Research on marine low sulphur fuel oil supply business development of marine in Zhejiang Free Trade Zone

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Abstract. With the vigorous advancement of global economic integration, the international trade in goods has become busier and busier, and the maritime industry has been booming. The number of ships has increased greatly, and the discharge of ships has become an important factor affecting the environment. For the international maritime organization (IMO) has decided to implement 0.5% of global sulfur restrictions by 2020. Zhejiang free trade zone has been paying attention to the dynamic and development trend of sulfur emission in the global shipping industry. And the obstacles to the bonded oil supply business of Zhoushan free trade zone in the low sulfur era are deeply thought and analyzed. The paper focuses on three main countermeasures and analyzes the advantages and disadvantages of these three countermeasures. It is hoped that the plan selection of future ships to deal with sulfur emission limit will be helpful.

1. Background

In October 2016 and July 2017, the IMO maritime environmental protection committee (MEPC) at the 70th meeting and 71st meeting agreed and confirmed the decision of the global cap on sulphur content of Marine fuels by 0.5% by 2020. The other set of North America, Hawaii, the Caribbean sea, the north sea and the Baltic sea control zone still impose a 0.1% fuel sulphur limit. In February 2018, the secretary-general of the IMO reiterated the plan at the fifth meeting of the pollution prevention and response division.

1.1. International convention

On October 27th local time in London, IMO decided that 0.5% of global sulfur limits would be effective from 2020 instead of 2025 after a postponed 5 years. It meant that regulations in Annex VI of International Convention for the Maritime Agreement Regarding Oil Pollution (MARPOL) which was passed in 2009, made it mandatory for all ships sailing beyond sulfur emissions control area (ECA) to use the fuel with sulfur content less than 0.5%.
Previously, the European Union had agreed to implement a 0.5% sulfur limit within 200 nautical miles of coastal areas among European Union member states[1].

1.2. Relevant policies and regulations in China
In December 2015, the ministry of transport issued a plan for the implementation of Marine emission control zones in the pearl river delta, Yangtze river delta and the bohai sea (beijing-tianjin-hebei region), requiring the three control areas to gradually impose a 0.5 % limit for sulphur content. Starting from January 1, 2018, the vessel shall will use the fuel with a sulphur content of less than 0.5% in the port of all ports in the discharge control area, and actually forward to September 1, 2017. Since January 1, 2019, ships entering the emission control zone should use the fuel with a sulphur content of less than 0.5%. Ships can take the equivalent of the above emission control by connecting shore power, using clean energy, tail gas treatment and so on[2].

In November 2017, the ministry of transport and other 13 departments jointly issued the enhancement of Marine low sulphur fuel supply protection and the guidelines for joint supervision. The guidance clearly states that through incentives and restraint mechanisms, enterprises should be actively guided to produce, sell and use low-sulphur fuel for ships in compliance with the regulations, ensure the supply of low-sulphur fuel for ships, and meet the needs of the shipping market.

2. Analysis of the main countermeasures

2.1. Use 0.5% low sulphur heavy fuel oil
The main advantage of the ship's direct use of low-sulfur oil is that, no matter the new ship or existing ship, doesn't need to upgrade and add equipment and system, saving the investment of related equipment and the future operation and maintenance, alkali solution, management and waste liquid recovery and disposal (only closed) costs and troubles, safety and reliability, no policy and control risk.

But the main disadvantage is that its price is much higher than ordinary heavy oil (HFO). According to January 17, 2018, the world's main port of Marine fuel oil price calculation (0.5% low sulfur oil has not been widely used, no quotation), 0.1% low sulfur oil is about $190 / ton higher than ordinary heavy oil, which greatly increases fuel cost expenditure.

Due to demand and cost, there are very few refineries in the world that produce heavy fuel oil of less than 0.5% sulfur. At present, 0.5% low sulfur oil in China is produced in the way that ordinary heavy oil mixed with light and low sulfur oil. In addition, China's policy on different tax number oil mixed and tax burden has not broken through, which will make China's 0.5% low sulfur oil small production scale, low production, which is difficult to meet the large-scale demand[3,4].

It is understood that sinopec is studying the technology of fuel desulfurization, currently estimated to cost RMB 700 / ton of fuel desulfurization. With the improvement of fuel desulfurization technology of oil refining enterprises, the cost of fuel desulfurization should be gradually reduced, and the low sulfur oil price will be decreased too, the increase of the consumption of low sulfur oil will inevitably reduce the price spread between the low sulfur oil and the ordinary heavy oil. The size of the price spread determines the economics of using low-sulphur oil.

2.2. Add SOx Scrubbers
The advantage of SOx scrubber is that the ships can continue to use the common heavy oil (HFO) which is much cheaper than low-sulphur oil and thus can greatly reduce fuel expense. But the main disadvantage is that both new ships and existing ships need to be added or upgraded with equipment and systems, that adds millions of dollars to each ship and the future operation and maintenance, alkali liquor, management and the waste liquid recovery disposal costs and troubles. There is also a need to increase the power consumption of hundreds to hundreds of kilowatts, taking up space, and there is a risk that the area will be limited and the malfunction will not run properly. According to the group owns a fleet of 850 ships, single ship investment of $350 to $4 million, to be spent almost $3 billion to $4 billion to increase SOx Scrubbers, and to be completed by 2020, will bring huge capital of pressure
and sail schedule lost (Estimated 10-15 days for single ship rehabilitation cycle). In addition, it is also a huge challenge for the shipyard to complete the installation by 2020, which is a difficult task\textsuperscript{[5]}.

what's more, even though the world's 0.5% low sulphur fuel standard in 2020 doesn't limit the level of PM emissions in clean exhaust, but in MARPOL annex VI article 14, the PM level of exhaust emissions from the scrubber system should be close to the level of low sulphur oil. Although the scrubber can reduce the PM to a certain extent, it is not certain that all scrubber systems can achieve the same level as the use of low sulfur oil. If some cases of scrubber as "equivalent way that could satisfy the requirement of rules" audit withdrawn due to PM to reduce value, or set a PM limit, scrubber may no longer be a meet MARPOL annex VI article 14 of the feasible solution.

The water within 24 nautical miles of the coast of California is only acceptable for the sulfur content of less than 0.1%, do not to accept the SOx scrubbers; The European Union, such as the north sea and Baltic port, also put forward that they will do not accept open exhaust gas desulfurization and other restrictions. When the IMO restrictions on sulfur are effective, in the interest of the ship, if the ship switches to normal heavy oil and does not conduct waste gas treatment during the voyage of the ocean and high seas, there is no effective way to regulate it, and some ships will cheat to avoid the regulation of sulfur. When the IMO restrictions on sulfur are effective, in the interest of the ship, if the ship switches to normal heavy oil and does not conduct waste gas treatment during the voyage of the ocean and high seas, there is no effective way to regulate it, and some ships will cheat to avoid the regulation of sulfur. The international maritime organization and the European Union will consider banning vessels carrying sulphur content more than the global limit on sulphur fuel, which would put them at risk by investing heavily in the owners of the SOx scrubbers.

2.3. Use LNG fuel
In the long run, LNG is the ideal choice for meeting the new standards of IMO. Because the main components of LNG are methane, compared with fossil fuels, its carbon content is 13% to 15%, and CO\textsubscript{2} emissions are 25% to 30% lower. There is almost no SO\textsubscript{x} and PM in the burners, and NO\textsubscript{x} emissions are relatively low\textsuperscript{[6]}.

But the use of LNG fuel is faced with many problems. First of all, LNG shipment is inherently dangerous. LNG is a dangerous chemical, but there are no relevant safety regulations for ship equipped with LNG fuel in China. The maintenance and construction of ships shall strictly comply with the corresponding requirements of international gas regulations, and it is also necessary to use strict training crew to reduce the risk factor of fire or explosion. Second, the LNG fuel tank needs more space. The density of LNG is less than half of HFO, and the calorific value is lower than heavy oil. Therefore, the capacity of LNG fuel tank is much larger than fuel oil. This will result in the reduction of ship carrying capacity and economic benefit. Thirdly, the higher cost of maintenance and construction on LNG ship. Gas engine fuel system are more expensive than ordinary engine fuel system. And as a cryogenic liquid, LNG must take special precautions to avoid contact with human and hull structures and need to continuously monitor leaks.

Due to the disadvantages such as large initial investment in new shipbuilding of LNG power system, difficulty in reconstruction, poor economy of small and medium-sized ships, unformed filling system and unstable long-term supply chain, it is difficult to carry out large-scale promotion of LNG in short term.

3. Opinions and Suggestions
Based on the comparison and analysis of the three schemes, only from the economic point of view shows that if the difference price between 0.5% low sulfur oil and normal heavy oil is $100 / ton, for most ocean-going ships, the SOx scrubber has better economy. But from the trend of the regulation, potential environmental protection new rules (nitrogen oxides and particulate emissions), low sulfur oil and general heavy oil future price trend, corporate social responsibility perspective, choose low sulfur oil or dual fuel oil and gas will become the owner, especially the large new build ship owner's first choice.
To this end, the following recommendations are made:

- Zhejiang free trade zone will actively promote the production and supply of compliance low sulfur oil, and strive to reduce the price difference between low sulfur oil and ordinary heavy oil, and realize the economic target of choosing low sulfur oil at an early date;
- In the planning of low sulphur fuel oil production at the same time, Plan to break through the difficult of different tax Numbers oil mixed, tax rebate for fuel oil export, bonded refining, oil import and export quotas and qualifications, such restrictions, as to play to the competitiveness of Zhoushan bonded fuel oil supply.
- Pay close attention to the ships that have been equipped with scrubber, collect information such as operation and maintenance management, alkali liquor filling, waste liquid recovery and disposal, so as to obtain relevant experience and verify the desulfurization effect.
- In combination with the changes in international oil and gas market, we attach great importance to tracking and studying the Marine LNG fuel technology and market, and timely promote the Marine LNG refueling business.

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