Paraxylene Crystallization Technology

MCDERMOTT TECHNOLOGY

Overview

Lummus Technology is the exclusive worldwide licensor of BP's paraxylene technology, a unique process employing single stage crystallization for paraxylene (pX) recovery. This innovative configuration paired with high feed impurity tolerance and low overall unit fuel consumption makes the BP/Lummus Technology pX crystallization technology the most energy efficient paraxylene recovery method.

BP, one of the world's largest pX producers, has continually improved both process performance and design for over 45 years in all of its six operating pX units. Such development has led to a highly optimized and cost advantaged route to paraxylene separation.

The BP/Lummus Technology paraxylene process is highly reliable, low cost and is capable of accepting a wide range of feed compositions.

Paraxylene yield is further increased via isomerization over a non-noble metal catalyst. Optimized fractionation reduces reboiler duty leading to lower energy requirement as well as lower emissions.

By producing paraxylene at purities of 99.8%+ via a single stage of crystallization, the BP/Lummus Technology paraxylene process has surpassed earlier crystallization technologies by exhibiting lower energy consumption and lower capital cost.

Advantages

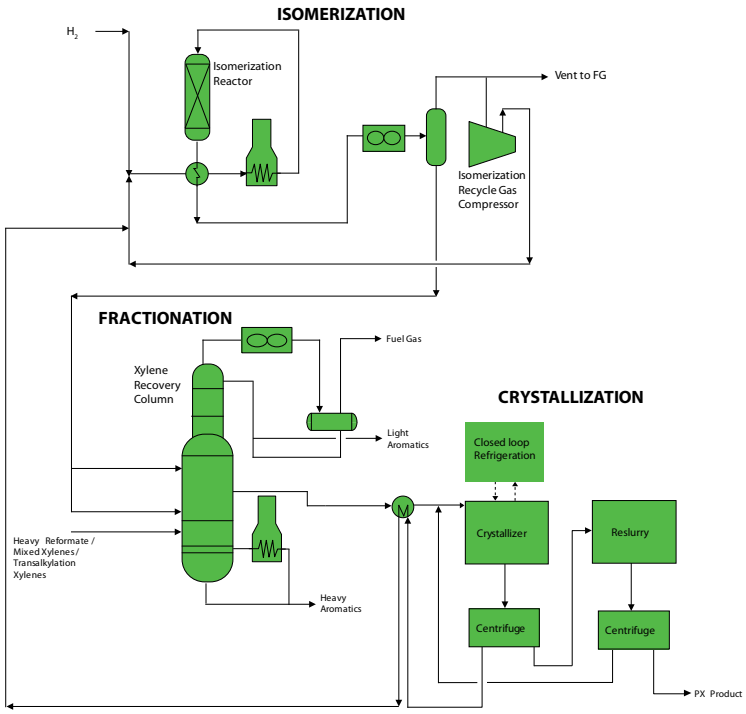
Process Features	Process Benefits
Innovative Crystallization Process	The recovery section of the BP/Lummus Technology paraxylene technology employs a single stage of pX crystallization followed by reslurry steps. This configuration leads to 50 percent lower energy requirements when compared to conventional crystallization technology. Continuous innovation applied to crystallization technology has allowed BP to increase pX production capacity and incorporate larger centrifuges and crystallizers while remaining one of the lowest operating cost producers of pX.
Highly energy efficient process with robust catalyst system	There are two major methods of pX separation being used in the majority of refinery-based aromatics complexes: crystallization and selective adsorption (SA). The BP/Lummus Technology paraxylene technology has been continuously optimized for over 45 years and offers a significant number of advantages over selective adsorption based processes.

- Lower overall energy usage
- Lower xylene splitter (xylene recovery column) operating pressure leads to overall process energy savings
- No isomerization stabilizer required – the top section of xylene splitter functions stabilizing
- No aromatics extraction process required for min. 99.9 wt% purity of benzene production
- Less stringent feed specification requirements requires a smaller column. A single fractionation column can handle up to three million metric tons per year of pX
- Higher Feed impurity tolerance – no oxygen stripper required for imported mixed xylenes
- Heavy reformate, transalkylation xylenes, or mixed xylene feed streams with high impurities levels from a variety of sources can be processed
- Lower emissions due to ⅓ fuel fired compared to SA
- No proprietary equipment required
- No special chemicals or adsorbent required
- Isomerization catalyst is non-noble metal, exhibits low xylene loss, high xylene approach to equilibrium, and good tolerance to sulfur, amines, and other poisons. Investment cost is lower due to no precious metals
- Able to handle wide range of feedstocks including high purity pX feeds from selective toluene disproportion process or equivalent with no additional equipment or utility consumption
- Smaller plot size requirement
- Lower CAPEX/OPEX
- High reliability and on-stream factor exceeding 96%

Performance Characteristics

PARAXYLENE SCOREBOARD	
Overall Energy Efficiency	High
Cost of Production	Low
Expected Catalyst Life	10 + years possible
pX Product Quality	99.8% +
Proprietary Equipment	None
Investment	Low
Max. Capacity for Single Train	> 3 MM metric tons/ year pX

Process Flow Diagram



Process Description

In the **isomerization** section, the pX-lean reject filtrate from the crystallization section is combined with hydrogen, vaporized and heated to reaction temperature, and fed to the isomerization reactor containing a proprietary High Selectivity DeEthylation (HSDE) catalyst. The catalyst isomerizes the xylenes to a near equilibrium mixture, converts ethylbenzene selectively to benzene and ethane, and cracks co-boiling C_9 paraffins and naphthenes to lower molecular weight hydrocarbons. Reactor effluent is cooled and separated in a series of exchangers and separators. The vapor from the separators is recycled to the suction of isomerization recycle gas compressor. The liquid is fed to the fractionation section.

The **fractionation** section consists of the xylene recovery column and associated equipment. A heavy reformate, transalkylation xylene, or mixed xylene feed stream is fed to the column along with reactor effluent from the isomerization section. The column separates these feeds into four distinct streams:

- Fuel Off-Gas (ethane rich) used either as fuel or sent to a cracker for the production of ethylene
- Light Aromatics (benzene rich) sent to a benzene fractionation for benzene recovery
- C8 Aromatics (primarily xylenes) taken as a sidedraw from the xylene recovery column sent to crystallization
- Heavy Aromatics (C_9+) sent to a transalkylation unit

The **crystallization** section takes the C_8 aromatics side stream from the xylenes recovery column. Due to the large differences in freezing points of the isomers, a closed loop refrigeration system is utilized to crystallize pX (which has the highest freezing point) from the other components. The centrifuges in this section provide the separation, producing two separate streams: a high purity pX product and a pX-lean stream, termed the reject filtrate, which is recycled back to the isomerization section.

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