

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).

See page two for Production Process.

State of the Art

Due to its good ignition quality, DME can be used in diesel engines as a substitute for diesel fuel. Compared to diesel DME has a lower viscosity. It is stored under relatively low pressure of 0.5 MPa in the liquid state. Because of this, slight modifications to the engine are necessary, primarily relating to the injection pump and the installation of a pressure tank, similar to that for LPG. Dimethyl ether in diesel engine burns very cleanly with no soot.

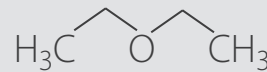
According to the EC Directives 2009/28/EC (RED) and 2009/30/EC (FQD) dimethyl ether is a biofuel if it is produced from biomass and intended for use as biofuel (in diesel engines). For other purposes (e.g. continuous combustion in boilers), DME can be blended with LPG. As part of the FP7 project BioDME under the leadership of the Volvo Group DME production is being optimized, especially for use as a transport fuel.

The demonstration plant in Piteå, which was put into operation in 2010, is the only gasification plant worldwide producing high-quality synthesis gas based on 100% renewable feedstock. 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.

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



Properties of dimethyl ester DME

Molecular mass: 46.07 g/mol
Density at 20°C: 668 kg/cm³
Viscosity at 20°C: 0.15 mPa s
Heating value: 28.4 MJ/kg
Vapour pressure at 20°C: 5100 hPa

Utilization

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

Relevant fuel regulations

EN590 (diesel fuel)

Main feedstocks

Black liquor, forest products, agricultural by-products, organic waste, energy crops

Scale of Production

Demonstration scale

Costs and GHG Balance

Origin	GHG [g CO ₂ eq/km]	Production cost [€/GJ]
Waste wood	12	16.8
Farmed wood	16	19.9
Black liquor	7	8.5

Assumes crude oil at 50 US-\$/bbl

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.



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.

Major stakeholders

Volvo Group, Sweden

Chemrec, Piteå, Sweden

Haldor Topsøe, Kgs. Denmark

Preem, Sweden

Total, France

Delphi, Luxembourg

DECHEMAETC, Sweden