

# SC DPG-1

## PURPOSE

The gasoline byproduct of ethylene production via the steam cracking of liquids contains a high content of unsaturated hydrocarbons (olefins and aromatics) making it an excellent source of aromatics and high octane gasoline components. Eliminating acetylenes, dienes and aromatic olefins in this pyrolysis gasoline can produce a number of important benefits:

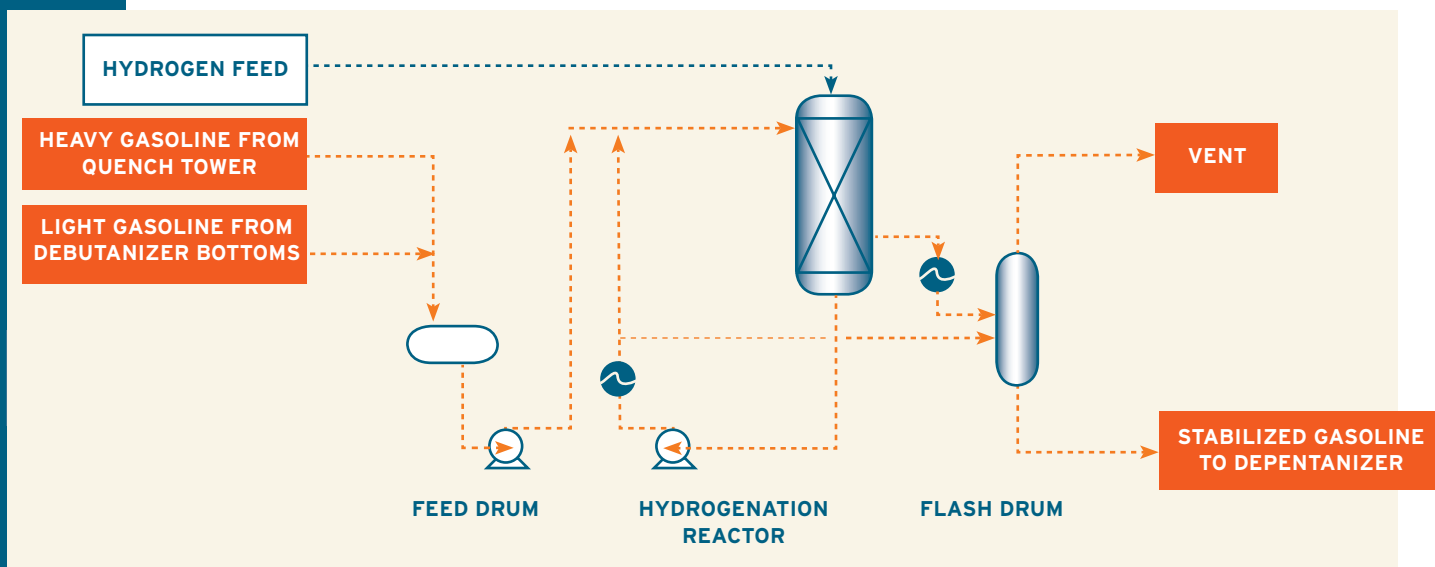
- Improve the Induction Period and Color
- Reduce gum content of gasoline blending components
- Reduce the energy to reprocess gasoline blending components
- Reduce fouling in the downstream hydrodesulfurization unit
- Improve the yield of petrochemicals and gasoline over heavy fuel.

A single stage selective hydrogenation unit can reduce the Diene Value to less than 1.0 and the styrene concentration to less than 0.1%.

## DESCRIPTION

Heavy gasoline from the quench tower and light gasoline from the debutanizer enter the feed drum. The feed is pumped to 450 - 600 psig, mixed with recycle and then introduced to the reactor. Hydrogen is added to the reactor to maintain system pressure. Most of the reactor effluent is recycled to the feed to limit the temperature rise and vaporization across the catalyst bed.

The reactor effluent is cooled and condensed. The excess hydrogen is normally routed to the hydrodesulfurization unit (DPG-2). The balance of liquid reactor effluent is routed to a depentanizer or directly to the hydrodesulfurization unit.

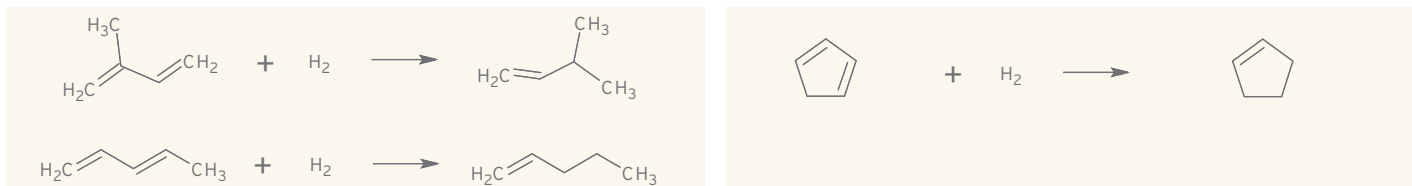


CUSTOM CATALYTIC SOLUTIONS

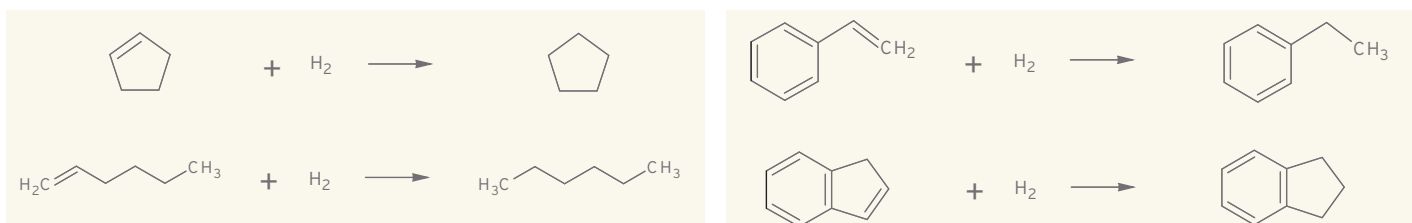
Elementally Better

## THE FOLLOWING REACTIONS TAKE PLACE ACROSS THE CATALYST BED:

**Selective hydrogenation of dienes** – The desired reactions are the conversion of isoprene, piperylene, and cyclopentadiene to the corresponding olefin.



**Olefin saturation** – Conversion of olefinic aromatics to alkyl aromatics is desirable. Examples include hydrogenation of styrene and indene. Conversion of cyclic olefins to cyclic paraffins (i.e. cyclopentene to cyclopentane) is also desirable. All other olefin saturation reactions (i.e. hexene to hexane) are undesirable.



**Aromatic saturation** – Conversion of benzene and other aromatics to cyclic paraffins is highly undesirable. These reactions are undetectable across palladium catalyst under normal operating conditions.

## CATALYST PERFORMANCE METRICS

Conversion of dienes and styrene is the most important function of the catalyst. High conversion requires a combination of **activity** and **selectivity**. Catalyst cycle length is affected by the operating temperature and the **hydraulic capacity** of the catalyst. The operating temperature is based on the catalyst **activity** and **selectivity**. Lower temperature and lower gum formation favor longer catalyst cycle length.

**ACTIVITY** is gauged by the temperature required to hydrogenate dienes and styrene at a given LHSV (liquid hourly space velocity, which is the inverse of residence time) and hydrogen partial pressure. Lower temperature is favored to reduce catalyst fouling and extend cycle length. Activity is adversely affected by sulfur, nitrogen, and oxygenates in the feed. The catalyst must be designed to overcome the inhibiting effects of these contaminants. Catalyst activity also determines how much unreacted hydrogen will be in the reactor effluent.

**SELECTIVITY** is the net amount of alkyl olefin that was produced compared to the amount of diene and aromatic olefin removed. Selectivity is a fundamental characteristic of the catalyst and therefore the focus of much design work. Without selectivity, all of the hydrogen fed could be consumed before all of the diene reacts. Catalyst selectivity also dictates the amount of hydrogen required to meet the product specification and the temperature rise in the reactor. Additionally, selectivity dictates how much gum is formed.

**HYDRAULIC CAPACITY** is defined as the amount of liquid and gas that can flow through the catalyst bed without channeling. Hydraulic capacity depends on the size and shape of the catalyst, uniformity of the particles, and the method used for loading the reactor. Low capacity can lead to phase segregation, dry-out, hot-spots, and subsequent short cycles. Excess capacity can lead to poor turndown, insufficient catalyst bed wetting, and subsequent short cycles. Catalyst hydraulic characteristics must be matched to the process requirements.