Gibson Ammonia Update
Ammonia – New Kid in the Engine Block

GIBSON SHIPBROKERS

Introduction

As the shipping industry searches for new zero emission fuels, the recurring themes of hydrogen, methanol and ammonia keep presenting themselves as the main focus for research and development. Ammonia, seems to have much of the momentum. Here we will outline some of the recent developments within the Ammonia fuel sector.

So what's all the noise about

Ammonia is a colourless fuel that emits no carbon dioxide when burned. It can be made using renewable electricity, water and air. Both fuel cells and internal combustion engines (ICE) can use it. Unlike hydrogen, it doesn't have to be stored in high-pressure or cryogenic tanks. It also has around 10 times the energy density of lithium-ion batteries.

So as a zero emission fuel, ammonia does have a lot going for it. Whilst there currently isn't a vessel that operates on the fuel, there are a number of engine manufactures that are developing suitable engines.

However, there are few concerns for engineers to overcome. Firstly ammonia is a hazardous product, it is also corrosive, and when burned at high temperatures it can produce nitrogen dioxide, which contributes to smog and acid rain. It also produces nitrous oxide, a more potent greenhouse gas than carbon dioxide and methane. These are known short comings with ammonia and can be mitigated in the design process of vessels. Despite these known concerns there is still much interest in making it work for the shipping industry, and indeed the general economy as a whole.

Hitting the books

There are a large number of studies that are currently underway looking at various aspects of the ammonia production and logistics chain. Singapore's Eastern Pacific Shipping has joined with Nanyang Technology University, Singapore to explore green ammonia production and supply, ammonia bunkering processes and adopting ammonia as a marine fuel.

TotalEnergies is also investigating ammonia as an alternative marine fuel. It is also cooperating with other players across a wide variety of sectors to assess the impact of ammonia as a fuel.

Japan's NYK Line has joined with ClassNK, Nihon Shipyard and Norway's chemical company Yara International to study the practical application of ammonia-fuelled ammonia gas carriers (AFAGC). The projects will provide the worlds first AFAGC. The study will evaluate the economic efficiency for charterers and shipowners and consider compliance with laws and regulations. Nihon Shipyard will be responsible for R&D and design as well as estimating the CO_2 emission reductions.

As a fuel?

Whilst there is much interest, it will take a while before the first vessels actually hit the water. Some of the first movers are:

Hoegh Autoliners intends to invest in up to 12 Aurora class multi-fuel and ammonia ready vessels designed with 9,100 car equivalent unit capacity. DNV has provided a new 'ammonia ready' notation for these vessels, which will be a first in the segment. The vessels are scheduled for delivery at the beginning of 2024.

Avin International ordered a second ammonia-ready Suezmax for $57.5 million from China's New Time Shipbuilding back in April 2021. The vessel will be delivered during 2022, which is expected to burn conventional fuels initially and will switch to ammonia as the bunker industry evolves.

Navigare Shipping & Logistics, AS Mosvolds Rederi and shipping consultant Amon Maritime have set-up a JV named Viridis Bulk Carriers, which will specialise in short-sea shipping, with the new vessels powered by green and blue ammonia. The vessels will also have exhaust gas after treatment systems optimised for ammonia which will eliminate any by-products. The vessels are planned for delivery in 2024-2025. Initially the zero carbon ammonia will be offered at a cost premium compared to MGO, but in time the company expects zero carbon ammonia to compete successfully on price.

Eidesvik Offshore's PSV *Viking Energy*, which has had several firsts, including being the first LNG-fueled PSV, the first battery powered PSV and in 2024, will become the first PSV to operate with fuel cells running on emission-free ammonia. A total of 2 MW of power will be installed. However, these will be newly designed solid-oxide fuel cells, which use a solid ceramic mater, zirconia as the electrolyte. This will allow it to operate at a high temperature of about 1,000°C.

Bunker vessels

Of course the obvious question is, if there are going to be ammonia fuelled vessels, where will they bunker? Well, as we have seen with the development of the LNG bunkering sector, it depends on the vessels and their trading patterns. Small-scale, locally trading vessels could be bunkered via truck-to-ship. Vessels on regular routes may well suit shore-to-ship transfers. Whereas vessels on longer or irregular trading patterns may be better serviced by bunker vessels. All this infrastructure will require financing, planning and construction.

In preparation for the arrival of ammonia fuelled vessels, Kanfer Shipping of Norway has signed a letter of intent (LOI) with Oceania Marine Energy of Australia to build an ammonia-ready LNG bunker vessel. The vessels will focus on Northwest and Eastern ports of Australia. Initially the vessel will utilised LNG as a bunker fuel, but as the country transitions towards green ammonia the vessel will be able to utilise the fuel.

Where are you going to get it from?

The idea that shipping (and other industries) can reach zero carbon is now an established theme within the energy sector. Reaching zero carbon is an altogether different issue. It would seem that there are a number of different methods to produce ammonia (and hydrogen), with each successive step, reducing, then eliminating carbon from the fuel. These are:

- **Brown ammonia** – higher carbon ammonia made using a fossil fuel as the feedstock.
- **Blue ammonia** – like brown ammonia but made with carbon capture and storage technology applied to the manufacturing process.
- **Green ammonia** – zero carbon ammonia, made using sustainable electricity, water and air.

Are we there yet?

The quest for shipping to become a zero emitter is now well established from the IMO, class societies, owners and charterers. The reality, however, might need some expectation management. There are still engineering concerns such as toxicity and how to design a safe fuelling system, as well as the massive investment required for a sufficient bunkering infrastructure, as well as replacing vessels with ammonia fuelled ships. So looks like there is still much to be done.

For additional information please contact: research@eagibson.co.uk