



Penex™ Process

Refining

Background

The petroleum industry is looking for economical solutions to meet new regulatory specifications for producing environmentally clean fuels. Most of the implemented legislation requires a reduction and a limitation on the concentration of benzene in the gasoline pool. This has increased the demand for high performance C₅ and C₆ naphtha isomerization technology because of its ability to reduce the benzene concentration in the gasoline pool while maintaining or increasing the pool octane.

The Penex process has served as the primary isomerization technology for upgrading C₅/C₆ light straight run naphtha feeds since 1958. Continuous design, operating and catalyst improvements have kept this process a state-of-the-art technology.

Benefits

The Penex process is specifically designed for the continuous catalytic isomerization of light naphtha. Some of the key benefits of this technology are:

- Increased RONC and MONC
- High isomerate yields (99+ volume-%)
- Low sulfur, olefin and benzene product for gasoline blending
- Wide range of recycle configuration for optimum design
- Flexible feed stock processing capabilities
- Low capital and utility costs due to no need for a fired heater or recycle compressor
- High on stream efficiency

Process Description

The Penex process is a fixed-bed process that uses high-activity chloride-promoted catalysts to isomerize C₅/C₆ paraffins to higher octane branched components. The reaction conditions promote isomerization and minimize hydrocracking. UOP currently offers I-8 Plus™ catalyst and I-82™ catalyst. These catalysts represent the most active and longest life catalysts available on the market today.

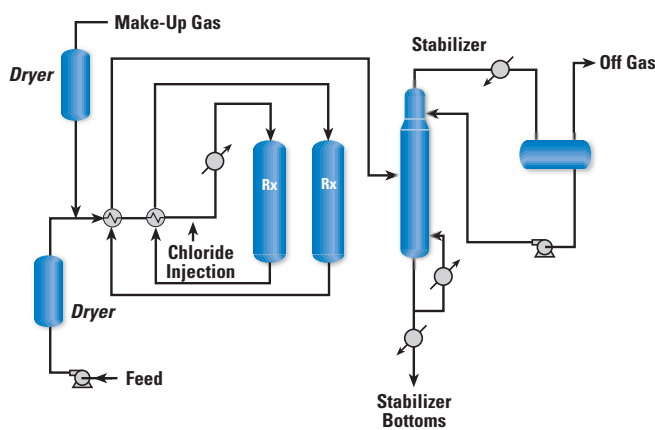
For typical C₅/C₆ feeds, equilibrium will limit the product to 83 to 86 RONC on a single hydrocarbon pass basis. To achieve higher octane, UOP offers several schemes

in which lower octane components are separated from the reactor effluent and recycled back to the reactors. These recycle modes of operation can lead to product octane as high as 93 RONC.

UOP's innovative Hydrogen Once Through Penex process flow scheme (Figure 1) results in a substantial savings in capital equipment and utility costs by eliminating the need for a product separator and a recycle gas compressor.

Typically, two reactors in series flow are used to achieve high on-stream efficiency. The catalyst can be replaced in one reactor while operation continues in the other. The stabilizer separates the light gas from the reactor effluent.

Figure 1 ■ Penex Process

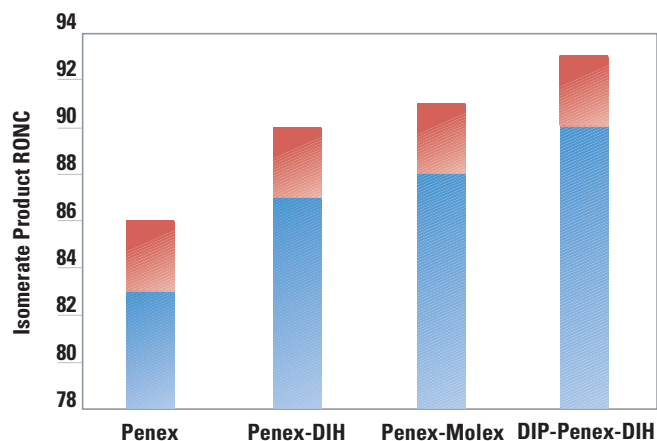


Penex Process Flow Schemes

Several factors are considered when choosing a Penex process flow scheme. One of the most important factors is desired product octane. Figure 2 shows typical product octane for different flow schemes. A range of octane is shown for each flow scheme to reflect the impact of feed composition on the product octane.

Penex process: The once-through flow scheme is the most widely used isomerization process for producing moderate octane upgrades of light naphtha. The Penex process can be integrated with a BenSat™ unit for an economical means of treating feeds with extremely high benzene contents.

Figure 2 ■ Octane Comparison
Feed RONC = 60 to 70



Penex process/DIH: This flow scheme uses a deisohexanizer (DIH) column to recycle methylpentanes, *n*-hexane, and some C₆ cyclics. It is the lowest cost option of the recycle flow schemes and provides a high octane isomerate product, especially on C₆ rich feeds.

Penex process/Molex™ process: This flow scheme uses Molex technology for the economical recycle of *n*-paraffin from the reactor effluent. The recycle of *n*-paraffins allows very high isomerate product octanes.

DIP/Penex process/DIH: This flow scheme offers the highest achievable octane. It uses a deisopentanizer (DIP) column upstream of the Penex unit to remove iso-pentane from the reactor feed and a DIH column to recycle *n*-C₅ and methylpentanes, *n*-hexanes and some C₆ cyclics.

Feed stocks

Conventional feeds are light straight run naphtha streams which have undergone normal treating. However, the Penex process does not require costly feed pre-fractionation for the removal of C₆ cyclics or C₇⁺ hydrocarbons. Extensive pilot plant work and operating experience has shown that the Penex process can process feeds with high levels of C₆ cyclics and C₇ components. In addition, feeds with substantial levels of benzene can be processed without the need for a separate saturation section. This allows the removal of benzene in the light naphtha while providing octane upgrading.

UOP experience

UOP is the leading world-wide provider of isomerization technology. More than 120 Penex units are in operation. Capacities range from 1,000 bpsd to more than 25,000 bpsd of fresh feed capacity.

For more information

Penex technological services are available on request. For more information, contact your local UOP representative or contact our Des Plaines sales office:

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