A world designed to last

Refinery off-gas recovery technology

Stand-alone and integrated refinery off-gas processing and high value product recovery



T.EN TECHNIP ENERGIES

Refinery off-gas technology

Technip Energies is the world leader in refinery off-gas recovery (ROG) projects. Our technology is suited to dedicated refinery units to recovery hydrogen and ethylene, combined refinery and ethylene plant integration projects to improve ethylene plant economics, as well as world-scale production of ethylene and propylene from ROG fed units.

- Technip Energies is the leading ethylene technology licensor with 40-50 percent of the total installed capacity worldwide.
- ROG technology can provide conversion of low-value refinery by-products to low-cost cracking furnace feedstock and a boost to high-value products (ethylene, propylene and hydrogen).
- ROG technology applies to new stand-alone facilities or recovery combined with a co-located ethylene plant.
- Significant references demonstrate highly reliable and inherently safe schemes.
- Our know-how provides proven arrangement of reactors, adsorbents and processing steps.
- Technip Energies has established relationships with the key adsorbent and catalyst suppliers.
- ROG successes highlight our commitment to innovation for the benefit of operating companies.
- ROG projects can be located on nearby plot with no impact to ethylene plant operations.

Customised solutions using Technip Energies experience in ROG and olefins technology provide significant economic improvement of ethylene plants co-located with refineries. Recovery of valuable ROG components enhances overall product sustainability by maximizing the value in the often-overlooked light ends produced in refining.



Potential ROG contaminants and treatment methods

Contaminant	Treatment method
Water	Molecular sieve
CO_2	Amine and/or caustic wash
H_2S	Amine and/or caustic wash
MA/PD	Selective hydrogenation
Butadiene	Selective hydrogenation
Oxygen	Deoxo reactor or fractionation to fuel gas
Ammonia	Water wash and adsorption
NOx	Caustic wash/deoxo/fractionated managed by cryogenic separation design
COS	Amine and/or caustic wash, fixed bed adsorption
Mercaptans	Amine and/or caustic wash, fixed bed adsorption
Arsine	Adsorption (Pb, Zn, Cu oxides)
Phosphine	Adsorption (Pb, Zn, Cu oxides)
Chlorides	Water wash and adsorption
Mercury	Impregnated charcoal, mercury sieves or sulphided metals

ROG technology for integration

Off-gases from refining can be classified into two categories: Saturated off-gases without olefins and unsaturated off-gasses with olefins.

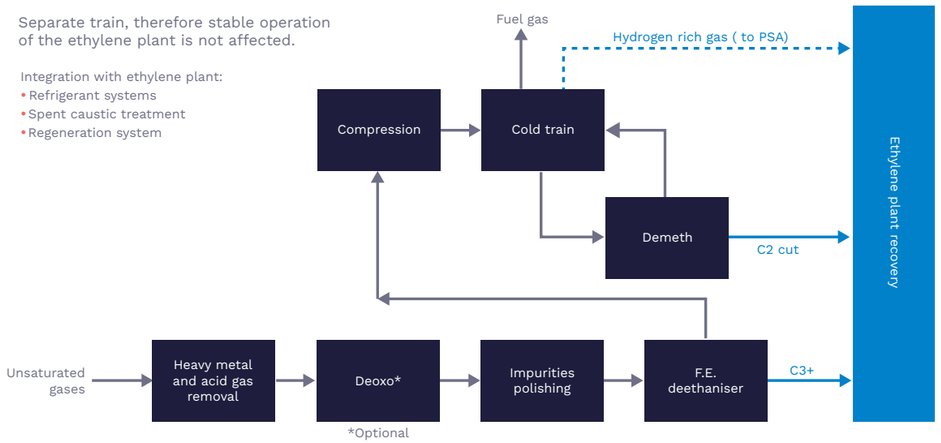
Unsaturated off-gases from refinery cracking processes such as delayed coking, fluid catalytic cracking (FCC) and deep catalytic cracking (DCC) contain significant quantities of olefins (notably ethylene and propylene) that can be fed to the recovery section of an ethylene plant to increase production.

Saturated off-gases containing saturated hydrocarbons can be sourced from hydrotreaters, saturated gas plants and refinery pressure swing adsorption (PSA) facilities and, once processed to recover ethane, propane and C4's, make ideal feed for the ethylene plant cracking furnaces, reducing the demand for fresh feed.

Reducing feed demand lowers operating costs, fuel gas demand, utility consumption and greenhouse emissions.

Key ROG integration features

- Optimized contaminant removal with no ROG sent directly to cracking furnaces or the recovery train
- Safe handling and management of oxides of nitrogen (NOx) risks
- Optimized ROG separation to enable integration with minimal alterations to the ethylene plant
- Potential hydrogen recovery to off-load reformer demand
- Nitrogen and methane recovery to fuel
- No impact on ethylene plant reliability or availability
- Utility requirements compatible with existing ethylene plant facilities
- Synergy with existing plant storage, flare system, regeneration and waste treatment facilities



Our ROG experience

Location	Off-Gas source	Deoxo reactor included	High value products	Completed
India	FCC/Coker	No	Ethylene	2024 (est.)
Azerbaijan	FCC	Yes	Ethylene	2020
Europe	FCC	No	Ethylene & propylene	2017
	Saturated off-gases	No	C2-C5 Alkanes	
India	FCC/Coker	Yes	Ethylene & propylene	2017
	Saturated off-gases	No	Ethane & propane	
China	DCC	Yes	Ethylene & propylene	2015
United Arab Emirates	FCC	Yes	Ethylene & propylene	2015
Russia	DCC	No	Propylene	2012
Brazil	FCC	Yes	Ethylene & propylene	2012
India	DCC	No	Propylene	2012
India	DCC	No	Propylene	2011
Taiwan	DCC	No	Propylene	2011
China	CPP	Yes	Ethylene & propylene	2009
Saudi Arabia	DCC	Yes	Ethylene & propylene	2009
Taiwan	FCC	Yes	Ethylene & propylene	2007
China	FCC	Yes	Ethylene & propylene	2006
Japan	FCC	Yes	Ethylene & propylene	2005
USA	FCC	Yes	Ethylene & propylene	2005
Thailand	DCC	No	Ethylene & propylene	1997
USA	FCC	No	Ethylene & propylene	1997

ROG technology for new petrochemical projects

TECHNOLOGY HIGHLIGHTS:

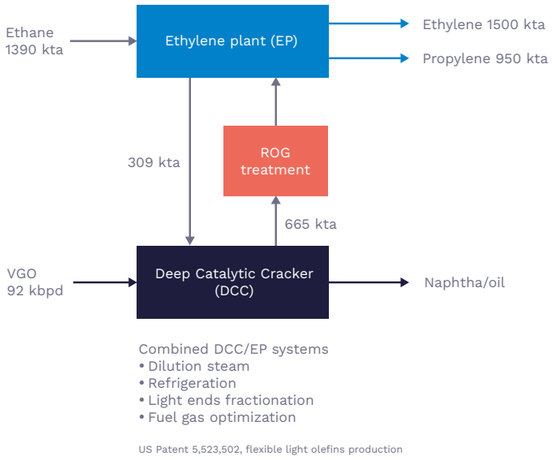
- Ethylene plant furnaces fed with fresh ethane feed - primary ethylene producer
- Refinery DCC unit fed with vacuum gas oil (VGO) - primary propylene producer
- Combined light ends recovery train to make polymer grade products: 1500 kta ethylene and 950 kta propylene
- Combined contaminant removal
- High propylene make



Petro Rabigh Project, Saudi Arabia

Petro Rabigh combined deep catalytic cracker (DCC) unit and ethylene plant

In a first-of-a-kind concept, Petro Rabigh of Saudi Arabia integrated DCC and ethylene technologies, resulting in one of the world's largest petrochemical facilities. The integration of these units was made possible by Technip Energies' knowledge and experience in catalytic cracking, olefin and ROG technologies.



Combined DCC/EP systems
- Dilution steam
- Refrigeration
- Light ends fractionation
- Fuel gas optimization

US Patent 5,523,502, flexible light olefins production



Reliance refinery off-gas cracker (ROGC) project

The Reliance cracker at Jamnagar in Gujarat, India is the world's largest ethylene plant fed purely from refinery off-gas. The project showcases the scalability of ROG technology from integration projects to this world-scale cracker.

TECHNOLOGY HIGHLIGHTS

- Refinery saturated gas plant provides ≈160 t/h of feed to the saturated gas treatment and recovery train. Ethane and propane are recovered to feed the cracking furnaces
- Refinery FCC and coker provides ≈280 t/h of feed to the unsaturated gas treatment and recovery train
- Recovered C2s and C3s are fed to the ethylene plant recovery section
- Dedicated multilayer contaminant removal schemes
- Capacity of 1400 kta ethylene and 170 kta propylene



3D model of ROGC project

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