Figure 1. LNG Membrane Fuel Tank – © GTT / Ship Studio.

SEARCHING FOR SOLUTIONS

Geoffroy Beutter, GTT, France, states the case for the GTT membrane tank as the preferred solution for LNG-fuelled ships in light of looming emissions legislation.

While the shipping industry is largely considered to be more environmentally friendly than other transport industries, shipowners/operators should continue to take responsibility for their contributions to air pollution.

No less than 10 MARPOL regulations, with regards to SO_x and NO_x emissions and the Energy Efficiency Design Index (EEDI), have been or will be implemented between 1 September 2017 and 1 January 2020. The implementation of the 2020 Global Sulfur Cap will probably be the biggest ever action to impact the operations of every vessel engaged in worldwide trade since the enforcement of the convention in 1983. Due to the long lives of vessels with marine diesel engines, and because fleet turnover is so slow, the emission benefits associated with the new standards will take a long time to reach their maximum effect. This is the reason why it is of essence that the regulations are enforced without delay.

Several technical options exist to comply with the MARPOL VI Regulations. One exists to comply with all of them. For the 2020 Global Sulfur Cap, there are two main approaches: the first is to continue using traditional dirty fuels and to clean the exhaust gas; the second is to use cleaner fuels. What are the drivers to

make the right decision? Ultimately it is up to the shipowners, their economics and their environmental policy. Only the shipowner (operator) has the right financial metrics and KPIs to make its business sustainable and profitable.

Matter of fuel

On the brink of the introduction of the 2020 Global Sulfur Cap, it is interesting to observe the respective positioning of the main industry stakeholders. For most of them it is business as usual; just wait and see. Although the high sulfur fuels remain at a relatively low price (already sharply increasing for the first months of 2018), the scrubbers to clean the exhausts are not free of charge and can increase the cost in operation. Although burning low sulfur fuels seems to be the simplest solution, it will deeply affect the operational revenue of the ships because of the very high price of this fuel. LNG would seem to be the exception to the rule as it will most probably retain its low prices for a while yet, however the capital expenditure for a ship fuelled with LNG is higher.

A lack of sufficient knowledge on how high the demand will be with regards to the production capacity leaves us in a context of many uncertainties with regards to the price of compliant fuels. In a recent study led by Wood Mackenzie, the demand of marine gas oil (MGO) is expected to increase up to 1.8 million bpd and will be met by ordering additional refinery runs. Traders will begin increasing MGO purchases from 4Q19 to accumulate stock before prices start to rise due to higher demand. It is expected as much as 0.3 million bpd of demand will be shifted from 2020 to 4Q19 due to this effect. The last months before the 2020 Global Sulfur Cap and those immediately after will see a bottleneck for the bunkering traders. In addition, using fuels will require significant attention being paid to the sources with regards to the possibility of mixing them or not. In fact, depending if they are produced from refinery or by blending of 0.1% ultra low sulfur fuel oil (ULSFO) with 3.5% high sulfur fuel oil (HSFO), the products cannot be stored in the same tank due to paraffin deposit. As a consequence, even the simplest solution, as it seems to be, will require a steel work onboard the ship to segregate the capacities and to multiply the fuel supply systems; adding more piping in the machinery arrangement.

There is no single standard for the new 0.5% low sulfur fuel oil (LSFO) that has been specified and agreed. Therefore, no one knows what types of fuel will be available, what the pricing will be like, the specification, or even the available quantity. Hopefully, a draft of best practice guidance for fuel oil purchasers, users and providers will be discussed at the next MEPC73 (October 2018).

These issues and uncertainties make cleaning the exhaust gases from HSFO with a scrubber look a far more straightforward solution. Indeed, with an open loop device, there is no need to store the residues onboard and it is easier to release it at sea. Is this the solution? Categorically not. Shifting harmful pollutants from air to sea is like sweeping dust under a rug. Furthermore, it requires a few hundred kW to run the exhaust cleaning equipment (180 – 240 kW for a scrubber sized to treat the exhausts from 10 MW engine), which will impair the EEDI of the ship. Also, for the record, Phase 3 of EEDI is likely to enter in force by 2022 alongside the recent IMO target discussed during the MEPC72 to reduce all shipping greenhouse gas (GHG) emissions by 50% in 2050. This will further reduce the plausibility of using scrubbers as a solution.

Aside from this, zero emission propulsion technologies are not expected to be available at an affordable price for the coming decades, making LNG a very attractive bridge solution for the medium and long-term. "Gas is not a silver-bullet, but it is a step in the right direction when it comes to reducing carbon emissions," says SGMF's Mark Bell. LNG's usefulness as a solution to curb harmful emissions is indisputable: no SO_x, low NO_x and no particulate matter. Indeed, when compared to heavy fuel oil (HFO) the difference is dramatic. LNG emits up to 90% less NO_x. Also, by using LNG, and taking advantage of a higher calorific value, a reduction in fuel consumption of 20%+ can be achieved. For example, for a typical 52 MW MEGI, the specific fuel oil consumption (SFOC) on MGO mode is approximately 0.17 kg/kWh, whereas it is 0.13 kg/kWh on LNG mode (source: MAN B&W).

Matter of space

The required volume of LNG to equal 1 t equivalent of MGO is 1.6 – 1.8 times more (1000 m^3 of MGO = 1600 m^3 of LNG). On top of this, LNG is a cryogenic product stored at -163°C. Therefore, the storage onboard the vessel is a challenge that only few recognised companies are equipped to overcome. Among these, France's Gaztransport & Technigaz (GTT) – an experienced player

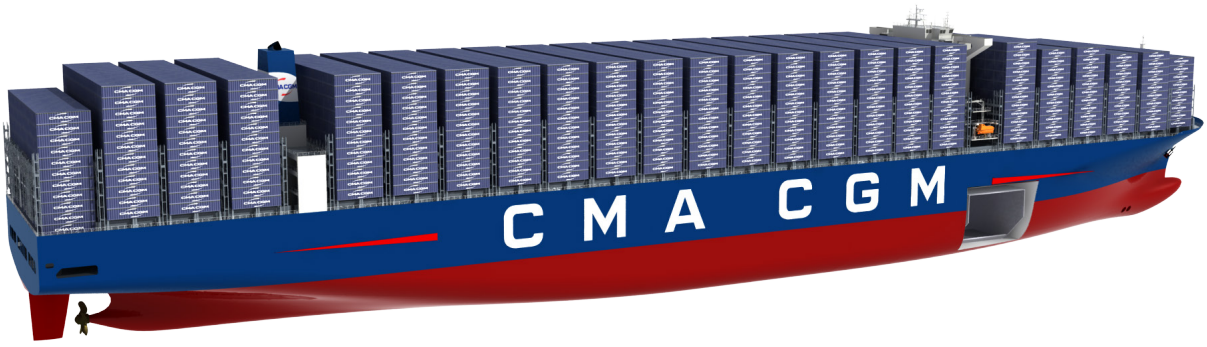

Figure 2. CMA CGM containership – © CMA CGM.

in the cryogenic liquefied gas storage market – is one such company, thanks to its membrane technology. The original philosophy of the technology was to maximise the carried volume by storing the LNG in bulk. The structure of the ship is the structure of the tank itself. The membrane technology fills two functions: to protect the structure of the vessel while securing the tightness on both sides; and to insulate the hold and keep the LNG cold. Considering the maximum filling limit stated by the IGF Code, a GTT Membrane tank can be filled up to 95% and even more in specific conditions. The quantity of unpumpables is less than 1% due to the specific sump well device. This makes the GTT Membrane tank the most efficient in term of usable LNG volume. When it comes to the required space dedicated for inspection surrounding the LNG tank, the added value of the GTT Membrane technology is undisputable: compared to other technologies offering independent tank solutions, known as Type C or Type B, GTT's Membrane technology can save up to 40% of the hold space of the vessel; freeing as much space as possible to be allocated for cargo.

All of these are certainly the reasons why the world's third biggest container liner CMA CGM chose GTT technology for its new flagships, the largest ever ordered containerships (9 x 22 000 TEU vessels). The ships are due to be equipped with dual-fuel propulsion X92DF engines, supplied by Winterthur Gas & Diesel Ltd. (WinGD). The main engine on each ship, as well as the dual-fuel auxiliaries, will be fuelled from a single LNG tank (18 600 m^3 capacity); enough to make the full Europe-Asia roundtrip with one bunkering in northern Europe. For such a bunker tank size to be re-supplied, a dedicated supply chain is being developed.
Mitsui O.S.K. Lines (MOL) has ordered a bunkership, with a capacity of 18 600 m^3, to be chartered by TOTAL who will supply LNG to CMA CGM. Thus, LNG as fuel continues to be developed in the shipping industry, since its arrival in the early 2000s in the Baltic region.

The number of LNG bunkering vessels has grown from one at the beginning of 2017 to six in early 2018. "The bulk LNG infrastructure is largely built, what remains is the last mile, in which the industry is showing a growing appetite to invest," said Peter Keller, multi-sector industry coalition SEA\LNG Chairman and Executive VP of TOTE (another shipowner that has chosen LNG as its fuel of choice for propulsion).

LNG has been used as a marine fuel for ships other than LNG carriers for almost two decades, and for more than 50 years when LNG carriers are considered. The remaining questions are not about technical reliability, availability or infrastructure. The question is to move ahead with the solution that will comply with the rules, existing and forthcoming, for the majority of the time. When considering disruptive technology, there are always either pioneers or followers. Several of the main shipping stakeholders have already made the choice to help the development of LNG as a commodity fuel. The early birds catch the worm. **LNG**