IHS Markit™

Propane Dehydrogenation

PEP Report 267D

December 2019

Mike Kelly
Director—Strategic Analytics & Process Technology

Process Economics Program

PEP Report 267D

Propane Dehydrogenation

Mike Kelly, Director—Strategic Analytics & Process Technology

Abstract

Propylene is second only to ethylene in size as the largest building block in the chemical industry. Historically, propylene was produced almost exclusively as a co-product in ethylene plants (steam crackers) and refinery operations (primarily fluid catalytic cracking). The supply landscape has changed dramatically over the last decade as propylene output from these traditional sources has slowed relative to demand. The resulting imbalance has led to an increasing reliance on other on-purpose technologies for manufacturing propylene.

Propane dehydrogenation (PDH) is an on-purpose technology that has gained much traction in the marketplace. The global supply of propane continues to expand on the back of shale gas/tight oil production, providing a relatively inexpensive feedstock for propylene production. The number of PDH plants around the world has more than doubled in the last 10 years, and another 10 million metric tons of additional capacity is expected to come online over the next 5 years.

In this report, which serves as an update to Report 267A (published on October 2015), a general review of the PDH technical field is provided along with detailed technoeconomic evaluations for the following PDH technologies:

- Lummus CATOFIN® process
- UOP Oleflex™ process
- thyssenkrupp STAR process®

The analysis and technoeconomic results that follow are based on a design capacity of 750 kMTA of polymer-grade propylene. Alternative capital investment and production cost estimates are also provided for plant capacities of 500 and 1000 kMTA. While the capital investment and production cost results herein are presented on a US Gulf Coast basis, the accompanying iPEP Navigator Excel-based data module (available with the electronic version of this report) allows for the viewing of results for other major regions along with the conversion between English and metric units.

Contents

Tables

Figures

Figures for Appendix E

Glossary

ABD	Apparent bulk density
ABS	Acrylonitrile butadiene styrene
AEPW	Alliance to end plastic waste
ASU	Air separation unit
atm	Atmospheres
BDH	Butane dehydrogenation
BFD	Block flow diagram
bhp	Brake horsepower
BLI	Battery limits investment
bpd	Barrels per day
Btu	British thermal units
CCR	Continuous catalyst regeneration
CDU	Crude distillation unit
CG	Chemical grade
COTC	Crude oil to chemicals
cP	Centipoise
CTO	Coal to olefins
CTP	Coal to propylene
Dia	Diameter
DMDS	Dimethyl disulfide
FCC	Fluidized catalytic cracking
FCDh	Fluidized catalytic dehydrogenation
FOB	Free on board
ft	Feet
ft^3	Cubic feet
g	Grams
gal	Gallon
GDP	Gross domestic product
gpm	Gallons per minute
HGM	Heat generating material
HPS	High pressure steam
hr	Hours
HRSG	Heat recovery steam generation
HSFO	High sulfur fuel oil
in	Inches
kCal	Kilocalorie
kg	Kilograms
kJ	Kilojoules
kMTA	Thousand metric tons per year
kPa	Kilopascals
kW	Kilowatt
kWh	Kilowatt hour
l	Liters
lb	Pounds
LHSV	Liquid hourly space velocity
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
m	Meters
M	Thousand

Glossary

m^2	Square meters
m^3	Cubic meters
MAPD	Methyl acetylene & propadiene
MDEA	Methyldiethanolamine
MEA	Monoethanolamine
mgal	Thousand gallons
min	Minutes
mlb	Thousand pounds
mm	Millimeters
MM	Million
mol	Moles
mol%	Molar percent
mPa	Megapascals
MSCF	Thousand standard cubic feet
MTBE	Methyl tert-butyl ether
MTO	Methanol to olefins
MTP	Methanol to propylene
MTPY	Metric tons per year
NGL	Natural gas liquids
OCT	Olefins conversion technology
ODH	Oxidative dehydrogenation
PDH	Propane dehydrogenation
PEP	Process economics program
PFD	Process flow diagram
ppb	Parts per billion
ppm	Parts per million
PSA	Pressure swing adsorption
psi	Pounds per square inch
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
PUR	Polyurethane
RGP	Refinery grade propylene
ROI	Return on investment
s	Second(s)
SCF	Standard cubic feet
SCM	Standard cubic meter
SCR	Selective catalytic reduction
SHP	Selective hydrogenation process
STAR	Steam active reforming
TAME	tert-Amyl methyl ether
TFC	Total fixed capital
tkIS	thyssenkrupp Industrial Solutions
VLGS	Very Large Gas Carriers
VOC	Volatile Organic Compounds
vol%	Volume percent
w/w	Weight for weight
wt%	Weight percent
yr	Year

IHS Markit Customer Care:

CustomerCare@ihsmarkit.com
Americas: +1 800 IHS CARE (+1 800 447 2273)
Europe, Middle East, and Africa: +44 (0) 1344 328 300
Asia and the Pacific Rim: +604 291 3600