Ship Operation Using LPG and Ammonia As Fuel on MAN B&W Dual Fuel ME-LGIP Engines

Using low carbon ammonia fuel

René Sejer Laursen
E-mail: ReneS.Laursen@man.eu
30-10-2018
MAN Energy Solution in World Trade

50% of World Trade is powered by MAN-ES Engines!

3000 MAN B&W engines can eventually be converted to ammonia operation.
Center of Competence 2-stroke Low Speed Diesel
Copenhagen, Denmark

- Design of Two-Stroke Engines
- Production of Spare Parts
- PrimeServ Academy
- R&D Center
- Diesel House

Employees (July 2017) 1,306
Changing from Coal to Oil

In 1912 the Diesel driven MV Selandia left Copenhagen into a world with no fuel bunkering possibilities
1050 HP B&W engine
Today - The Dual Fuel success

4 x World’s first duel fuel driven ships equipped with MAN B&W engines

**World’s first** LNG driven ocean going ship
Owner: TOTE
Ship type: Container ship
Capacity: 3,100 Teu
Dual Fuel engine type: 8L70ME-C8.2-GI

**Owner**: MOL
Ship type: Methanol carrier
Capacity: 50,000 dwt
Dual fuel engine type: 7S50ME-B9.3-LGI

**Year 2012**

**World’s first** methanol driven ocean going ship

**World’s first** ethane driven ocean going ship
Owner: Hartmann Schifffahrt
Ship type: LEG Carrier
Capacity: 36,000 M³
Dual Fuel engine type: 7G50ME-GIE

**Year 2014**

**World’s first** LPG driven ocean going ship
Owner: Exmar
Ship type: VLGC
Capacity: 80,000 M³
Dual Fuel engine type: 6G60ME-LGiP

**Year 2018**
CSSC-MES Diesel Co. Celebration
Manufacturing 10 million MAN Diesel & Turbo designed BHP
The new MAN B&W ME-LGIP engine
Regulation – a driving factor for engine development

Today, focus is on SO$_x$ and NO$_x$:

- NO$_x$ reduction is achieved with EGR and SCR
- SO$_x$ reduction is achieved with MGO, LFSO, scrubber, LNG, methanol and LPG

In the future, we will see a growing focus on CO$_2$, methane slip and VOC:

- 40% reduction of carbon intensity per transport work by 2030 and 70% by 2050 compared with 2008
- 50% reduction of greenhouse gas emissions from ocean shipping by 2050 compared with 2008
- Reduction of methane slip emissions $\rightarrow$ Diesel cycles
- Reduction of VOC emissions $\rightarrow$ ME-LGIP

*Carbon free fuels will be mandatory to meet the 2050 goal*
Our dual fuel done right engine technology is well suited to support such goals
Ammonia, NH₃ as green fuel produced with renewable energy
Ammonia is the logic option

NH₃ advantages as green fuel:

• No carbon. Clean combustion without CO₂ or carbon
• Can be produced 100% by electrical energy
• Can easily be reformed to H₂ and N₂
• Can be stored with high energy density at < 20 bar
• Low risk of fire. Relatively specific ratio of NH₃ and air (15-25%) is required to sustain combustion
The new MAN B&W ME-LGIP engine

Two-stroke market – Dual fuel contracting of total contracting

- Highest thermal efficiency
- Lowest unburned hydrocarbons
- Largest range of available fuel types
- Best controlled combustion under all dynamic and ambient conditions
The New MAN B&W ME-LGIP Engine

LGIP Technologies Confirmed at RCC - LGIP Injection Concept

Cylinder cover with LPG injection valve and gas block – same system to be used for NH3

Valve control block:
- ELWI-valve (fuel pressurization)
- ELGI-valve (injection timing)
- Hydraulic accumulator
- Hydraulic and sealing oil connections

Double wall gas piping:
- LPG inlet
- LPG return
The new MAN B&W ME-LGIP engine
This engine type can be modified to burn ammonia as well.

- Development time of an ammonia engine 2-3 years
- We will be ready when the market comes
- Efficiency 50%
NOx emission – ammonia.

Selective Catalytic Reduction (SCR) Process – removing NOx emissions

This SCR process requires ammonia in order to work.

Exhaust gas

NO_2 → NO → NH_3

40% urea solution
CO (NH_2)_2 \cdot 5(H_2O)

NH_3

SCR Reactor

N_2
H_2O

4NO + 4NH_3 + O_2 = 4N_2 + 6H_2O
6NO_2 + 8NH_3 = 7N_2 + 12H_2O
The new MAN B&W ME-LGIP engine
LR1 tanker ME-LGIP auxiliaries – for ammonia the tank size will double due to the lower energy content
Conclusion

Propulsion solutions on short term:

• New fuels with lower CO₂ emission will be needed to meet EEDI
• To increase the efficiency; solutions like PTO, WHR will be more common

Propulsion solutions on long term:

• Two stroke engines will remain as the most dominating propulsion solution
• Carbon free produced methanol, ammonia, LNG and biofuels will be available
• All above fuel types can be burned in the 2-stroke ME-C, ME-GI or ME-LGI engine
• Engine Efficiency above 50% (60% incl. WHR & PTO)

Development of an ammonia fuelled ME-LGI engine:

• History shows that ammonia works as an engine fuel.
• Engine development will be done when the market comes.
• Development time is estimated to 2-3 years.
• Development cost of an ammonia engine, estimated to 5 mill EUR.
Thank you!
Do you have any questions?