Liquids Processing
Chapter 15

Reasons for Liquids Processing

Make a shippable liquid product
  • Reduce vapor pressure
Sweeten – reduce sulfur content
Make individual salable products
Topics

Condensate processing
- Vapor pressure control
- Sweetening
- Dehydration

NGL processing
- Fractionation
- Sweetening
  - Amine treating
  - Adsorption
  - Caustic treating
- Dehydration
  - Adsorption
  - Desiccant (nonrenewable)
  - Gas stripping
  - Fractionation

Condensate processing

Simple condensate processing

Vapor pressure spec – 10 – 15 psi RVP
  - If trucked off site, more typically 9 – 12 psi RVP

D86 end point no more than 370°F
Typical NGL Fractionation Arrangement

![Diagram of NGL fractionation arrangement](image)

**Figure 13.2** NGL fractionation train


Typical NGL Fractionation Conditions

<table>
<thead>
<tr>
<th>Operating Pressure, psi-20</th>
<th>Number of Actual Stages</th>
<th>Btu Lower</th>
<th>Gas Recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dewaterer</td>
<td>250 (20-250)</td>
<td>60-70</td>
<td>80-90</td>
</tr>
<tr>
<td>Dehydrator</td>
<td>50 (5-50)</td>
<td>70-75</td>
<td>85-90</td>
</tr>
<tr>
<td>Dehydrator</td>
<td>20-40</td>
<td>75-85</td>
<td>85-90</td>
</tr>
<tr>
<td>Dehydrator</td>
<td>1.20-1.75</td>
<td>80-100</td>
<td>85-100</td>
</tr>
<tr>
<td>Condensate Separator</td>
<td>80-85</td>
<td>90-100</td>
<td>85-100</td>
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* Btu lower refers to section marked.
* Gas recovery is section option.

Liquid Sweetening & Dehydration

Upstream treatment of the gases will usually remove H₂S but not CS₂ or mercaptans

Liquid treating options
  • Amines — effectiveness is similar to gas treating
  • Adsorption
    • Effective if no water is present
  • Caustic treating
    • Converts sulfur compounds into water soluble mercaptan salt; oxidized with air to form disulfide oil

RSH + NaOH → RSNa + H₂O
2 RSNa + ½ O₂ + H₂O → RSSR + 2 NaOH

Typical NGL Fractionation

<table>
<thead>
<tr>
<th>Distillation</th>
<th>Boiling Point (°F)</th>
<th>Number of Actual Stages</th>
<th>Ref/°F</th>
<th>Top Feed</th>
<th>Bottom Feed</th>
<th>Top/Bottom Ratio</th>
<th>Top Feed - Bottom Feed</th>
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<tr>
<td>Dehnaturizer</td>
<td>200 - 400</td>
<td>10 - 30</td>
<td>Top/Fed</td>
<td>Top Feed</td>
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Ref: GPSA Data Book, 13th ed.

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Liquid Sweetening

UOP’s Merox process is very common

- Catalytic oxidation process. Carried out in an alkaline environment with aqueous solution of NaOH (strong base) or NH3 (weak base).
- Reactions (using NaOH)
  - Extraction: \( R-\text{SH} + \text{NaOH} \rightarrow \text{NaS-R} + \text{H}_2\text{O} \)
  - Regeneration: \( 4\text{NaS-R} + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{R-S-S-R} + 4\text{NaOH} \)
  - Overall: \( 4\text{R-\text{SH}} + \text{O}_2 \rightarrow 2\text{R-S-S-R} + 2\text{H}_2\text{O} \)

- Can control to less than 10 ppmv mercaptan level
- Disulfides leave in the Merox reactor in caustic/aqueous phase. Once oxidized forms a non-soluble disulfide oil.

Liquid Dehydration

Low mutual solubility of liquid water & liquid hydrocarbons

- Greatest mutual solubility is with aromatics (benzene, ...) & water
- Process options: adsorption (e.g., mole sieves), desiccant, gas stripping

Summary

Extent of processing depends on product(s) to be made

- Simplest processing is to stabilize the condensate
- Separation into multiple products usually done at large facility or centralized processing facility
  - Separate the lightest fractions first
  - Separate isomers after carbon-number fraction separated from rest of liquids

Sweetening

- Merox unit can remove all sulfur compounds – makes disulfide oils

Dehydration

- Typical processes are mole sieve adsorption, desiccant adsorption, & gas stripping