Honeywell UOP | Petrochemical Processes

UOP MaxEne™ Process

Advanced process to optimize performance of naphtha steam crackers and catalytic reformers

Introduction

The UOP MaxEne process is a new and innovative process for simultaneously optimizing the operations of naphtha steam crackers and catalytic reformers. The MaxEne process separates naphtha into a normal paraffin (*n*-paraffin) rich stream and a non-normal rich stream containing branched paraffins using UOP's Sorbex™ Technology.

When fed to the naphtha steam cracker, the n-paraffin rich stream increases the combined yield of ethylene and propylene by up to 30%. The *n*-paraffin rich stream can also reduce coking by up to 50%, which can facilitate increases in throughput or extended run times between de-coking cycles.

The non-normal rich stream also has significant benefits when processed in the catalytic reformer including lower operating temperatures, improved selectivity and reduced coking. C_5^+ yield can be increased by up to 6% including up to 3% more total aromatics. Coke formation on the catalyst can be reduced by up to 25%, which can facilitate increases in throughput.

The first commercial scale MaxEne unit began operation in early 2013.



Simultaneously optimizes the profitability of refining and petrochemical operations by creating improved feedstocks for catalytic reforming and naphtha cracking process units.

Application

Worldwide, naphtha is the most common feedstock processed in steam crackers for the production of light olefins. A typical naphtha feedstock contains a mixture of paraffinic, naphthenic, and aromatic hydrocarbons with varied molecular weight and molecular structure.

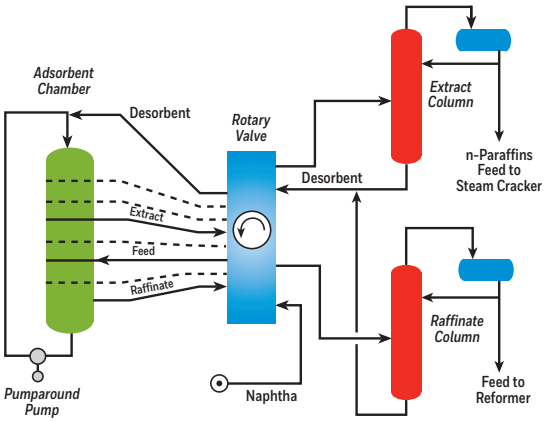
The composition of naphtha feedstocks varies considerably, yet the composition has a significant impact on ethylene, propylene, and by-product yields. For example, in order to increase the yield of ethylene and propylene it is desirable to have a high concentration of *n*-paraffin in the naphtha.

Coincidentally, refiners and aromatics producers desire naphtha feedstocks that are depleted of normal paraffin. Naphtha that is depleted of n-paraffin contributes more octane value to the refiner's gasoline pool and increases aromatics yield in an aromatics complex.

Ideally, ethylene producers would utilize naphtha with a high normal paraffin concentration, and refiners and aromatics producers would utilize naphtha that is depleted of normal paraffin. UOP's MaxEne technology is now available to cost-effectively separate full range naphtha into one stream rich in *n*-paraffin and a second stream depleted in *n*-paraffin.

As shown in Figure 1, the MaxEne process employs continuous separation of *n*-paraffin from non-normal paraffin in naphtha.

Figure 1 - MaxEne Process Flow



The separation takes place in an adsorption chamber that is divided into a number of beds that each contains proprietary, shape-selective adsorbent. Each bed in the chamber is connected to a rotary valve that is used to direct the flows to simulate moving bed counter-current adsorptive separation.

There are four major streams distributed by the rotary valve to and from the adsorbent chamber. The streams are as follows:

- The feed stream is the naphtha feed. It contains a mixture of hydrocarbons.
- The extract stream contains normal paraffin and a liquid desorbent. Naphtha rich in normal paraffin is recovered from this stream by fractionation and is sent to the naphtha cracker.
- The raffinate stream contains non-normal components of the naphtha feed and a liquid desorbent. Naphtha depleted in normal paraffin is recovered from this stream by fractionation and is sent to a refinery or an aromatics complex.
- The desorbent stream contains a liquid desorbent that is recycled from the fractionation section to the chamber.

The rotary valve is used to periodically switch the position of the liquid feed and withdrawal points in the adsorbent chamber. The process operates in a continuous mode at low temperatures in liquid phase. This enables reduced operating costs, low energy requirements and long adsorbent life compared to past processes.

Process Performance

The MaxEne Process can be designed and operated to achieve various levels of normal paraffin purity and recovery. The UOP rotary valve has been engineered for reliability and has been proven in more than 100 process units worldwide. Rotary valves typically operate for several years without the need for maintenance. On-stream availability for a typical Sorbex process unit is very high with minimal maintenance required due to the mild operating conditions.

Case Study

A study was performed for a client who wished to increase ethylene and aromatics production from an existing integrated petrochemical facility. In addition to improvements in the selectivity for both the cracker and reformer, it was estimated that reduced coking from processing improved feedstocks would allow an 11% increase in throughput for both units. As summarized in Table 1, the MaxEne process increased the combined yield of ethylene and propylene by 18%.

Table 1 - Impact of MaxEne Implementation on Cracker Yields

Cracker Products	Base Case KMTA	With MaxEne KMTA
Ethylene	316	374
Propylene	162	190
Butylenes	95	96

The naphtha that was depleted in n-paraffin was sent to the catalytic reformer to form aromatics for an integrated aromatics complex. In the base case, throughput for the reformer was constrained by limits in the continuous catalyst regeneration unit. This constraint was removed after processing the naphtha feedstock through MaxEne technology. The overall effect of the MaxEne process on yield of product from the aromatics complex is summarized in Table 2.

Table 2 - Impact of MaxEne Implementation on Aromatics Complex Yields

Reformer Products	Base Case KMTA	With MaxEne KMTA
p-Xylene	457	520
Benzene	131	139
LPG	44	38

The overall economic benefit of the MaxEne process to this customer is summarized in Table 3.

Table 3 - Overall MaxEne Economic Impact

Incremental Product Revenue ($MM US/yr)	269
Incremental Feed Costs ($MM US/yr)	152
Incremental Gross Margin ($MM US/yr)	117

A simple payback of less than 2.5 years was estimated for this project.

Commercial Experience

In collaboration with our technology commercialization partner, Sinopec, the first commercial MaxEne unit came on stream in early 2013. UOP has licensed more than 100 process units based on Sorbex technology. It is a well proven and reliable technology that is currently used in aromatics, refining, and detergents applications.

For more information

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