

Dimethyl ether (DME)

Lab scale

Bench scale

Pilot Plant

Demonstration

Production

Introduction

Dimethyl ether (typically abbreviated as DME), also known as methoxymethane, wood ether, dimethyl oxide or methyl ether, is the simplest ether. It is a colourless, slightly narcotic, non-toxic, highly flammable gas at ambient conditions, but can be handled as a liquid when lightly pressurized. The properties of DME are similar to those of Liquefied Petroleum Gas (LPG). DME is degradable in the atmosphere and is not a greenhouse gas.

See page two for Production Process.

Applications

Due to its good ignition quality, with a high cetane number, DME can be used in diesel engines as a substitute for conventional diesel fuel. However, compared to diesel fuel DME has a lower viscosity (insufficient), and poor lubricity. Like LPG for gasoline engines, DME is stored in the liquid state under relatively low pressure of 0.5 MPa. This helps to limit the number of modifications required to the engine. Still, some slight engine modifications are necessary, primarily relating to the injection pump and the installation of a pressure tank, similar to that for LPG. The fuel line must also be adapted with specific elastomers.

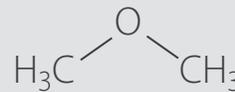
DME in diesel engine burns very cleanly with no soot.

The infrastructure of LPG can be used for DME. As part of the FP7 project BioDME, under the leadership of the Volvo Group, DME production is being optimized, especially for use as a transport fuel.

European Projects on DME

BioDME - Production of DME from Biomass and utilisation as fuel for transport and for industrial use. Funded by 7th Framework Programme and Swedish Energy Agency.

Molecular Formula



Comparison of Fuel Properties

Property	DME	Diesel
Density at 20 °C [kg/l]*	0.67	0.83
Lower heating value [MJ/kg]*	28.4	43.1
Cetane number*	60	50
Fuel equivalence*	0.59	1
GHG [gCO ₂ eq/MJ]**	Waste wood DME: 5	
	Farmed wood DME: 7	

Source: FNR 2012. * Median values are used for simplification. Please refer to the standards for ranges. ** Directive 2009/28/EC, total for cultivation, processing, transport and distribution

Utilization

Substitute for diesel fuel; transportation fuel; power generation fuel; domestic gas

Relevant fuel regulations

EN590 (diesel fuel)

Main feedstocks

Forest products, agricultural by-products, organic waste, energy crops, black liquor

Scale of Production

Demonstration scale

Production process

DME is primarily produced by converting natural gas, organic waste or biomass to synthesis gas (syngas). The syngas is then converted into DME via a two-step synthesis, first to methanol in the presence of catalyst (usually copper-based), and then by subsequent methanol dehydration in the presence of a different catalyst (for example, silica-alumina) into DME.

The following reactions occur:



Alternatively, DME can be produced through direct synthesis using a dual-catalyst system which permits both methanol synthesis and dehydration in the same process unit, with no intermediate methanol separation, a procedure that, by eliminating the intermediate methanol synthesis stage, the licensors claim promises efficiency advantages and cost benefits.

Both the one-step and two-step processes are commercially available.

DME can also be converted itself into olefins and synthetic hydrocarbons.

Major stakeholders

Volvo Group, Sweden

Chemrec, Piteå, Sweden

Haldor Topsøe, Kgs. Denmark

Preem, Sweden

Total, France

State of the Art

The DME demonstration plant in Piteå, Sweden, which was put into operation in 2010, is the only gasification plant worldwide producing high-quality synthesis gas based on 100% renewable feedstocks. The raw material used is black liquor, a high-energy residual product of chemical paper and pulp manufacture which is usually burnt to recover the spent sulphur.



BioDME plant with DME log truck in foreground © Chemrec 2011

Further information

Up-to-date information on Dimethyl ether DME R&D&D is available on the European Biofuels Technology Platform website www.biofuelstp.eu.