



Technology Profile

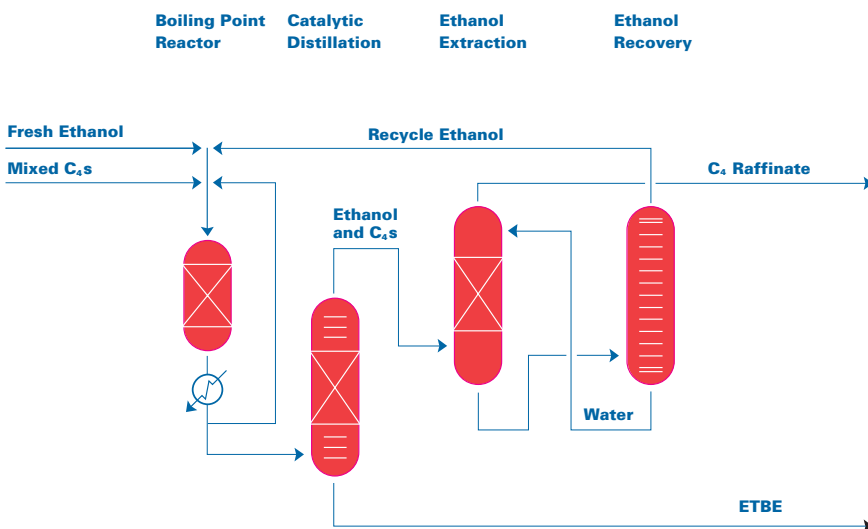
Overview The CDEtbe catalytic distillation technology processes C₄ streams from steam cracker and isobutane dehydrogenation units to produce ETBE. CDEtbe is one of a family of process technologies developed and commercialized by Catalytic Distillation Technologies (CDTECH) for license to the petroleum refining and petrochemical industries. CDTECH is a partnership between Lummus Technology, a CB&I company, and Chemical Research & Licensing, a CRI company.

ETBE Synthesis ETBE is formed by the catalytic etherification of isobutylene with ethanol. The patented CDEtbe process is based on a two-step reactor design, consisting of a fixed bed reactor followed by final conversion in a catalytic distillation column. The process utilizes an acidic ion exchange resin catalyst in both its fixed bed reactor and proprietary catalytic distillation structures.

The boiling point reactor is designed so that the liquid is allowed to reach its boiling point by absorbing the heat of reaction, after which a limited amount of vaporization takes place thereby maintaining precise temperature control. The amount of vaporization is fixed by recycling cooled reactor effluent. The maximum temperature is adjusted by setting the total system pressure. Since the reacting liquid mixture temperature cannot exceed the boiling temperature, control is far superior to those systems in which heat must be transferred by convection or conduction. This design retains the heat of reaction as latent heat, reducing heat input requirements for the ensuing fractionation. Reactor effluent is cooled by condensation rather than by convection, resulting in the use of smaller-sized equipment.

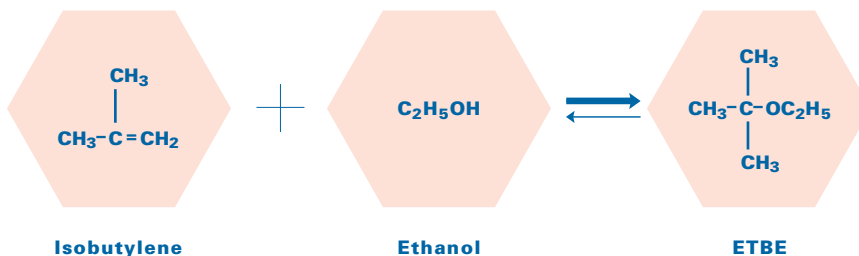
The unique catalytic distillation column combines reaction and fractionation in a single unit operation. It allows a high conversion of isobutylene (exceeding fixed bed equilibrium limitations) to be achieved simply and economically. By using distillation to separate the product from the reactants, the equilibrium limitation is exceeded and higher conversion of isobutylene is achieved. Catalytic distillation also takes advantage of the improved kinetics through increased temperature without penalizing equilibrium conversion.

CDEtbe Process Flow Diagram



Process Chemistry

Etherification



Typical Overall Material Balance Isobutylene conversion percent: 95+

Feeds	LB/HR
C ₄ s (Isobutylene 27.0 wt. %)	20,900
Ethanol (95 vol %)	4,700
Products	
C ₄ Raffinate	15,400
ETBE product	10,200

ETBE Product Composition (excluding C₅+) Wt. %

C ₄ s	<0.1
Ethanol	<1.0
Di-isobutylene	0.5
TBA	0.4
DEE	0.2
ETBE	97.8
Total	100.0

Advantages

CDTECH's 'Boiling Point' reactor offers:

- Simple and effective control
- Elimination of hot spots
- Long catalyst life
- High flexibility
- Low capital cost
- Elimination of catalyst attrition
- Most effective heat removal technique

CDTECH's catalytic distillation offers:

- Improved kinetics
- High conversion (beyond fixed bed equilibrium limit)
- Low capital cost
- Low utilities
- Long catalyst life with sustained high conversion
- Reduced plot area

CDTECH process offers:

- Low ethanol content in ETBE product without additional processing

CDTECH

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