Ethylbenzene/Styrene Monomer

Overview

The Lummus/UOP EB*One* ethylbenzene and Lummus/UOP "Classic" styrene monomer technologies have earned the reputation for being the most modern, efficient, and reliable processes for the production of intermediate ethylbenzene (EB) and styrene monomer (SM), respectively.

The liquid-phase EB*One* process uses a fixed-bed zeolite catalyst system and represents a major technological step change from older vapor phase EB technologies. The catalyst provides a run-length of three to five years, thus eliminating the need for regeneration equipment. The process has low investment requirements, provides high yields and is energy efficient. Xylene impurity formation is practically eliminated, resulting in an EB product of excellent quality. The process enables owners to maintain a safe, reliable, easy-to-operate plant. It has been commercially proven, exhibiting efficient, predictable, and stable operation. Use of regenerated catalyst is also commercially proven, exhibiting performance equal to or better than fresh catalyst.

The "Classic" SM process is well known in the industry for its deep vacuum/adiabatic EB dehydrogenation technology and demonstrated high mechanical integrity. The unique dehydrogenation reactor system is designed to operate at the most cost effective, minimal operating pressure for achieving the highest SM selectivities at high conversions. An off-line optimizer (SM GAIN™) can also be provided to allow personnel to closely monitor the important process variables and operate the plant at optimum conditions. Our ongoing program of catalyst and process development provides clients with technologies that have significant capital and operating cost advantages, as well as world-renowned operating reliability and mechanical integrity. More than 30 commercial plants are in operation worldwide.

Advantages

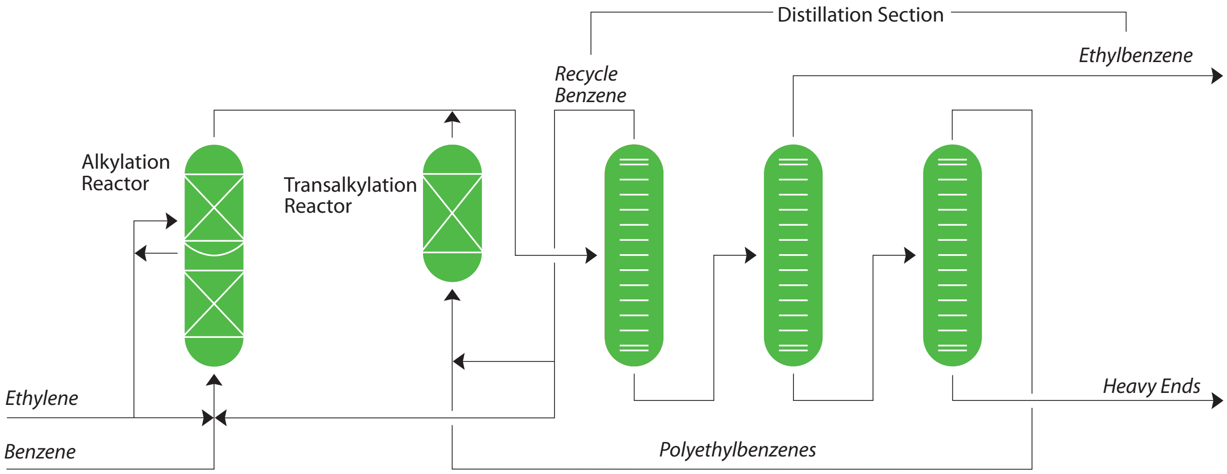
EB*One* Ethylbenzene

Process Features	Process Benefits
Long catalyst run-length with excellent stability	Minimizes plant downtime
Highly selective reaction	Insignificant amounts of xylenes are produced, providing highest product quality
High yield	Minimizes production cost
All carbon steel equipment	Reduces investment

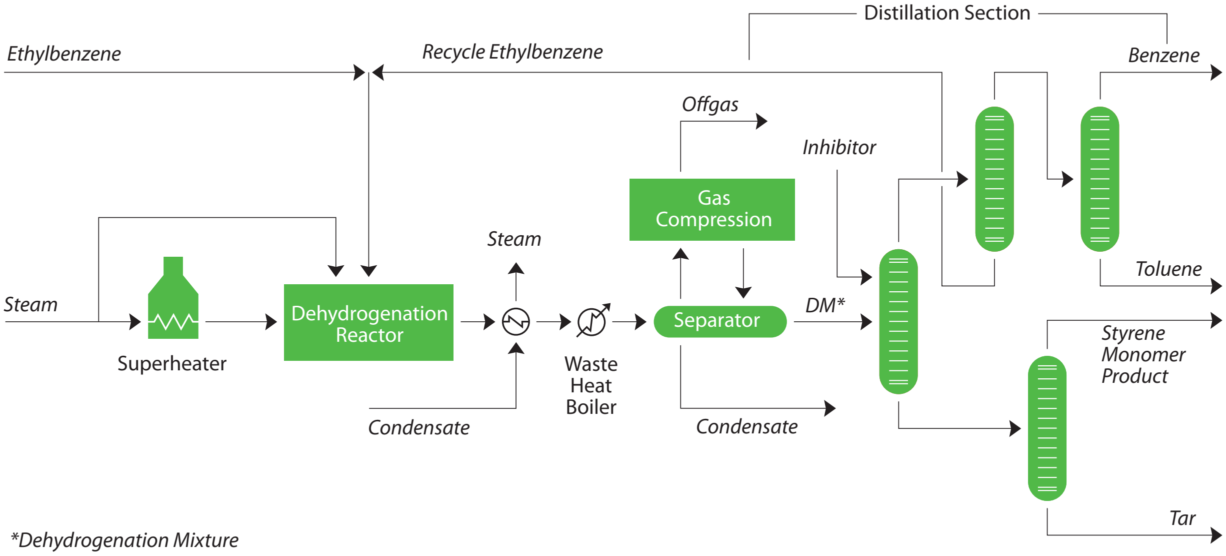
"Classic" Styrene Monomer

Process Features	Process Benefits
Substantial recovery of low-level energy without compression	Increases energy savings
Unique reactor system achieving high single-pass conversions and high selectivities	Reduces investment • Exceptional mechanical reliability
Long reactor run-lengths	Reduces downtime
Low steam/hydrocarbon ratio	Lower production cost
Off-line styrene plant optimizer (SM GAIN™)	Allows optimization of operations using a personal computer

Ethylbenzene Process Flow Diagram



"Classic" SM Process Flow Diagram



Process Description

The manufacture of EB involves the alkylation of benzene with ethylene to yield a mixture of alkylated benzenes and excess benzene. This mixture is distilled to recover EB, recycle benzene, and higher ethylated benzenes. The latter are transalkylated with benzene to form additional EB. The recycle benzene is sent back to the alkylator and transalkylator reactor vessels, and the EB product is sent to the dehydrogenation section of the styrene unit.

The major reactions in the manufacture of SM are the dehydrogenation of EB to SM and hydrogen.

Dehydrogenation side reactions produce benzene and toluene and some light compounds. The catalytic dehydrogenation reaction is endothermic, with reaction heat supplied by a superheater. The reactor effluent is cooled by generating steam. The offgas stream is compressed and used as fuel in the steam superheater. The dehydrogenated mixture is distilled to recover SM product, recycle EB, as well as benzene and toluene by-products.

Inhibitors are added to prevent styrene polymerization in the process equipment.

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