Simulation of NGL Feed Treatment Using a Depropanizer Column

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Background & Description:

This report presents the simulation of an NGL (Natural Gas Liquids) feed treatment process aimed at recovering light hydrocarbon products through a depropanizer column. The process involves initial vapor–liquid separation, thermal conditioning of the liquid stream, and subsequent processing in a depropanizer with 24 stages. The simulation, performed in HYSYS using the Peng-Robinson fluid package, optimizes operational parameters to recover light products such as ethane and propane while directing heavier fractions for further fractionation at a third-party facility.

The treatment of NGLs is critical in the oil and gas industry, as it allows the recovery of high-value light hydrocarbons. Efficient separation of light components like ethane and propane is essential to meet market specifications and pipeline quality standards. In this study, a complete process flowsheet has been simulated, incorporating a two-phase separator, a series of heat exchange and pumping operations, and a depropanizer column to achieve effective separation of light gases from the heavier hydrocarbon mix.

The overall process comprises several key steps:

1. **Two-Phase-Separation:** The raw NGL feed undergoes an initial separation in a two-phase separator, where the lighter gases are separated from the liquid phase. The extracted light gases are subsequently compressed for export to the pipeline.
2. **Thermal Conditioning of the Liquid:** The liquid stream from the separator is pumped and then processed through a heat exchanger and a heater. These steps adjust the temperature of the liquid to optimize its entry conditions into the depropanizer column.
3. **Depropanizer Column Operation:** The conditioned liquid is fed into a depropanizer column consisting of 24 stages. The column, equipped with a reboiler (once-through, regular HYSYS reboiler) and a partial condenser, operates under a controlled pressure profile (top pressure of approximately 1925 kPa and bottom pressure of 2070 kPa) with the feed introduced at stage 12. This configuration is designed to maximize the recovery of light products (ethane and propane) while ensuring that the heavy fraction is directed to a third-party fractionation facility.

The simulation confirmed the feasibility of the process and provided key insights into the separation efficiency:

- Effective Vapor–Liquid Separation:
  The initial two-phase separator successfully divides the NGL feed, allowing the light gases to be isolated for subsequent compression and export.
- Optimized Thermal Conditioning:
  The combination of the heat exchanger and heater effectively conditions the liquid stream, ensuring that it enters the depropanizer column at optimal temperatures for efficient separation.
- Depropanizer Performance:
  Operating the column at the prescribed pressures and stage configuration resulted in a top product rich in light hydrocarbons (primarily ethane and propane). The use of a partial condenser and once-through reboiler, along with an appropriate reflux ratio, facilitated the high-quality separation of light and heavy fractions.

The use of HYSYS in conjunction with the Peng-Robinson model proved to be highly effective in simulating the complex thermodynamics of the NGL feed treatment. Key observations include:

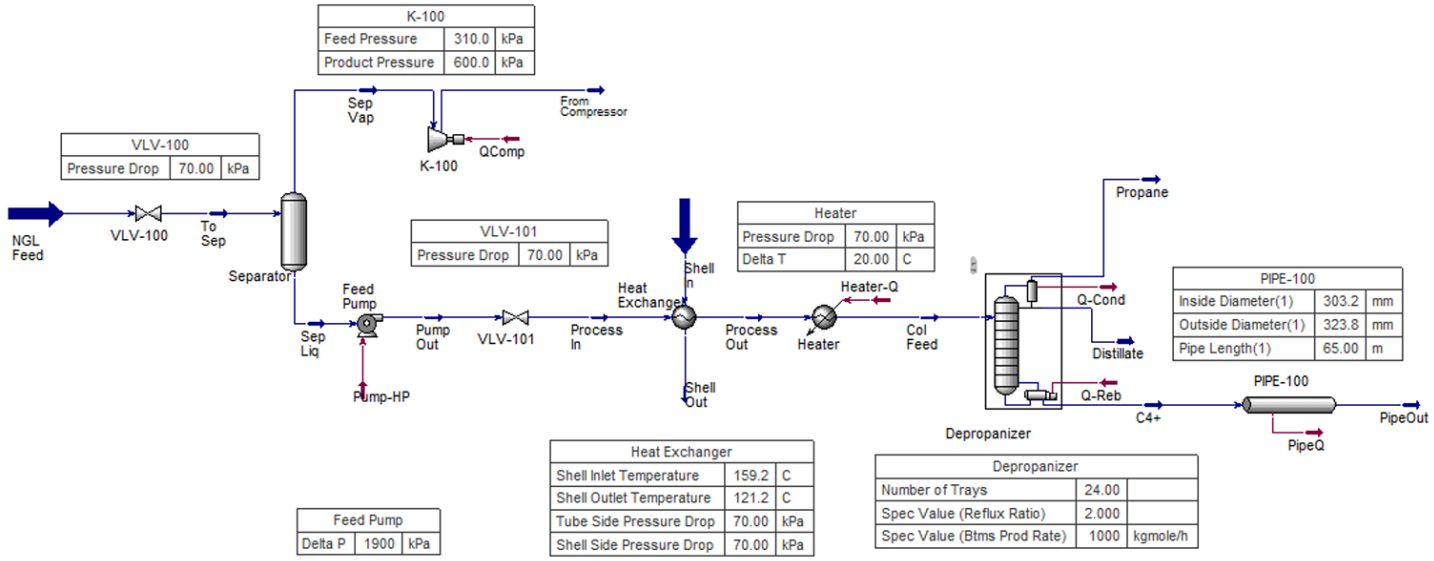
- Process Integration:
  The integration of separation, thermal conditioning, and depropanization stages was critical in optimizing the recovery of light hydrocarbons. Each unit operation must be finely tuned to maintain process efficiency and product quality.

- Pressure and Temperature Control:
  Managing the pressure and temperature profiles, particularly in the depropanizer column, is essential for ensuring a sharp separation between light and heavy components.
- Scalability and Industrial Relevance:
  The simulation demonstrates that such an integrated process can be scaled up to industrial levels, where maximizing product recovery and minimizing operational costs are paramount.

This mini-report details the simulation of an NGL feed treatment process involving a two-phase separator and a depropanizer column. The HYSYS simulation, underpinned by the Peng-Robinson model, confirms that proper integration of separation, thermal conditioning, and column operation can effectively recover light hydrocarbons such as ethane and propane. This simulation approach provides valuable insights for process optimization and can aid in the design of efficient industrial treatment facilities.

Thermodynamic package: The Peng-Robinson model is employed due to its suitability for simulating systems involving hydrocarbons, ensuring accurate thermodynamic calculations.

Flowsheet



Results:

Master Property Tableau (See Files for results)

Nb : Insignificant quantities (<0) of components in the product streams can be considered negligible, effectively approximating them to zero without impacting the overall process results or conclusions (see flowsheet).