LNG: The Future Fuel for Mega Yachts?
A Study on Using LNG on the 106 m Oceanco Yacht

Summary

T. van Schelven
February 12, 2016

With the introduction of new regulations by the IMO, the search for fuel alternatives has become an interesting topic. The IMO has introduced emission regulations. These regulations are created in order to minimize SO$_X$ and NO$_X$ emissions [3, 4]. Ships can comply with these regulations by for instance using Liquefied Natural Gas (LNG) as fuel, this is also what Oceanco is interested in. LNG creates the possibility to eliminate the SO$_X$ emissions and reduce the NO$_X$ emissions with 85% [1]. This research investigates the use of LNG as only fuel on one of the Oceanco yachts, the 106 m Oceanco yacht. Therefore the research question for this research is: What is the impact on the design of the 106 m Oceanco yacht when only LNG is used as fuel?

The main specifications of this yacht can be described by five reference values:

1. The current design is classed by Lloyd’s Register.
2. The maximum speed is determined at 20.5 knots.
3. The range is currently 5000 nm at a cruising speed of 14 knots.
4. The luxury area on board the yacht is 2269 m$^2$.
5. The dimensions are as designed for the 106 m Oceanco yacht.

Furthermore the research question states that the yacht should use only LNG. This eliminates the possibility of using dual-fuel engines, or using MDO for the hotel load. The objective of the research question states that the impact on the design is investigated. This is done by checking the impact on the reference values after several concepts have been researched.

A technical selection was made for the engines and tanks. Two engines are selected: a high speed MTU engine and a medium speed Bergen Rolls-Royce engine. For both engines a gas-direct alignment and a gas-electric alignment have been researched. For the tanks, a type C tank and a membrane tank are investigated. The advantage of the type C tank is the high allowable pressure of 10 bar g, for the membrane tank this is 0.7 bar g. A disadvantage of the type C tank is the cylindrical shape, which is space inefficient. While the membrane tank can be shaped to fit in the available space [2, 7].

The concepts are investigated and compared. The final concept for the 106 m LNG Oceanco yacht uses four high speed MTU 16V4000 M64 engines, as well as four Mitsubishi GS12RMPTK generators [5, 6]. These are fueled from the membrane tank, installed forward of the engine room. Reviewing the initial reference values, the following conclusions can be drawn.

The first reference value states that the original design is classed by Lloyd’s Register. The LNG concept is classed by Det Norske Veritas, this creates more possibilities to place the LNG application.

The second reference value was the maximum speed of at 20.5 kn. Due to the limited amount of high speed gas engines available the speed is lowered to 19.5 kn, which is a reduction of 1 kn.

The third reference value described the 5000 nm range at a cruising speed of 14 kn. This reference value is not met, however when the cruising speed is lowered to 10 kn the range becomes 3927 nm. Which is considered to be sufficient, as the yacht is in this case able to cross the Atlantic Ocean.

The fourth reference value states that the luxury area of this yacht is determined at 2269 m$^2$. In the new design the luxury area is reduced to 2085 m$^2$. This is due to the LNG tank, which is placed on the tank deck. In the original design the fuel tanks were placed in the double bottom. With LNG tanks this is not allowed, therefore the membrane tank is placed on the tank deck.

The fifth reference value refers to the dimensions of the original design. There are two option which could be researched: fix the main dimensions and change the functional requirements, or fix the functional requirements and change the dimensions. In this research it was chosen to fix the dimensions and change the functional requirements, therefore this reference value has not been changed.

To conclude, four of the five reference values have been changed. This shows that the impact on the 106 m Oceanco yacht is significant. Especially the impact on the luxury space in considerable, the total area required for the LNG application is 184 m$^2$. In order to have a greener yacht which complies with the new IMO regulations, it is possible to use LNG. However, an owner would have to compromise with a lower maximum speed, range, cruising speed and less luxury area.

References

[2] GTT. Mark III System - GTT.