On-purpose Butadiene Production by LG-Chem process

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Glossary

ABS	Acrylonitrile butadiene styrene
ACN	Acetonitrile
Al	Aluminum
atm	Atmospheres
BCM	Billion cubic meters
BFD	Block flow diagram
BFW	Boiler feedwater
bhp	Brake horsepower
Bi	Bismuth
BLI	Battery limits investment
Btu	British thermal units
°C	Degree Celsius
Capex	Capital expenditure
¢/lb	Cents per pound
Ce	Cerium
¢/Mgal	Cents per thousand gallons
¢/kWh	Cents per kilowatt-hour
C_n	Carbon number where n denotes numbers
Co	Cobalt
CO	Carbon monoxide
cP	Centipoise
Cs	Caesium
CW	Cooling water
DEHA	Diethylhydroxylamine
dia.	Diameter
DMA	Dimethylacetamide
DMF	Dimethyl formamide
DMSO	Dimethyl sulfoxide
$/Mgal	Dollars per thousand gallons
$/Mlb	Dollars per thousand pound
$/MMBtu	Dollars per million British thermal unit
EPA	Environmental Protection Agency
°F	Degree Fahrenheit
Fe	Iron
FOB	Freight on board
ft	Feet
ft dia	Feet diameter
ft^3	Cubic feet
g	Grams
G&A	General and administrative
gal	Gallons
Gcal/hr	Gigacalorie per hour
GHSV	Gas hourly space velocity
gpm	Gallons per minute
h^{-1}	Per hour
HC	Hydrocarbon
hr	Hour
HSS	Heat-stable salts
HVAC	Heating, ventilating and air conditioning
In	Inch
K	Potassium
kg	Kilograms
kJ	Kilojoules
kPa	Kilopascals
kW	Kilowatt

kWh	Kilowatt hour
lb	Pounds
lb/hr	Pounds per hour
lb/yr	Pounds per year
m	Meters
M	Thousand
max.	Maximum
Mgal	Thousand gallons
min.	Minimum
Mlb	Thousand pounds
Mlb/hr	Thousand pounds per hour
mm	Millimeters
MMBtu/hr	Millions British thermal units per hour
MMt	Million metric tons
Mo	Molybdenum
mol	Mole
mol%	Molar percent
mPa	Megapascals
MT	Metric tons
MT/hr	Metric tons per hour
MT/yr	Metric tons per year
NBR	nitrile rubber
NMP	N-methyl-2-pyrrolidone
O	Oxygen
ODH	Oxidative dehydrogenation
Opex	Operational expenditure
P	Phosphorus
PBR	Polybutadiene rubber
PEP	Process Economics Program
PFD	Process flow diagram
POM	Polyoxymethylene
ppb	Parts per billion
ppm	Parts per million
ppmw	Parts per million weight
psi	Pounds per square inch
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
PTFE	Polytetrafluoroethylene
ROI	Return on investment
s	Second(s)
SBR	Styrene-butadiene rubber
SCF	Standard cubic feet
SCM	Standard cubic meter
Si	Silicon
sq ft	Square feet
SS	Stainless steel
TBC	Tertiary butyl catechol
TFC	Total fixed capital
USGC	United States Gulf Coast
vol%	Volume percent
w/w	Weight for weight
wt%	Weight percent
yr	Year
Zn	Zinc
Zr	Zirconium

Abstract

1,3-Butadiene is almost entirely produced as a by-product of ethylene steam cracking of naphtha or gasoil feedstocks. With the growing demand of 1,3-butadiene driven by rising global car production, it is not economically feasible to meet this rising demand through the expansion of ethylene steam cracker facilities. Petrochemical producers have expanded their butadiene production capacity through the installation of on-purpose butadiene production facilities.

PEP Report 35E (2012) presented the process economics of two commercially successful processes: (i) n-butane dehydrogenation based on the Lummus Catadiene® process and (ii) mixed butenes oxidative dehydrogenation based on the TPC Oxo-D™ process. The process economics of two additional processes for the oxidative dehydrogenation of n-butene were later covered in PEP Report 35F (2014): (i) low energy-intense process by TPC and (ii) dual catalyst system by SK Energy.

In this review, we will explore the oxidative dehydrogenation of n-butenes based on patent information from LG Chem. The production economic assessment presented in this review is based on a plant located in the United States Gulf Coast (USGC) region, with an annual production capacity of 100,000 tons/year of 1,3-butadiene. An interactive iPEP Navigator® module, which is an Excel-based computer costing tool developed by S&P Global Commodity Insights, is also attached with the electronic version of this review to allow quick calculation of the process economics in other major regions of the world.

The technological and economic assessments of the process are Process Economics Program (PEP)'s independent interpretation of the commercial process based on information presented in the open literature, such as patents or technical articles. Although they may not reflect in whole or in part the actual plant configuration, we do believe that they are sufficiently representative of the process and process economics within the range of accuracy required for a conceptual process design evaluation.

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