Methanol - An Ultra Clean Marine Fuel Solution

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Methanex
The world’s largest producer and supplier of methanol to major international markets
Waterfront Shipping

- 28 vessels, including 7 methanol dual-fuel vessels
- 4 new methanol dual-fuel vessels on order (2019)
Methanol Marine Fuel
Methanol Marine Fuel

Methanol is an innovative alternative fuel solution with many benefits

- Low emissions
- Wide availability
- Innovative Technology
- Cost competitive
- Fuel flexibility
- Safe, environmentally friendly
Marine Fuel Emissions Regulations

Cleaner-burning marine fuels being phased in due to increasingly strict emissions regulations

IMO Sulphur Limits – Marpol Annex VI

IMO limits SOx content of fuel to 0.1% in ECAs. Global sulphur cap of 0.5% (from current 3.5%) to come into effect in 2020.

IMO Nitrogen Oxides Limits – Marpol Annex VI

Tier III NOx limits effective in North America in 2016 and North and Baltic effective 2021 (newbuilds only)

Source: IMO
Emissions Reductions

Methanol is a clean-burning fuel that meets stringent environmental regulations

Source: Stena Lines
Emission reductions when compared to heavy fuel oil
Wide Availability

Methanol infrastructure already in place and well positioned to reliably supply the global marine industry

Methanol Global Terminal Locations

Methanol global terminal locations based on available information; not a complete list

North America Methanol Market

Red flags/circles represent existing methanol supply locations; lines represent rail networks

Source: Methanex
Low-Cost Infrastructure and Capital Costs
- Methanol is a cost-effective, liquid marine fuel alternative
- Methanol offers fuel flexibility

- Liquid fuel at ambient temperature & pressure
- Low cost infrastructure
- Compatible with diesel infrastructure

- Engine technology straightforward/minor modifications required
- Flex fuel (diesel or methanol) maintained mitigating commodity price & technology risks
Methanol - Environment, Health and Safety

*Methanol is a clear, colourless liquid that quickly and naturally biodegrades*

- More environmentally benign than conventional marine fuels (i.e. HFO and MGO)
- Long history of methanol safe handling
- International standard (IGF Code) under development for methanol as marine fuel
Cost Competitive Fuel Cost vs. Marine Gas Oil (MGO)
- Methanol is an economically viable alternative marine fuel over the cycle
- Potential for short payback on investment based on historical fuel pricing

Marine Fuel Pricing
Methanol adjusted to MGO Energy Equivalency

Chart source: Platts and IHS Chemical
- Methanol: USGC spot price adjusted to energy equivalent of MGO (2.16 factor)
- MGO: West Coast N.A. Average: Vancouver, Seattle, San Francisco, LA; Europe: Rotterdam, Antwerp, Hamburg; Asia: Singapore, S. Korea, Hong Kong, Shanghai
Waterfront Shipping

Methanol dual fuel vessels – An operator’s experience
Strong partnerships with key stakeholders

*The world’s first methanol-fuelled tankers*

Vessel concept developed together with MAN Diesel & Turbo, Alfa Laval, DNV-GL and the Norwegian Maritime Directorate.

Seven ships currently operating from Hyundai Mipo Dockyard and Minaminippon Shipbuilding for Marinvest, Westfal-Larsen and MOL on long term time charter with Waterfront Shipping.

An additional four ships on order (delivery 2019) from Hyundai Mipo Dockyard for Marinvest, IINO Kaiun Kaisha, Ltd. and Mitsui on long term charter with Waterfront Shipping.
Recognitions and Milestones

Accolades from the marine industry for use of clean-burning methanol

With new order, 40% of WFS tanker fleet to be methanol-fuelled

MANCHAC SUN: Methanol-fuelled methanol carrier

Best Fuel Solution Award
Waterfront Shipping

WINNER

Lindanger
World's First Methanol-Powered Tanker
Builder: Hyundai Heavy Industries
Owner: Waterfront Shipping

Highly Commended
Company of the Year
Waterfront Shipping Company
Design Philosophy: General design decision

Primary focus: personal and system safety
Secondary focus: engine reliability

Main design considerations

- **Gas safe** engine room
- **Single failure** results in Second Fuel (SF, Methanol) shut down or SF stop
- Methanol system **must not impact** the engine running on MDO/HFO
- Methanol system is an “Add-On” to the ME engine
Methanol concept: A fail-safe add on system

High pressure direct methanol injection using low pressure supply and hydraulic activation, through separate injectors, with conventional fuel pilot for ignition.

MAN B&W 6G50ME-B9.3-LGI-M

- Methanol fuel service tank with transfer system
- Liquid fuel supply system (LFSS)
- Fuel Valve Train (FVT)
- Nitrogen purging and inerting
- Cooling and sealing oil systems
Methanol concept: Supply System (LFSS)
Safety features

- **Fail Safe System** - Auto change over from SF to PF
- **Nitrogen** Purging
- **Double Walled** Piping and Components
- Leakage **Detection**
- Continuous **Ventilation**
- **Intrinsically safe** components
- Fixed **CO2 Extinguishing System**
- **CCTV** Monitoring
- **Alarms** with shutdown and purging
- **Immediate switch** to conventional fuel
- **Fire fighting on deck**
- Fire fighting in **ER**
Novel ideas based on proven technology

Centered on the **MAN ultra-long-stroke dual fuel engine** (6G50ME-B9.3-LGI), ensuring a **solid and reliable framework**.

Designed with instantaneous, **automatic fall-back to conventional fuel** in the unlikely event of a disruption of methanol supply.

Able to operate at **unrestricted power, equivalent efficiency, reduced emissions**, with 5% pilot fuel.

Fuel Booster Injection Valves with **integrated pressure booster allow for low pressure supply of methanol fuel**, through double wall pipes from the Liquid Fuel Supply System on main deck.
FBIV and conventional fuel injector slide valve
Status

- Continue to operate on methanol
- **3 fuel options** (HFO, LSGO, MEOH): flexibility in many price scenarios
- Cylinder chambers are much cleaner
- Difficulties encountered previously have been generally sorted out
- Engineering crew transfer their knowledge from conventional engines
- MAN provides **LGI-M specific training** to engineers
Going Forward
ME-LGI Next Generation simplified piping
Going Forward
Potential NOx Tier III compliance – Methanol + Water

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Key Takeaways
Positive outlook for methanol marine fuels

- Methanol is proven to meet current and future emission regulations
- Valuable learnings on solutions to further enhance vessel operating performance and adopt methanol at a commercial scale
- Methanol is a competitive alternative marine fuel
Thank you!

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