UOP
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BenSat™ Process

Refining

Applications

For most refiners, the issue of benzene in the gasoline pool is one of managing benzene production from the catalytic reformer. The two primary strategies to accomplish this goal include the minimization of benzene and benzene precursors in the catalytic reformer feed, or the elimination of the benzene from the reformate after it is formed. The BenSat process can be applied in either of these strategies. For example, a BenSat unit can be located on the overhead stream of a naphtha splitter, as an alternative to C_5-C_6 isomerization, to remove the natural benzene concentrated by aggressive reformer feed prefractionation. Alternatively, a BenSat unit can be used on a light reformate stream to remove the benzene that has been produced in the reformer.

Process advantages

The BenSat process offers many advantages including:

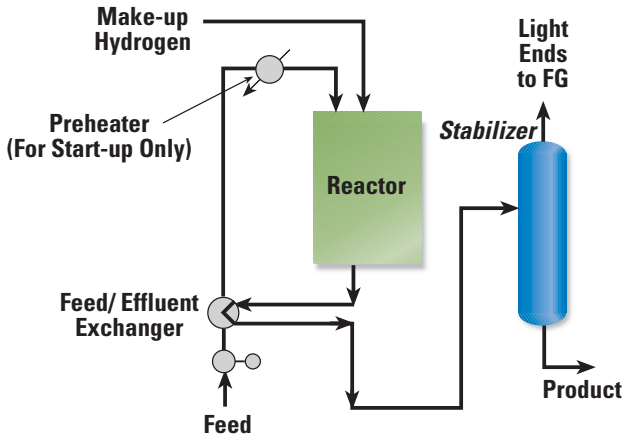
- Low cost construction
- No recycle gas
- Low utilities
- Long catalyst life
- High catalyst selectivity
- Feed stock processing flexibility
- High on-stream efficiency

Process description

The BenSat process was developed as a low-cost, stand-alone option to treat C_5-C_6 feedstocks that are high in benzene. Benzene is saturated to C_6 naphthenes. The catalyst used in this process is highly selective for benzene saturation to C_6 naphthenes.

Makeup hydrogen is provided in an amount slightly above the stoichiometric level required for benzene saturation. The heat of reaction associated with benzene saturation is carefully managed to control the temperature rise across the reactor. Use of a relatively high space velocity in the reactor contributes to the unit's cost-effectiveness.

BenSat Process



Revamp opportunities

A stand-alone BenSat unit can be easily installed on light reformate or light straight-run (LSR) naphtha streams. UOP can assist refiners in a revamp analysis to determine if existing equipment can be reused in the BenSat unit. For example, using an existing stabilizer in the refinery rather than installing a new, dedicated stabilizer in the BenSat unit may be possible.

Feed

Typical feeds include hydrotreated LSR naphtha or light reformate streams. Typical feed compositions are shown below. The BenSat process is designed to handle 30 vol-% or more benzene in the feed.

Typical Feed Compositions, lv-%

		Light Reformate	
Component	**LSR**	**Light Cut**	**Heart Cut**
C_5 Paraffins	28	29	0
C_5 Naphthenes	4	0	0
C_6 Paraffins	35	34	47
C_6 Naphthenes	17	3	3
C_7^+	8	16	24
Benzene	8	18	26
Total	100	100	100

Yields

For feeds with 5-30 vol-% benzene, the C_5^+ volumetric product yields are 101-106 % of the feed. Because of high catalyst selectivity, hydrogen consumption is minimized and is near the stoichiometric level of three moles of hydrogen per mole of benzene saturated. The BenSat process saturates benzene without an increase in RVP. An overall loss of octane occurs in the BenSat process because the benzene is converted to the lower-octane C_6 naphthene components. Alternatively, use of the Penex-Plus™ process to saturate benzene and isomerize the paraffins increases the overall octane.

Commercial status

The first BenSat unit was started in 1994. Since then, seven additional units have been commissioned either as a stand-alone unit or integrated with the Penex™ process in a Penex-Plus unit configuration. Several additional units are in design and construction.

For more information

BenSat 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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