Gemini™ Oxidative Coupling of Methane

LUMMUS TECHNOLOGY

Overview

The Oxidative Coupling of Methane (OCM) catalytic process transforms methane—one of the most abundant, inexpensive and widely available hydrocarbons on earth—into commodity chemicals in an efficient, cost-effective, scalable manner using processes that can be seamlessly integrated into existing industry infrastructure. At the core of this process is the Lummus proprietary Gemini™ OCM reactor and catalyst, which enables the reaction that converts methane to ethylene in an adiabatic catalytic fixed bed and the subsequent cracking reaction of ethane and/or propane to ethylene and/or propylene in an adiabatic zone. This technology can reduce oil imports, lower prices for consumers and businesses, increase profits for gas producers, reduce environmental emissions, and contribute towards a more sustainable future.

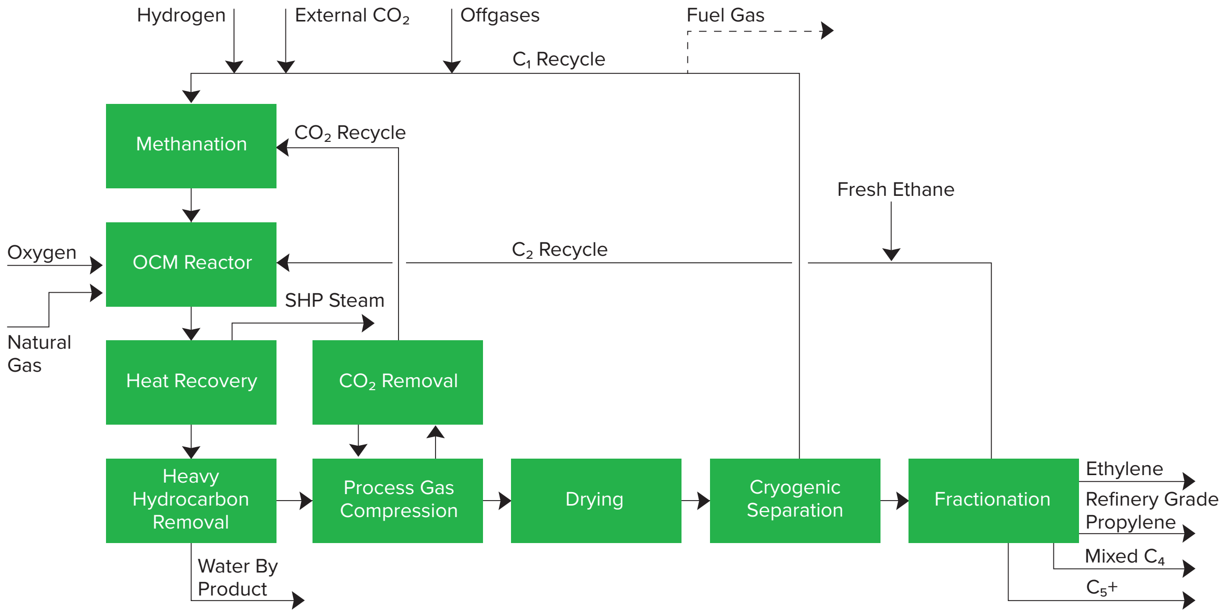
Advantages

Process Features	Process Benefits
Fixed bed refractory-lined adiabatic design	Reliable and robust with high on-stream factor
Flare gas, Fuel gas, biogenic methane, CO_2 and abundant natural gas as feedstock	Low value gas stream to valuable olefins. Site Decarbonization
Methane containing feedstock from different sources with flexible composition and ability to co-feed ethane or propane.	Feedstock Flexibility
High catalyst selectivity and low light-off temperature	Lower operating cost
Integrated post-bed cracking section to maximize olefins production	Lower investment and operating cost
Can be integrated with other technologies such as Dimer/OCT, Gas Processing, PDH, Steam Cracker, Refining and Methanol plant	Lower investment and operating cost

Performance Characteristics

Typical Feedstocks		Ethylene Product	
Methane	> 95 mol %	Ethylene	99.95 mol % min
Ethane	< 3.5 mol %	Methane	500 ppm
Propane	0.20 mol %	Ethane	500 ppm
Butanes	0.25 mol %	C3+	10 ppm max
C_5+	0.007 mol %	Acetylene	1.0 ppm max

Block Flow Diagram



The diagram shown is for the production of polymer grade ethylene, referred to as Gemini™. For polymer grade propylene production, the process is integrated with Dimerization/OCT Unit, referred to as Orion™.

Process Description

The OCM process involves an OCM Reactor system that converts methane and ethane to ethylene over a proprietary catalyst at relatively moderate temperatures and pressures.

Downstream of the OCM catalyst bed, the high temperature of the process gas permits injection of ethane or propane for cracking to ethylene or propylene. This section of the reactor is referred to as Post Bed Cracking. The C_2 Splitter in the Fractionation Unit recycles all ethane produced by the process. However, additional ethane or propane can be sourced from a nearby pipeline and fed to the OCM plant.

Process gas from the OCM Reactor is first cooled in the Heat Recovery section where SHP steam is generated. Process condensates and some heavy hydrocarbons are separated from the gaseous effluent, compressed and treated for CO_2, then dried.

After drying, the gas is cooled. Ethylene along with ethane and heavier components are removed from the gas in the Cryogenic Separations Unit. The C_2 plus liquid product is sent to the Fractionation Unit. C_2 plus is further separated to produce high purity ethylene, ethane (internally recycled), propylene (refinery-grade), mixed C_4's and C_5 plus streams.

The gas from the overhead of the Demethanizer, consisting mainly of methane, hydrogen and CO, is sent to a Methanation Unit where CO, CO_2 and H_2 are converted to methane. CO_2 is recycled from the CO_2 Removal unit to the Methanation Unit to maximize the conversion of hydrogen. Additional H2, CO2 and Offgases rich in H2 and methane can be routed here from external sources. After methanation, the methane recycle gas is combined with natural gas make-up feed before being preheated and used as OCM Reactor feed.

Process Chemistry

Oxidative Coupling of Methane

$2CH_4$	+	O_2	$\longrightarrow$	C_2H_4	+	$2H_2O$	+	Heat
Methane		Oxygen		Ethylene		Water		

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