

Catalytic

Distillation

Technologies

## Selective Hydrogenation of Refinery C<sub>4</sub> Feeds



### Technology Profile

**Overview** The C<sub>4</sub> CDHydro catalytic distillation technology processes C<sub>4</sub> streams from refineries to produce a stream with a high butylenes content that is essentially free of butadiene. The treated C<sub>4</sub> stream is suitable for MTBE production, butene-1 production, or alkylation feed. The C<sub>4</sub> CDHydro process 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.

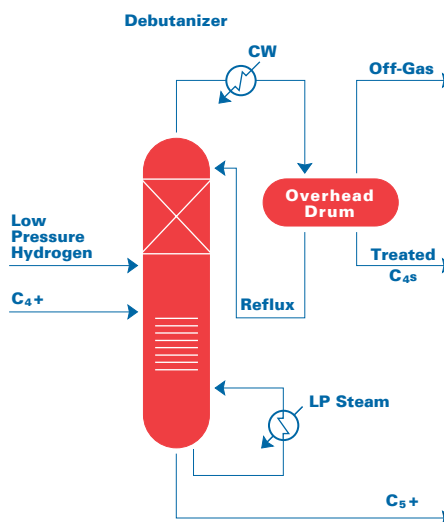
**Selective Hydrogenation** The patented C<sub>4</sub> CDHydro process achieves selective hydrogenation of butadiene to normal butenes in a catalytic distillation column. Selective hydrogenation increases butenes available for alkylation or isomerization, reduces acid consumption in alkylation units, and greatly improves the quality of HF alkylate. The process uses commercially available catalyst in proprietary catalytic distillation structures.

Refinery C<sub>4</sub> streams are combined with hydrogen in the catalytic column. Treated C<sub>4</sub> products are taken overhead. The washing action of the reflux minimizes oligomer formation, flushing heavy compounds from the catalyst and promoting long catalyst life. Excess hydrogen and lights are vented from the overhead drum. The catalyst will react acidic sulfur compounds with diolefins to form heavy compounds which exit in the tower bottoms. The distillate product is essentially mercaptan-sulfur-free.

*The unique catalytic distillation column combines reaction and fractionation in a single unit operation.* This constant pressure boiling system assures precise temperature control in the catalyst zone. Low reaction temperature and isothermal operation enhance selectivity and minimize yield losses to paraffins. Isomerization of butene-1 to butene-2 can be maximized to improve HF alkylate quality or minimized for increased butene-1 recovery.

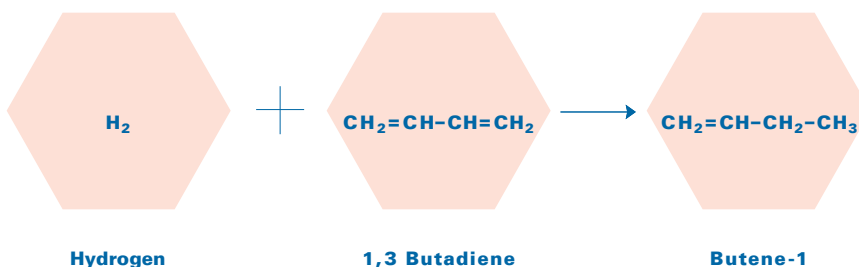
Capital costs are considerably lower than conventional hydrotreaters since the single column design eliminates costs associated with fixed-bed systems. Additionally, the ability to remove acidic sulfur compounds eliminates the need for sweetening. The C<sub>4</sub> CDHydro process would typically be installed in a debutanizer, either as a retrofit or in a new column.

### C<sub>4</sub> CDHydro Process Flow Diagram

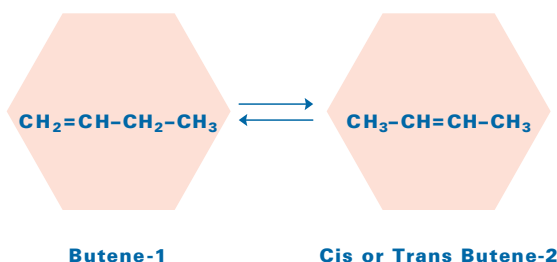


## Process Chemistry

## Selective Hydrogenation



## Isomerization



## Advantages

C<sub>4</sub> CDHydro process offers:

- Low operating pressure
- Low operating cost
- High product yield (low paraffin make)
- No polymer recycle across catalyst
- No sweetening required
- Essentially mercaptan sulfur-free distillate product
- Flexible butene-1/butene-2 ratio
- Retrofit to existing C<sub>4</sub> columns
- All carbon steel construction
- Isomerization option
- No hydrogen compressor

CDTECH's catalytic  
distillation offers:

- Isothermal operation
- High conversion
- Low capital cost
- Low utilities
- Long catalyst life with sustained high conversion
- Reduced plot area

## Typical Overall Material Balance

Feeds	LB/HR	
C <sub>4</sub> + (Butadiene 0.35 wt. %)	288,300	(30,000 BPD)
Hydrogen (100 % basis)	60	(273,000 SCFD)
Products (will depend on separation requirements)		
Treated C <sub>4</sub> s	100,400	
C <sub>5</sub> +	187,600	
Off-gas	360	(zero if PSA hydrogen used)

Typical C<sub>4</sub> Product Composition

(will depend on feed composition and client requirements)

Residual Butadiene in distillate	<10 ppm
Paraffin make (n-butane)	<1 %
Butene-1/Butene-2 ratio	0.05 – 0.3
Sulfur	<1 ppm

## CDTECH

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