# CHEMICALS

**Project Fact Sheet**

# High Octane Fuel-Stocks via Reactive Distillation

## Benefits

- Lowers energy consumption
- Reduces sulfur dioxide emissions
- Lowers capital investment costs
- Easily retrofitted into existing refineries

## Applications

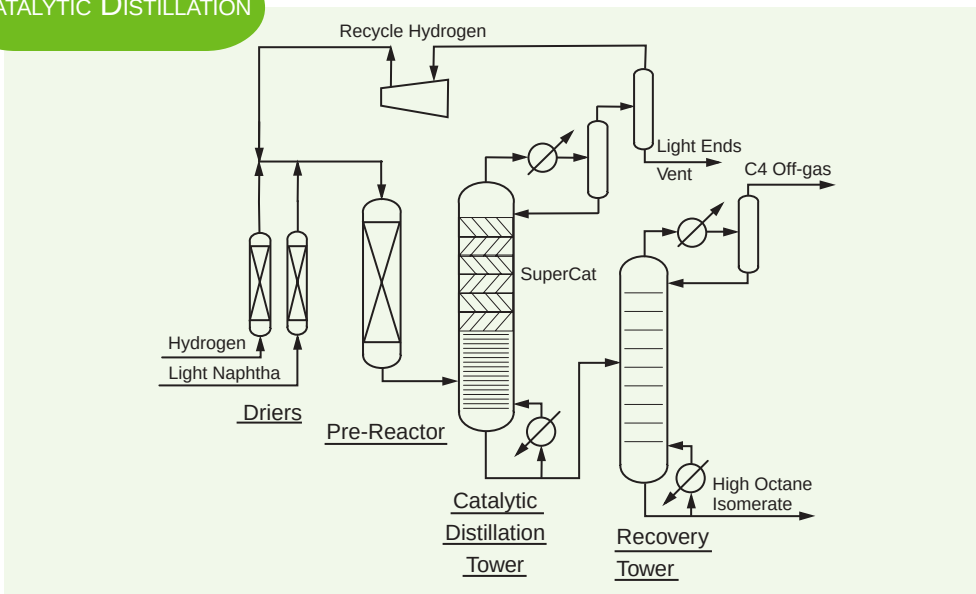
The catalytic distillation process is a low-cost option for isomerization and is suited for retrofitting a reforming or hydrotreating unit in an isomerization unit.

## New catalytic distillation technology produces ultra-clean fuels and reduces emissions

It has become increasingly important to meet U.S. demand for liquid transportation fuels with cleaner fuels that are environmentally friendly in production and use. The market demands that these "green" fuels also maintain or increase gasoline octane. Consequently, refiners are re-evaluating their currently available blend-stocks and refinery configurations to determine how they can best produce gasoline to meet market demands and new specifications for cleaner gasoline while reducing energy use. To address these challenges, project partners are working to develop a new catalytic distillation technology using a high-efficiency structured catalyst to produce environmentally sound, high-octane gasoline additives.

The structured catalyst combines high mass-transfer rates with chemical reaction, and will produce high-octane isomerate from light naptha using catalytic distillation, a process that combines reaction and distillation in one vessel using structured catalysts as the enabling element. By distilling the products from the reactants in the reactor, catalytic distillation breaks the reaction equilibrium barrier. This eliminates the need for additional fractionation and reaction stages, while increasing conversion and improving product quality. Both investment and utility costs are far lower than the conventional reaction followed by distillation process. Furthermore, improved product selectivity leads to a reduction in raw material consumption and less waste.

### Catalytic Distillation




**Process flow diagram for catalytic distillation technology.**

## Project Description

**Goal:** The goal of this project is to develop a light naphtha refining technology to produce high-octane isomerate (iso-paraffins). To achieve this goal, partners will use a unique multi-functional support for catalytic distillation (CD) reactors that combines a high performance catalyst substrate with a gas/liquid mixing device. The new multi-functional support has greater liquid/solid contacting areas that simulate very small particle diameters, giving high activity with low mass-transfer resistance. Its unique design allows intimate vapor/liquid contacting, which leads to low height equivalent to a theoretical plate (HETP). Since the catalyst is structured using "bricks," it is loaded directly into the reactor. This cuts down manufacturing costs tremendously. The increased overall effectiveness will lead to considerably lower catalyst loadings and, hence, smaller reactor volumes. This will significantly reduce investment costs and increase the economic viability of CD-based technologies.

According to early test results, the gas-phase pressure drop across the catalytic packing appears to be similar to the dry pressure drop across conventional structured packings. Capillary forces strongly influence liquid hold-up in the catalyst beds of the catalytic packing. The liquid is strongly drawn into the reticulated support irrespective of how the liquid is distributed on top of the column. The liquid loading point is considerably greater for the new structured catalyst than conventional structured catalysts. As a result, irrigation of the packing under industrially relevant liquid flow rates minimally affects the pressure drop. The multifunctional catalyst support has liquid/solid mass transfer rates that are significantly higher than conventional systems. Since most CD-based processes suffer from inter-phase mass transfer limitations, a new structural catalytic packing-based CD process will offer a much higher reaction rate per unit volume of reactor than current systems.

## Progress and Milestones

Initial research confirmed that the developed catalytic packing is a viable catalyst support for catalytic distillation columns under industrially relevant gas and liquid flows.

Current research is focused on developing the technology to produce iso-pentanes and iso-hexanes from normal paraffins using a catalytic distillation system. The following are milestones for current research:

- Develop a viable catalytic system for reactive distillation columns that gives a higher conversion at product selectivity and catalyst lifetimes comparable to current isomerization catalysts while operating under milder operating conditions
- Design a well-integrated reactive distillation column that enhances performance of the new multi-functional structured catalyst under commercially relevant operating conditions

## Commercialization

Exelus, Inc. is currently in negotiations with a leading catalyst company to form a consortium that will develop and commercialize the new catalytic distillation process technology known as SuperCat-ISOM. The technology will be piloted using a five barrel/day unit at a refinery located in the U.S. Gulf Coast starting in 2003. The first commercial plant using the developed technology is expected to go on-stream in 2006.

### Project Partners

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