S&P Global
Commodity Insights

Process Economics Program (PEP)

December 2023

Diesel Hydrocracking for Naphtha

PEP Review 2023-08

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Glossary

AGO	Atmospheric gasoil
bara	Absolute pressure
barg	Gauge pressure
BCM	Billion cubic meters
b/d	Barrels per day
BLI	Battery limits investment
Btu	British thermal units
BTX	Benzene, toluene, xylene
CCR	Continuous catalytic regenerative
CHPS	Cold high pressure separator
CLPS	Cold low pressure separator
COTC	Crude oil to chemicals
FBP	Final boiling point
FCC	Fluid catalytic cracking
FOB	Free on board
gal	Gallon(s)
gpm	Gallons per minute
hr	Hours
HLPS	Hot low pressure separator
HHPS	Hot high pressure separator
HPNA	Heavy polynuclear aromatics
IBP	Initial boiling point
ISBL	Inside battery limits
Kb/d	Kilobarrels per day
kg	Kilograms
kWh	Kilowatt-hour
lb	Pounds
LCGO	Light coker gasoil
LCO	Light cycle oil
LPG	Liquefied petroleum gas
m^3	Cubic meter
M	Thousand
Mgal	Thousand gallons
Mlb	Thousand pounds
mm	Millimeters
MMBtu/hr	Million British thermal units per hour
MMlb/y	Million pounds per year
MMt	Million metric tons
MMt/y	Million metric tons per year
mol%	Molar percent
N+A	Naphthene and aromatics
NBP	Naphtha boiling point
Nm^3	Normal cubic meter
OSBL	Outside battery limits
PEP	Process Economics Program
PFD	Process flow diagram
PNA	Poly-nuclear aromatics
ppm	Parts per million
ppmw	Parts per million by weight
PSA	Pressure swing adsorption
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
ROI	Return on investment

RON	Research octane number
s	Second(s)
SCF	Standard cubic feet
SCM	Standard cubic meter
TBP	True boiling point
TFC	Total fixed capital
t/hr	Metric tons per hour
UCO	Unconverted oil
USGC	United States Gulf Coast
VGO	Vacuum gasoil
vol%	Volume percent
wt%	Weight percent
y	Year

Abstract

Product slates of crude oil refineries are expected to shift gradually toward more base chemicals feedstock at the expense of transportation fuels. One of the options to increase petrochemical naphtha production is to hydrocrack various refinery distillates in the diesel boiling range into naphtha. These streams include straight-run diesel, fluid catalytic cracker light cycle oil, hydrocracker light gasoil and coker light gasoil. The technology for producing naphtha from diesel is not new and is closely related to fixed-bed gasoil hydrocracking technology to produce middle distillates, namely diesel and kerosene. These so-called distillate hydrocrackers have been used mostly in the United States where gasoline demand far outstrips diesel demand for use as transportation fuel. In the last few years, several new diesel hydrocracker units have been designed for petrochemical naphtha production in the mainland Chinese crude oil to chemicals (COTC) complexes. These complexes convert a much higher fraction of feed crude to chemicals feedstock than traditional fuels refineries do.

This Process Economics Program (PEP) review presents a brief status of the global and US diesel and light distillate hydrocracker capacity trends. A detailed review of the diesel hydrocracker technology is also presented which includes the process configuration, operating conditions, catalyst selection and chemistry.

PEP's design of a 60,000 b/d (2.9 million metric tons per year) diesel hydrocracker operating in full conversion to heavy naphtha and lighter products is presented. The design is for a single-stage fixed-bed hydrocracker with 65% single pass conversion with full recycle of the unconverted diesel, followed by separations and product fractionation sections. The design is based on generic diesel hydrocracking technology developed from patent literature and publications made by various technology developers and PEP in-house databases. We provide our basis of design, detailed process description, a HYSYS® simulation-based heat and material balance, sized equipment list, inside battery limits (ISBL), outside battery limits or offsites (OSBL) and total fixed capital cost estimates. Production cost evaluation is given for the main heavy naphtha product from the unit. The evaluation is developed for a US Gulf Coast (USGC) location and can be extrapolated to several other locations around the globe.

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