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Syngas to DME by Air Products Process

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Table of contents

1 Introduction 7

2 Summary 8

3 Industry status 10

4 Technology review 13

DME production pathways 13

Single step synthesis of DME 15

Reaction conditions 15

Liquid Phase DME (LDPME™) by Air Products & Chemical Inc. 16

5 Process economics 20

Design basis 20

Process description 21

Material balance 22

Equipment list 23

Utilities summary 25

Cost estimates 25

Fixed capital costs 25

Production costs 26

Economic discussion 26

Carbon dioxide and water footprints 33

Appendix A — Design and cost basis 34

Design conditions 35

Cost basis 35

Capital investment 35

Project construction timing 36

Available utilities 36

Production costs 37

Effect of operating level on production costs 37

Appendix B — Cited references 38

Appendix C — Process flow diagrams 41

Tables

Table 2.1 Summarized design basis and assumptions of Air Products LPDME™ syngas to DME process 8
Table 2.2 Summary of production costs of Air Products LPDME™ syngas to DME process 9
Table 4.1 Physical properties of major alternative fuels and commonly used fuels 13
Table 5.1 Design basis and assumptions for Air Products LPDME™ syngas to DME process 20
Table 5.2 Air Products LPDME™ syngas to DME process — Major streams flow 22
Table 5.3 Air Products LPDME™ syngas to DME process — Major equipment 23
Table 5.4 Air Products LPDME™ syngas to DME process — Utilities summary 25
Table 5.5 Air Products LPDME™ syngas to DME process — Total capital investment 27
Table 5.6 Air Products LPDME™ syngas to DME process — Variable costs 28
Table 5.7 Air Products LPDME™ syngas to DME process — Production costs 29
Table 5.8 Air Products LPDME™ syngas to DME process — CO_2 and H_2O footprint 33

Figures

Figure 3.1 Distribution of global methanol consumption by end use 11
Figure 3.2 Global distribution of methanol demand by fuel applications — 2026 12
Figure 4.1 Two-step method 14
Figure 4.2 Single-step method 14
Figure 4.3 Air Products & Chemical Inc.’s DME production block flow diagram (First mode) 17
Figure 4.4 Air Products & Chemical Inc.’s DME production block flow diagram (Second mode) 18
Figure 4.5 Air Products & Chemical Inc.’s DME production block flow diagram (Third mode) 19
Figure 5.1 Effect of plant capacity on investment costs 30
Figure 5.2 Net production cost and product value of DME as a function of purified syngas price 30
Figure 5.3 Net production cost and product value of DME as a function of hydrogen (99 vol%) price 31
Figure 5.4 Net production value of DME as a function of operating level and plant capacity 31
Figure 5.5 Product value of DME as a function of operating level and plant capacity 32

Appendix C Figures

Figure C1 Process flow diagram for Air Products LPDME™ syngas to DME process 42

Glossary

°F	Degree Fahrenheit
¢/lb	Cents per pound
¢/kWh	Cents per kilowatt-hour
$/t	Dollars per metric ton
atm	Atmospheres
Bcm	Billion cubic meters
BFD	Block flow diagram
BFW	Boiler feedwater
Bhp	Brake horsepower
BLI	Battery limits investment
Btu	British thermal units
Capex	capital expenditure
Cc	cubic centimeters
cP	Centipoise
cf/ft^3	Cubic feet
CW	Cooling water
DME	dimethyl ether
DOE	Department of Energy
FOB	Freight on board
ft dia	Feet diameter
G&A	General and administrative
g	Grams
gal	Gallons
g/cm^3	Grams per cubic centimeter
GHSV	gas hourly space velocity
gpm	Gallons per minute
h	Hours
HAD	hydrodealkylation
HP	High pressure
HVAC	Heating, ventilation, and air conditioning
Kcal	Kilocalories
kcal/kg	Kilocalories per kilogram
kg	Kilograms
kJ	Kilojoules
kPa	Kilopascals
kW	Kilowatts
lb	Pounds
LNG	liquefied natural gas
LPG	liquefied petroleum gas
mgal	Thousand gallons
mlb	Thousand pounds
MMBtu	Million British thermal units
MMlb/y	Million pounds per year
MMt	Million metric tons
MMt/y	Million metric tons per year
MOC	materials of construction
mol%	Molar percent
mol/mol	Mole per mole
mPa	Megapascals
MTBE	methyl tert-butyl ether
MTO	Methanol-to-olefins
opex	operating expense
OSBL	outside battery limits
PEP	Process Economics Program
PFD	Process flow diagram

ppb	Parts per billion
ppm	Parts per million
psi	Pounds per square inch
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
R&D	research and development
rDME	renewable DME
ROI	Return on investment
s	Second(s)
scf	Standard cubic feet
scm	Standard cubic meter
SL	Standard liter
SS	Stainless steel
sq ft	Square feet
t	Metric ton
TAME	Tertiary amyl methyl ether
t/y	Metric tons per year
TFC	Total fixed capital
vol%	Volume percent
w/w	Weight for weight
wt%	Weight percent

Abstract

Growing global interest in clean, synthetic fuels has renewed attention on dimethyl ether (DME), a sulfur-free, low-emission alternative to diesel and liquefied petroleum gas (LPG). DME can be produced via the conventional two-step route, methanol synthesis followed by dehydration, or by single-step processes that integrate both reactions within a single reactor. Among these emerging single-step technologies, the Liquid Phase DME (LPDME™) process developed by Air Products has been extensively studied as a conceptual approach for producing DME directly from synthesis gas. Although pilot-scale demonstration runs were successfully carried out at the US Department of Energy's LaPorte Alternative Fuels Development Unit, no commercial-scale deployment has been reported to date. The LPDME™ concept integrates methanol synthesis and dehydration within a single slurry-phase reactor, enabling direct production of DME while minimizing the overall equipment count.

In this review, a comprehensive review of a conceptual LPDME™ process is presented, with emphasis on its technological configuration and economic feasibility. The process is particularly relevant for energy-intensive regions such as mainland China, India, Japan, and South Korea, where demand for cleaner alternatives to diesel, LPG, and liquefied natural gas (LNG) continues to grow. In addition to its environmental advantages, DME's physical and combustion properties closely resemble those of LPG, making it suitable for power generation, residential heating, and transportation applications.

The review includes a detailed technoeconomic evaluation based on a conceptual plant design located on the US Gulf Coast, with a production capacity of 665 million pounds per year (MMlb/y). It covers the process flow diagram (PFD), material balance, equipment sizing and specifications, and cost estimates, including battery limits, off-sites, variable costs, capital expenditures (capex), and operating expenses (opex). The economic assessment is based on publicly available, nonproprietary sources such as patents and technical literature, and represents Process Economics Program's (PEP) independent interpretation of the commercial process. While the analysis may not fully reflect actual plant configurations, it is considered sufficiently accurate for conceptual design purposes. An interactive iPEP™ Navigator tool is also included, allowing users to explore process economics across different units and global regions.

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