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Production of Dimethyl Carbonate and Propylene Glycol from Propylene Oxide

PEP Review 2026-15

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Glossary

$/h	Dollars per hour
$/kg	Dollars per kilogram
$/Mlb	Dollars per thousand pounds
$/t	Dollars per metric ton
bara	Bar absolute pressure
BFW	Boiler feedwater
bhp	Brake horsepower
BLI	Battery limits investment
°C	Degrees Celsius
capex	Capital expenditure
¢/gal	Cents per gallon
¢/kWh	Cents per kilowatt-hour
¢/lb	Cents per pound
¢/Mgal	Cents per thousand gallons
CW	Cooling water
DMC	Dimethyl carbonate
DPG	Dipropylene glycol
EC	Ethylene carbonate
EG	Ethylene glycol
ETP	Effluent treatment plant
EU	European Union
°F	Degrees Fahrenheit
FOB	Free/freight on board
ft	Feet
ft dia	Feet diameter
ft T-T	Feet tangent-to-tangent
G&A	General and administrative
gal	Gallons
g/cm^3	Grams per cubic centimeter
gpm	Gallons per minute
kg	Kilograms
kg/h	Kilograms per hour
kJ/mol	Kilojoules per mole
KO	Knockout
kW	Kilowatts
kWh	Kilowatt-hour
lb	Pounds
lb/lb	Pounds per pound
lb/h	Pounds per hour
LP	Low-pressure
LTCS	Low-temperature carbon steel
MC	Methyl carbamate
Mlb/h	Thousand pounds per hour
MMBtu/h	Million British thermal units per hour
MMlb/y	Million pounds per year
MMt, mil. metric tons, million mt	Million metric tons
MMt/y	Million metric tons per year
MN	Methyl nitrite
mol%	Molar percent
MP	Medium-pressure
MW	Molecular weight
opex	Operating expenditure
PC	Propylene carbonate
PEP	Process Economics Program
PFD	Process flow diagram

PG	Propylene glycol
Pharma/agro	Pharmaceutical/agrochemical
PO	Propylene oxide
ppm	Parts per million
ppmv	Parts per million by volume
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
REF	Refrigeration
ROI	Return on investment
ROW	Rest of the world
sq ft	Square feet
SS	Stainless steel
t/h	Metric tons per hour
TR	Refrigeration tons
t/y	Metric tons per year
TFC	Total fixed capital
USGC	US Gulf Coast
wt%	Weight percent
y	Years

Abstract

Dimethyl carbonate (DMC) is an important industrial chemical. One of its main uses is in the production of polycarbonate. Apart from this, it is used as a solvent in paints and adhesives, as well as in the production of pharmaceuticals and pesticides. It can also be used as an oxygenate in transportation fuels. In recent years, DMC has gained importance due to its use as a solvent in lithium-ion batteries. DMC is nontoxic to humans, does not negatively impact the environment, and is also quickly biodegradable, making it especially suitable for use as a chemical.

Propylene glycol (PG), also known as monopropylene glycol or 1,2-propanediol, is a colorless, viscous, hygroscopic liquid with a low degree of toxicity. It is a versatile, synthetic organic liquid used across multiple industries. It is used in cosmetics and personal care products, in the food and beverage industry, and as an antifreeze agent.

Traditional synthesis of DMC required phosgene as a base material, which is toxic and hazardous. This disadvantage of the source material prompted researchers to investigate alternative routes for DMC manufacturing that would reduce the impact of DMC use on human health and the environment, without seriously affecting the economics of DMC production. A common method for producing DMC is via transesterification of ethylene carbonate (EC) or propylene carbonate (PC) with methanol. In addition to being environmentally friendly, this process produces ethylene glycol (EG) or PG, respectively, as a useful coproduct.

The Process Economics Program (PEP) in its previous reports, PEP Report 301 *Dimethyl Carbonate* (October 2017) and PEP Report 50F *Polycarbonate Update* (February 2020), has covered the technology and process economics of producing DMC via transesterification of EC with methanol.

This review focuses on the production of DMC and PG via transesterification of PC with methanol. Propylene oxide (PO) is considered the primary raw material, and production of PC by carbonylation of PO is included in the review. In addition to a detailed process analysis, this review includes a technoeconomic evaluation of the technology, along with process flow diagrams (PFDs), material balance, major equipment list with specifications, capital and operating expenditures (capex and opex), and the overall production cost. This is PEP's independent assessment based on information presented in the open literature, such as patents or technical articles, and may not reflect in whole or in part the actual plant configuration. It is believed that these sources are sufficient to represent the process and process economics within the range of accuracy necessary for the economic evaluation of the conceptual process design of this technology. An iPEP Navigator module, an Excel-based computer costing model developed by S&P Global Energy, is also available with this review to allow quick calculation of the process economics for other major regions of the world.

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