^2\) ;

Mitsubishi Heavy Industries, Ltd. (MHI) has completed the development of the new type of next generation type LNG carrier called [Sayaendoh] that was evolved from Moss type in which spherical tanks are installed for carriage of LNG (liquefied natural gas) and they have successfully acquired the order of this new type of ship.

MHI has made efficient the structure of whole ship of [Sayaendoh] by shading tanks by continuous cover made in one body with ship's hull, and realized the lightness and compactness. Comparing with Moss type in which each of the upper hemisphere of spherical tanks projected on deck of hull is independently shaded by hemispheric cover and the lower hemisphere of the tank is supported by cylinder type
structure called skirt, the strength of whole hull has been secured by shading with the cover made in one body continuously extended from hull. The continuous cover substantially reduces the wind pressure to become resistant against propulsion and contributes to lower fuel consumption during the actual ship’s operation.

![Fig.1.1.1 LNG carrier [Sayaendo]](image)

As the main engine of the above ship, MHI has adopted new type steam turbine plant [MHI Ultra Steam Turbine Plant] (UST: Reheating marine propulsion steam turbine) in which the heat energy efficiency is enhanced by use of reheating the steam, and they have been successful in remarkable reduction of fuel consumption by more than 20% in comparison with the same of conventional ship together with the realization of lightness and compactness.

MHI agreed to conclude the construction contract to build 2 ships of next generation type LNG carrier [Sayaendo] with Mitsui O.S.K. Lines, Ltd and Osaka Gas International Transport Inc., one of group companies of Osaka Gas Co., Ltd.

The above LNG carriers are scheduled to be completed and delivered respectively in 2014 and 2015 and the principal particulars of each ship are length: 288.0m, width: 48.9m, draft at full loaded condition: 11.5m, gross tons: 138,000 (deadweight tons: 75,000), service speed: 19.5 knots and total tank capacity: 155,000m³.

1.1.4.2 Large LNG-fuelled container ship on which IHI SPB tank is used (MHIMU) 3)

I.H.I. Marine United (IHIMU) has developed the environmentally friendly LNG fuel gas system to satisfy the Tier III which is the control level of exhaust of NOx and SOx by IMO (International Maritime Organization) that will become effective in 2016 for the use of liquefied natural gas (LNG) as propulsion fuel, and they have completed the concept design of large container ship (10,000TEU) as an example case of the above application.

This LNG fuel gas system developed by IHIMU this time has been developed by utilization of their original technology, SPB (Self-supporting Prismatic Shape IMO type B) LNG tank, and the followings are the special features of the system.

Since any sloshing is not caused at what kind of surface level the liquefied gas is contained in SPB fuel tank, the tank excels in reliability and structural durability, and therefore, it is suited to be used as marine fuel tank always exposed to waves. As SPB fuel tank has no restriction for designing its shape, it is possible to make the tank arrangement of the efficient capacity with meeting the complicated inboard space. In comparison with the fuel tank being used on board the ferries operated in North Europe, more reduction of weight can be expected, and it may be possible to realize the LNG-fuelled system that controls to the minimum level of reduction of cargo loading weight compared with the conventional heavy oil fuelled ships.
The fuel system makes it possible to flexibly match the various type of gas supply system by equipping submerged pump within tank and making independently the transfer system and supply system from tank separate. In the case of the above large container ship developed this time, the ship navigates by using LNG as fuel for clearing the control in the area called ECA (Emission Control Area) where Tier III has officially been decided to be applied upon the control becoming effective in 2016 and ship navigates outside of ECA by using C heavy oil as fuel in the same way as before, which enables to control the decrease of number of container loading at the minimum by limiting the crusng range by using of LNG fuel gas up to approximate 2,000 nautical miles and by arranging the LNG fuel tank of about 2,000m³. The main particulars of the said container ship are length overall: about 330.0m, width (molded): about 48.0m, depth (molded): about 27.0m, loading capacity of container: 10,000TEU and service speed: 23.0 knots.

1.1.4.3 Next generation type large bulk carrier “G Series” (Universal Shipbuilding Corporation) 4); Universal Shipbuilding Corporation has developed this time the next generation type large bulk carrier “G Series”, on which they successfully reduced by 25% the exhaust of greenhouse effect gas (GHG) and started the sales activities. The special features of 200,000 dwt type bulk carrier (G209BC), one of “G Series” ships, can be raised as follows. The principal objects of the development of this ship were the reduction of resistance and horse power, and the reduction of GHG 25% has been achieved by the improvement of hull performance, the construction of machinery plant of low fuel consumption and the improvement of performance in actual sea etc.. They standardized to equip the ship with the detection and monitoring system of the most optimum navigation route named SeaNavi®, which contributes to the shipping firm’s production of the save-energy operation plan [Ship Energy Efficient Management Plan] (SEEMP), and as a result, the loading capacity could be increased about 3% compared with the ships so far built by Universal Shipbuilding Corporation.
1.1.4.4 LNG Carrier “Double Eco MAX” (Mitsui Engineering & Shipbuilding Co., Ltd.)

Mitsui Engineering & Shipbuilding Co., Ltd. (MES) has completed the development of new type of LNG carrier [Double Eco MAX], in which MES adopted the gas burning slow speed diesel engine [ME-GI] as propulsion system and successfully reduced by 30% fuel consumption and exhaust quantity of CO₂, and they have prepared the line-up of new types, 147,000m³ type, 155,000m³ type and 180,000m³ type and started their sales proposal of these ships to their clients.

Double Eco MAX is characterized by the installation of ME-GI engine that has achieved 30% reduction of fuel consumption and exhaust of CO₂. This engine makes it possible to burn gas only or heavy oil only or mix of gas and heavy oil notwithstanding that it is 2 stroke low speed diesel engine which heat efficiency is high. By the above special characteristics, the propulsion system directly connected to propeller can be realized through 2 way burnings of fuels, gas and heavy oil, in order to attempt to reduce fuel cost and exhaust of CO₂ to the maximum extent. (“Ecology MAX”)

Also, this propulsion system of 2 way burnings of fuels makes it possible to choose the most economical fuel from time to time depending on the variable situation of fuel cost and to produce economical merit in the ship's operation. (“Economy MAX”)

As for the successful completion of gas burning slow speed 2 stroke engine, it can be mentioned that this engine has been realized on the basic technology of “GIDE” (Gas Injection Diesel Engine / Power generation plant to which gas burning slow speed diesel engine has been adopted for the first time in the world), on which the test operation was carried out over 20,000 hours at Chiba Works of MES. ME-GI engine has succeeded the functions of gas burning of GIDE, and in addition, it is electronically...
controlled and its environmental capacity and efficiency has been improved throughout all operation sphere.
As it is a new type of engine, the risk assessments have been implemented by MAN Diesel & Turbo and DNV • ABS (Classification Societies), and the high safety has been fully testified.

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