

# Methanol – an alternative fuel for greener shipping

Methanol is a promising alternative fuel for reducing emissions and improving the environmental performance of shipping. It contains no sulphur and because it is a clean burning alcohol, emissions of NO<sub>x</sub> and particulate matter from combustion are low. It is widely available and storage and distribution are similar to conventional fuels. Interest in this fuel is growing, and SSPA was co-coordinator of an important pilot project to demonstrate the use of methanol fuel on-board a ship and in adapted marine engines.



The Stena Scanrail with methanol tank installed on the weather deck.

## Main drivers for fuel choice

**When assessing alternative fuels for shipping, many factors need to be considered, including:**

- market factors such as cost and availability
- technical and operational factors including necessary onboard installations, safety, maturity of technology, and availability of equipment
- environmental factors including emissions, fuel production and transport impacts (“well to tank”), and impacts from accidental spills.

New regulations have driven shipowners to find ways of reducing emissions of sulphur and nitrogen oxides. Over the longer term, it is expected that there will also be targets for reduced particulate matter and CO<sub>2</sub>. Switching from heavy fuel oil to a cleaner alternative fuel is a good solution from many perspectives.

## Why methanol?

One of the objectives of the recently completed EffShip (Efficient Shipping with Low Emissions) project was to identify possible alternatives to existing marine fuels that could result in lower emissions and be implemented within the next five years. It was concluded that methanol is a competitive alternative for meeting emissions guidelines, and based on this the SPIRETH (Alcohol (Spirits) and Ethers as Marine Fuel) project was formed to investigate this alternative more thoroughly. SPIRETH focused on an investigation of technical, operational, safety, and emission factors of methanol-based fuels through on-board demonstration and full scale laboratory testing.

## Wide availability and many feedstocks

Methanol, also known as methyl alcohol or

wood alcohol, is the simplest alcohol and widely used in the chemical industry. It is also used as an energy source, and this application is growing. The majority of methanol produced today is from natural gas, the same feedstock used for LNG. Although it takes more energy to produce methanol, there are many advantages due to the simplified distribution and use. It is a liquid transported in chemical product tankers at atmospheric temperature and pressure, and stored in tanks similar to those used for gasoline. Thus distribution, handling, and bunkering systems for methanol would be very similar to those used today for traditional marine fuels.

Methanol can be produced from a wide range of feedstocks – any carbon source can be used. Natural gas and coal are the most common, but the most exciting for the future are the renewables. Some examples of renewable



*Methanol has many environmental advantages, including lower air emissions and reduced spill impacts, as compared to the heavy fuel oil traditionally used in shipping.*

feedstock used in current production are forest biomass, municipal waste, and black liquor from pulp mills. On Iceland, methanol is produced using CO<sub>2</sub> emissions and energy from a geothermal plant, and has been certified as a renewable fuel of non-biological origin. Ships converted to operate on methanol can simply begin blending in renewable methanol in the future to reduce their operational carbon footprint.

Although methanol has many characteristics making it suitable for a marine fuel, prior to the SPIRETH project it had not been tested in marine diesel engines.

### ***Demonstrating methanol on a ship***

The SPIRETH project objective was to test the fuels methanol and di-methyl ether (DME) in



*Methanol is a liquid at ambient temperature and pressure and was stored in a tank container for the SPIRETH project.*

marine engines in a full-scale pilot project. Two project testing and development streams were defined as follows:

- DME: An OBATE™ (On Board Alcohol to Ether) process unit for dehydrating methanol to a fuel mix of DME, water, and methanol was designed, installed, and operated on-board the Stena Scanrail, a ro-pax ferry operating between Gothenburg, Sweden, and Frederikshavn, Denmark. An auxiliary engine was modified to run on the OBATE™ fuel mix and installed on board the ship.
- Methanol: Conversion of a full-scale marine diesel engine in a laboratory installation to run efficiently on methanol with pilot fuel ignition.

### ***Methanol shown to be a viable alternative***

SPIRETH has shown that it is feasible to convert ships to operate on methanol and DME-based fuels, and these fuels are viable alternatives to reduce emissions. On-board arrangements for methanol storage, distribution, and handling were designed and installed on the Stena Scanrail. A retrofit solution was developed for conversion of a ship's main diesel engine to methanol operation, for testing in a laboratory. Low emissions, high efficiency, robust solution and cost-effective conversion were key factors considered when evaluating the different combustion concepts and design solutions. Diesel combustion of methanol with pilot fuel ignition was determined to be the preferred combustion retrofit concept.

The risk and safety analysis in SPIRETH contributed to the development of ship classification society rules for methanol as a



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ship fuel. The work also contributed to the International Maritime Organization's draft IGF code (International Code of Safety for Ships using Gases or Other Low-Flashpoint Fuels).

### ***Future projects and directions***

Interest in methanol as a marine fuel continues to grow. The SPIRETH project has contributed to Stena Rederi's initiation of a project to convert the Stena Germanica, the world's third largest ro-pax ferry, to methanol operation. There has been significant international interest in project findings and methanol is now firmly on the list of viable solutions for improving the environmental performance of shipping.

### ***The SPIRETH project***

The SPIRETH project consortium consisted of SSPA Sweden (project coordinator), ScandiNAOS (technical coordinator), Stena Rederi, Haldor-Topsøe, Wärtsilä, Lloyd's Register EMEA, and Methanex. The project was co-funded by the Swedish Energy Agency, Baltic Sea Action Plan Facility Fund (Nordic Investment Bank), the Nordic Council of Ministers' Energy & Transport Programme, and the Danish Maritime Fund. Read more at: [www.spireth.com](http://www.spireth.com)

