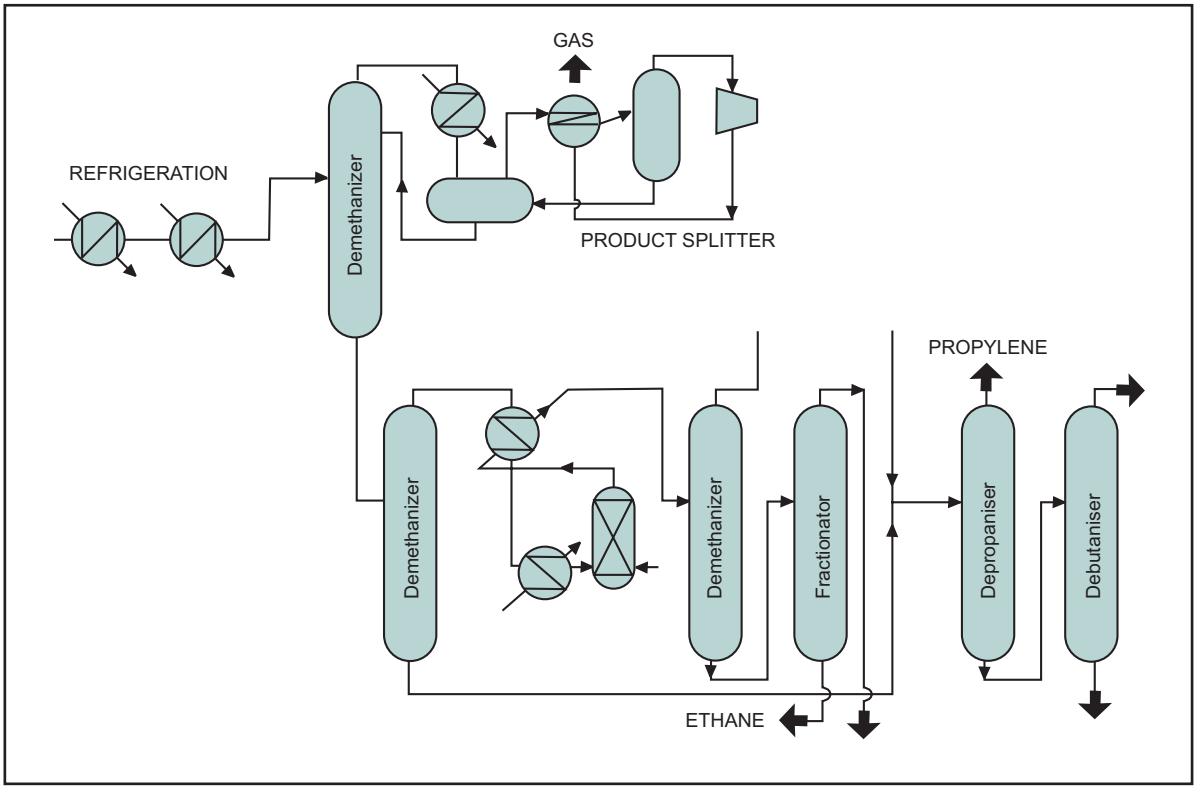
Fractionation cryogenic distallation



Introduction

For the production of ethylene, the separation of the feedstock into the various desired products is preceeded by steam cracking, quench, compression and drying, after which the product gases are capable of being cryogenically distilled or fractionated. These are the final steps of the ”cold section” of the ethylene plant.

The plant section of fractionation is a building block, with various methods of separating out specific products. The industry is still searching for the most efficient sequence for these methods. Therefore, this report will deal with each method separately, on the basis of a conventional fractionation sequence. Each ethylene plant will apply its own sequence based on the normal feedstock, the desired purity of end product, and the range of end products to be produced.

When investments in new ethylene plants are down, capital expenditures may be made to optimize the fractionation area, where bottlenecks can occur due to plant expansions upstream.

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Distallation column control
The Process

In this conventional fractionation section (see above illustration), the dried gases are cooled to -120 °C/-184 °F and pass through the demethanizer. The C1 or methane cut is further separated to recover methane, and the bottom product is sent to the de-ethaniser. The de-ethaniser top product is sent through a secondary demethaniser and then through an ethanelethylene splitter, before the ethylene is recovered and the ethane is recycled to the cracking furnaces. The bottoms of the de-ethaniser are sent to the depropaniser for separation of the propylene. The bottoms of the depropaniser are sent to the debutaniser for separation into light fuels and butane.

De-Ethaniser. The de-ethanizer column functions as a fractionator to separate out as much ethane as possible. The liquid feed is introduced on the top tray of the de-ethaniser column, which is heated and operating at 25-30 bar/360-435 psi pressure. An asymmetrical separation is effected so that a very low concentration of ethane exits by way of the bottom product, and some heavier components remain in the top product.

Demethaniser. The demethaniser is similar to the de-ethaniser, except the end product is methane.

Depropaniser. The depropaniser works much the same as the de-ethaniser, except that the separation is symmetrical between propane and isobutane.

Debutaniser. The debutaniser is similar to the de-ethaniser, with butane and light fuels as end products.

Cascade Refrigeration System. The refrigeration system is the heart of the cryogenic distillation process. Refrigerated liquids are produced for use in other parts of the process. In addition, products from the distillation, such as liquid ethylene and propylene, are put to use in the refrigeration process. The liquid components, which are at -100 °C/-150 °F are vaporized at constant pressure in a heat exchanger, which is also cooling products for the distillation process. The vaporized refrigerants are compressed and condensed in an atmospheric cooler (propylene circuit) or a heat exchanger (ethylene circuit).

Ethylene Fractionator. The de-ethaniser top product is usually sent to the ethylene fractionator, where ethylene is separated at very high purity by cryogenic distillation from the ethane which is often recycled to the cracking furnaces.

Propylene Fractionator. Similar to the ethylene fractionator, the depropaniser propane cut is sent to the fractionator for high purity cryogenic distillation.

Product Splitters. Product splitters are small fractionating columns that serve to split charge gas components. All components that are more volatile than those required in the end product are vaporised with the aid of steam injected into the bottom of the stripper. The vaporized impurities are sent back to the main column, or another stripper, and the bottom products can be sufficiently pure for the purpose required and be sent to storage.

Two other steps of the fractionation process, acetylene conversion and hydrogenation, are described in separate process summaries. The removal of acetylene and hydrogenation are processes that can be found in the fractionation area, depending on the plant requirements.

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