IPOR℠ - Iso-Pressure Open Refrigeration C_3^+ Recovery

MCDERMOTT TECHNOLOGY

Overview

Lummus Technology's proprietary Randall Gas IPOR℠ process is a state-of-the-art, high efficiency refrigeration process that recovers 99+% propane from gas streams with essentially no ethane recovery. The design utilizes a conventional closed loop propane refrigeration cycle and an open loop ethane-rich mixed refrigeration cycle.

Closed loop propane systems are commonplace in the gas processing industry. These systems have proven to be both simple and reliable; however, their operating temperatures are typically restricted to approximately -40°F, which limits the achievable product recoveries.

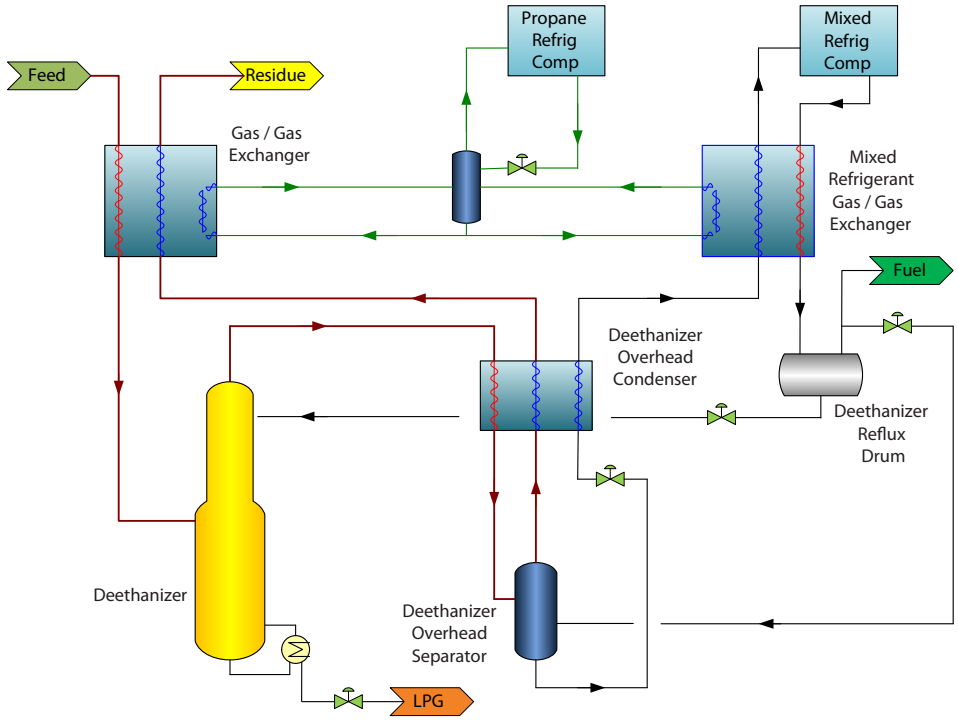
The unique feature of the IPOR process is its open loop, ethane-rich, mixed refrigeration cycle. This refrigerant is extracted from the feed gas itself and is a mixture of predominantly ethane with lesser concentrations of methane, propane and other feed gas constituents. This refrigeration cycle serves a dual purpose: it provides refrigeration for the process to achieve cryogenic temperatures while at the same time providing an ethane-rich reflux stream to the fractionation column, the combination of which allows for high product recoveries and thermal efficiencies.

The IPOR process can also be used to recover LPG and hydrogen from refinery off-gas.

Advantages

Process Features	Process Benefits
Applicability	▪ Feed gas ranges from 5MMSCFD to 200+ MMSCFD ▪ Low to moderate feed gas pressures (200 - 550 psig) ▪ Significant propane recovery advantage over turbo-expander processes with moderate to rich feed gas streams ▪ Hydrogen and LPG recovery from refinery off-gas
Thermal Efficiency	▪ 10-40% less compression power required than comparable turbo-expander design
Reliability	▪ No turbo-expander or light hydrocarbon pumps ▪ Comparable to conventional refrigeration ▪ Uses industry standard equipment
Operability	▪ High turndown capability, without reducing recovery levels ▪ Fast start-up ▪ Suitable for remote unattended applications
Constructability	▪ Low equipment count and small footprint ▪ Mostly carbon steel construction ▪ Easily designed for modularization

Process Flow Diagram



Process Description

This process description is of a typical IPOR process.

Feed gas is cooled and partially condensed in the gas/gas exchanger by cross exchange with cold residue gas and the propane refrigerant.

The feed gas stream is then fed to the mid-section of the deethanizer column. Below the feed tray, the stripping section of the column removes the lighter components to meet product specifications for the LPG product. Heat for separation is provided by the deethanizer reboiler.

Above the feed tray is the rectification section of the column where the cooled feed gas flows countercurrent to the reflux stream. The reflux stream is fed to the top tray and provides additional cooling for the feed gas stream. The reflux also absorbs propane and heavier components from the gas, thereby achieving high product recoveries.

The overhead gas stream from the deethanizer, containing primarily light components from the feed gas stream and a small portion of the propane, is further cooled in the deethanizer overhead condenser against cold residue gas and the ethane rich mixed refrigerant streams.

The cooled and partially condensed overhead gas stream flows to the deethanizer overhead separator. The deethanizer overhead separator performs two functions:

- Acts as a conventional two phase gas-liquid separator
- Provides surge capacity for the liquid mixed refrigerant system

The liquid from the deethanizer overhead separator, a mixture of methane, ethane, and propane, is let down and used as the refrigerant for the open loop mixed refrigerant cycle. The liquid mixed refrigerant is let down, vaporized, compressed, condensed, and enters the deethanizer reflux drum. The vapor (residue gas) is heated in the main exchanger and gas/gas exchanger.

For refinery off-gas applications, a hydrogen purification platefin exchanger and a hydrogen separator are added after the residue gas stream leaves the gas/gas exchanger to produce a hydrogen-rich product stream.

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