PETROCHEMICALS

UOP Advanced Methanol to Olefins (MTO) Process

Selective propylene and ethylene production

Introduction

Ethylene and propylene are in increasing demand worldwide and have significant value in the marketplace. Methanol to Olefins (MTO) technology was developed to link ethylene and propylene production to cost-advantaged raw materials, such as natural gas (methane), coal or petroleum coke. With MTO technology, methanol is an intermediate product in MTO projects.

The UOP Advanced MTO Process provides a number of benefits when compared to competing MTO technologies:

- Highest ethylene and propylene yield, lowest methanol consumption - Carbon yield > 90 Wt%
- Wide flexibility in P/E production ratio – 0.8 to 1.6
- Lowest MTO catalyst consumption
- Largest single train design light olefin production capacity, up to 1,800 kmta light olefins

Advanced MTO process technology produces light olefins at lower costs and higher yields compared to traditional technologies using cost-advantaged alternative feedstocks, such as natural gas or coal via methanol.

Applications

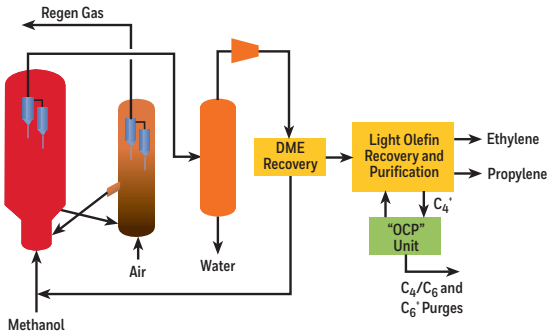
New MTO projects are often developed as gas-to-olefins (GTO) or coal-to-olefins (CTO) projects, which include the conversion of natural gas or coal to synthesis gas ("syngas") followed by conversion to methanol.

Transport of light olefins is costly, therefore new projects often include the conversion into olefin derivatives such as polyethylene (HDPE, LDPE, LLDPE) polyvinylchloride (PVC), and polypropylene or other derivatives that are more cost effectively transported to their end markets.

For existing naphtha steam crackers that are converting to ethane feedstock, Advanced MTO can utilized to produce propylene and other higher olefins in order to meet current production requirements.

Another option would be locating an MTO unit downstream of an existing methanol plant with excess capacity, to meet local demands for olefins and polyolefins.

MTO Integrated with Olefin Cracking Technology



Description

The UOP Advanced MTO Process integrates the UOP/Hydro MTO process and the Total Petrochemicals/UOP Olefin Cracking Process (OCP) to provide an economical means to convert methanol to light olefins, primarily ethylene and propylene.

The UOP/HYDRO MTO process uses a fluidized reactor and regenerator system to convert methanol to olefins using a proprietary, SAPO-34 catalyst. This catalyst has been optimized by UOP to maximize steady-state yields of ethylene and propylene while achieving excellent long term stability and minimizing catalyst consumption, all of which enable Advanced MTO to achieve the lowest operating costs per unit of product among any of the competing processes.

Similar to Fluid Catalytic Cracking (FCC), a portion of the catalyst is continuously withdrawn from the reactor and transferred to the regenerator where accumulated coke is removed from the catalyst via combustion with air. A portion of the regenerated catalyst is continuously transferred from the regenerator to the reactor to maintain the proper inventory and activity of the catalyst in the reactor. This provides continuous smooth steady-state operation. This type of reaction system has been proven very effective over decades of operation in UOP Fluid Catalyst Cracking (FCC) process units in petroleum refineries.

In the UOP Advanced MTO Technology, the C_4^+ byproduct stream from the UOP/HYDRO MTO process is converted using the Total Petrochemicals/UOP Olefin Cracking Process, OCP. It converts C_4^+ olefins to ethylene and propylene. The effluent from the OCP reactor section is compressed and combined with the MTO products for final fractionation and purification. This further increases the overall yield from the integrated complex.

The high yield from the UOP Advanced MTO Technology minimizes the size and investment required for the upstream syngas and methanol plants, and it minimizes or eliminates the need to market lower-value fuel products. The high yields are achievable with on-stream flexibility over a broad range of propylene to ethylene product ratios (Product P/E).

The Advanced MTO Process was first demonstrated on a semi-commercial scale by Total Petrochemicals in Feluy, Belgium. The plant circulates and regenerates catalyst continuously and used crude methanol as a feedstock at a rate of more than 10 MT per day.

Feedstock

Feedstock for the UOP Advanced MTO process is methanol (crude or high purity) usually produced from synthesis gas ($CO + H_2$), which is produced from cost advantaged feedstock sources such as coal, natural gas or petroleum coke.

Catalyst

The MTO reaction is catalyzed by the MTO-100 silicoaluminophosphate synthetic molecular sieve based catalyst. This catalyst has demonstrated the degree of attrition resistance and stability required to handle multiple regenerations and fluidized bed conditions over the long term. The catalyst is highly selective toward the production of ethylene and propylene.

The Olefin Cracking Process uses a proprietary zeolitic catalyst supplied by UOP. The catalyst provides high selectivity and yields with good stability and uniquely low coking tendency.

Commercial Experience

UOP's first commercial Advanced MTO plant started up in 2013 at Wison Clean Energy Company Ltd., in Nanjing, China with a light olefin production rate of 295 kMTA. A second unit similar to Nanjing started up in 2015 at Yangmei, Shandong Province, China. The third commercial start-up of Sailboat in 2016 (Jiangsu Province, China) is the largest single train MTO unit in the world, with a production capacity of 830 kmta light olefins. At least 5 new MTO units are expected to start up in 2019 and 2020, and beyond.

For more information
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