Natural Gas Processing
Recovery, Separation, and Fractionation of NGL (Natural Gas Liquids)

Natural gas field processing and the removal of various components from it tend to involve the most complex and expensive processes. Natural gas leaving the field can have several components that will require removal before the gas can be sold to a pipeline gas transmission company. All of the H2S and most of the water vapor, CO2, and N2 must be removed from the gas. Gas compression is often required during these various processing steps.

The condensable hydrocarbons heavier than methane which are recovered from natural gas are called (NGL). Associated gas usually produces a higher percentage of natural gas liquids. It is generally desirable to recover NGL present in gas in appreciable quantities. This normally includes the hydrocarbons known as C3+. In some cases, ethane C2 can be separated and sold as a petrochemical feed stock. NGL recovery is the first operation in gas processing, as explained in Chapter 16. To recover and separate NGL from a bulk of a gas stream would require a change in phase; that is, a new phase has to be developed for separation to take place by using one of the following:

1. An energy-separating agent: examples are refrigeration (cryogenic cooling) for partial or total liquefaction and fractionation.

2. A mass-separating agent: examples are adsorption and absorption (using selective hydrocarbons, 100 - 180 molecular weights).

The second operation is concerned with the fractionation of NGL product into specific cuts such as LPG (C3/C4) and natural gasoline. The fact that all of the field processes do not occur at or in the vicinity of the production

operation, does not change the plan of the system of gas processing and separation.

Recovery and Separation of NGL:

Options of Phase Change

To recover and separate NGL from a bulk of gas stream, a change in phase has to take place. In other words, a new phase has to be developed for separation to occur. Two distinctive options are in practice depending on using energy separating agents (ESAs) or mass separating agents (MSAs).

1. Energy Separating Agent

The distillation process best illustrates a change in phase using ESA. To separate, for example, a mixture of alcohol and water, heat is applied. A vapor phase is formed in which alcohol is more concentrated, and then separated by condensation. This case of separation is expressed as follows:

A mixture of liquids + Heat → Liquid + Vapor

For the case of NGL separation and recovery in a gas plant, removing heat (by refrigeration) will allow heavier components to condense; hence, a liquid phase is formed. This case is represented as follows:

A mixture of hydrocarbon vapor - Heat → Liquid + Vapor

Partial liquefaction is carried out for a specific cut, whereas total liquefaction is done for the whole gas stream.

2. Mass Separating Agent

To separate NGL, a new phase is developed by using either a solid material in contact with the gas stream (adsorption) or a liquid in contact with the gas (absorption).

NGL are normally fractionated into three streams:

-An ethane-rich stream used for producing ethylene

-Liquefied petroleum gas (LPG). It is a propane-butane mixture and is important feedstock for olefin plants.

-Natural gasoline

Natural gas liquids may contain significant amounts of cyclohexane.

Shale Gas

Conventional gas reservoirs are areas where gas has been "trapped." After natural gas is formed, the earth's pressure often pushes the gas upward through tiny holes and fractures in rock until it reaches a layer of impermeable rock where the gas becomes trapped. This gas is relatively easy to extract, as it will naturally flow out of the reservoir when a well is drilled.

Shale gas is defined as natural gas from shale formations (i.e., natural gas trapped within shale, fine-grained sedimentary rocks, formations). Shale has low matrix permeability to allow significant fluid flow to the wellbore, therefore commercial production requires mechanically increasing permeability. Shale gas reserves have been known for a long time, but natural fracture technology used earlier was uneconomical to produce shale gas. Recent developments in horizontal drilling and hydraulic fracturing (called fracking) made it viable. Mitchell energy, a Texas gas company, first achieved economical shale gas fracture in 1998. Shale gas is currently in an evolutionary stage and so far is largely confined to North America.

The complete technology and economic factors are yet to mature. Several high-profile shale gas drilling efforts in Europe have already failed