Lummus Technology
a CB&I company

Cumene

Overview

Polimeri Europa and Lummus Technology, a CB&I company, offer the Polimeri/Lummus technology for the production of high purity cumene. This technology incorporates many decades of operating experience by Polimeri Europa and Lummus' design expertise, as well as proven and superior technology features. Together, they ensure the reliability and superior performance of the cumene plant.

Compared to other zeolite-based liquid-phase processes, the Polimeri/Lummus cumene process attains higher product yield (99.7 wt%) with excellent product purity (99.95%) and requires lower investment cost. The quality of the cumene product – attained without clay treatment – easily surpasses the requirements of phenol producers.

The Polimeri/Lummus cumene process uses Polimeri's proprietary zeolite catalyst PBE-1, which has been used in commercial operation since the mid 1990s. PBE-1 has a higher selectivity to cumene than other common zeolite catalysts, and is equally effective for alkylation of benzene as well as the transalkylation of polyisopropylbenzenes to cumene. It is noncorrosive, regenerable and environmentally friendly.

The Polimeri/Lummus cumene process consumes no chemicals other than feedstocks and creates no hazardous effluents.

Advantages

Process Features	Process Benefits
Proprietary, non-corrosive PBE-1 zeolite catalyst	Product yield of 99.7 wt% • High activity and selectivity with minimal formation of by-product impurities • Typical cumene purity is 99.95% or higher • Extremely tolerant to poisons • Proven run-lengths of up to five years • Low catalyst cost
Low pressure and low temperature operation	All carbon steel construction • Low investment and plant maintenance costs • Low energy costs
No chemicals required	Low operating cost
No acidic waste streams and minimal fugitive emissions	Low environmental impact
Can be designed to process chemical and refinery grade propylene feedstocks in addition to polymer grade propylene	Improves plant economics

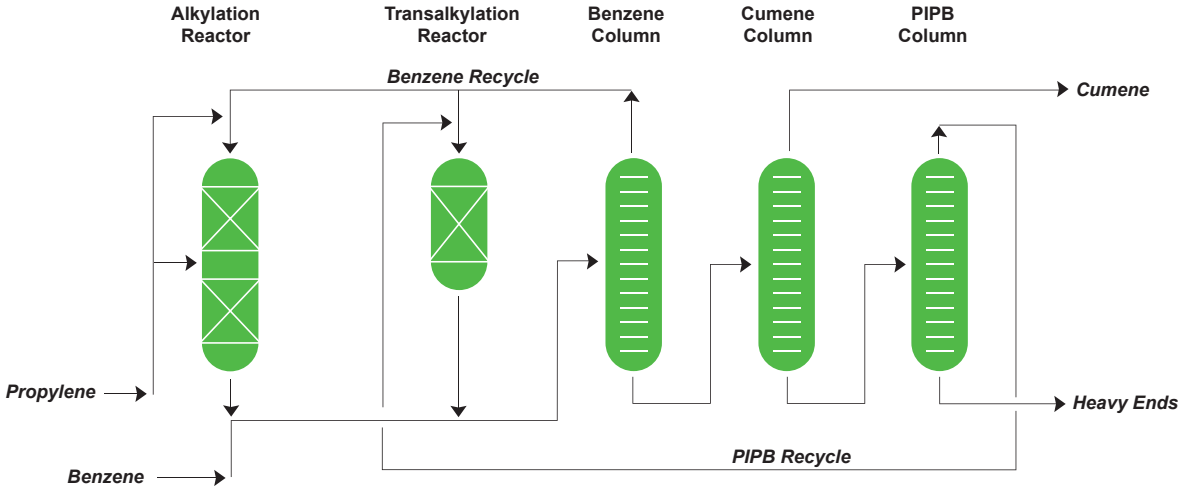
Performance Characteristics

Typical Overall Material Balance	
Feeds	**MT/MT Cumene Product**
Propylene (100% basis)	0.352
Benzene (100% basis)	0.651
Products	
Cumene	1.000
Heavy residue	0.003
Propane	Dependent on propylene feed purity

Cumene Product Quality	
Purity	99.95 wt.% typical
Sp. Gr., 20/20°C	0.864 min.
Distillation range (including 152.5°C)	1°C max
Bromine Index	2 typical

Cumene

Process Flow Diagram



Process Description

Cumene is made by the alkylation of benzene with propylene, which yields a mixture of alkylated and polyalkylated benzenes. Excess benzene is used so propylene reacts completely. Propylene is injected before each catalyst bed to improve catalyst selectivity and enhance its activity and stability.

The mixture of alkylated and polyalkylated benzenes is sent to a distillation train that consists of a benzene column, cumene column and poly-isopropylbenzene (PIPB) column. The polyalkylated benzenes recovered in the PIPB column are transalkylated with benzene to produce additional cumene for maximum cumene yield. The alkylation and transalkylation effluents are fed to the benzene column, where the excess benzene is taken as the overhead product for recycle to the reactors.

The benzene column bottoms goes to the cumene column, where product cumene (isopropylbenzene) is taken as the overhead product. The cumene column bottoms is sent to the PIPB column, where overhead PIPB is recycled back to the transalkylation reactor.

The bottoms of the PIPB column is composed of a small amount of high boilers that can be used as fuel. Propane and other non-condensables contained in the propylene feed pass through the process unreacted and are recovered as propane product or as fuel.

The cumene unit has considerable flexibility to meet a variety of local site conditions (i.e., utilities) in an efficient manner.

Process Chemistry

Alkylation

C_6H_6 (Benzene) + $CH_3CH{=}CH_2$ (Propylene) $\rightarrow$ $C_6H_5CH(CH_3)_2$ (Cumene)

$C_6H_5CH(CH_3)_2$ (Cumene) + $CH_3CH{=}CH_2$ (Propylene) $\rightarrow$ $C_6H_4[CH(CH_3)_2]_2$ (Di-isopropylbenzene)

Transalkylation

$C_6H_4[CH(CH_3)_2]_2$ (Di-isopropylbenzene) + C_6H_6 (Benzene) $\rightarrow$ 2 $C_6H_5CH(CH_3)_2$ (Cumene)

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