NGL EXTRACTION
SPE - BACK TO BASICS

Ed Wichert
Sogapro Engineering Ltd.
September 27, 2011
DEFINITIONS

• NGL - C$_{2+}$
• LPG - C$_3$ and C$_4$
• LNG - C$_1$
• Condensate - plant inlet separator hydrocarbon liquid
• Pentanes-Plus - C$_{5+}$ (stabilized condensate)
## TYPICAL GAS ANALYSIS

<table>
<thead>
<tr>
<th>Component</th>
<th>Mol Fraction</th>
<th>Liquid Recovery L/1000m³</th>
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<td><strong>TOTAL</strong></td>
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Source | Date | Notes |
|--------|------|-------|

NGL → LPG → C₅+
CHARACTERIZATIONS

- Dry Gas
- Lean Gas
- Rich Gas
- Wet (hydrocarbon) Gas
- Solution Gas
- Sales Gas or Residue Gas
<table>
<thead>
<tr>
<th>Component</th>
<th>Dry Gas</th>
<th>Rich Gas</th>
<th>Wet Gas (reservoir comp.)</th>
<th>Solution Gas</th>
<th>Sales Gas</th>
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<td>H₂</td>
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<tr>
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</table>
WHY EXTRACT NGL?

• Meet Sales Gas Specifications (TCPL)
  – -10 degrees C (at 5 000 kPa)
• Make Money
NGL EXTRACTION METHODS

- Short Cycle Dry Desiccant Adsorption
- Cooling
  - Joule-Thomson Expansion
  - Refrigeration
    - With glycol
    - With methanol
  - Turbo-Expander
- Lean Oil Absorption
RULES OF THUMB REGARDING EXTRACTION PROCESSES

• For hydrocarbon dewpoint control only:
  – Short cycle adsorption
  – Joule-Thomson expansion
  – Refrigeration to about −20 °C
• For basic NGL recovery:
  – Refrigeration to about −20 °C
  – Lean oil absorption at ambient temperature
  – Turboexpander without external refrigeration
• For high NGL recovery, including ethane:
  – Turboexpander
  – Refrigeration to about −30 °C
  – Refrigerated lean oil absorption (not suited for ethane recovery).
• All require economic comparisons
SCHEMATIC OF SHORT CYCLE ADSORPTION PROCESS EQUIPMENT
SCHEMATIC OF JOULE-THOMSON PROCESS EQUIPMENT

- Inlet Gas
- Inlet Separator
- Heat Exchanger
- Sales Gas
- Gas to Recycle
- Condensate to Stabilizer
- Glycol Reconcentration
- Condensate/Glycol Separator
- Heater
- Choke
- LT Separator
- TC
- Sales Gas
- Condensate to Stabilizer
TYPICAL HEAT EXCHANGE AND PROPANE CHILLER EQUIPMENT
Ifpex-1: Simultaneous Water & HC Dewpointing

Raw Gas

Methanol Make up

Cold Process

Dry Gas

MeOH/Water

Water

NGL
SCHEMATIC OF IFPEXCOL PROCESS EQUIPMENT
D. J. Morgan,
O&GJ May 3/76
SCHEMATIC DRAWINGS OF DIFFERENT FRACTIONATION PROCESSES

**Schematic of Stabilizer Operation**
- Feed from Inlet Separator
- Butane and Lighter Overhead
- C5+

**Schematic of De-ethanizer Operation**
- Feed from Refrigeration Process
- Ethane and Lighter Overhead
- C3+ Product

**Schematic of LPG and C5+ Recovery**
- Feed from Refrigeration or Turboexpander Process
- Ethane and Lighter Overhead
- Propane and Butane Mixture (LPG)
- C5+ Product

**Propane and Butane Mixture (LPG)**
- Feed from Refrigeration or Turboexpander Process
- C5+ Product
SCHEMATIC DRAWING OF DIFFERENT FRACTIONATION PROCESSES (cont’d)

Feed from Refrigeration or Turboexpander Process

Ethane and Lighter Overhead

Propane

Butane

C5+ Product

DE-ETHANIZER

DE-PROPANIZER

DE-BUTANIZER
Feed from Refrigeration or Turboexpander Process

Ethane and Lighter Overhead

DE-ETHANIZER

DE-PROPANIZER

DE-BUTANIZER

Propane

Butane

C5+ Product
SCHEMATIC DRAWING OF FRACTIONATION PROCESS EQUIPMENT

Source: Part of Chart in O&GJ, June 6, 2011
Picture of fractionation tower
Lean Oil
Absorber
Inlet Gas
Sales Gas
Lean Oil
Tank
Cooler
Lean Oil
Stripper
Reflux
Gas to
Recycle
Condensate to
Fractionator
Rich Oil
Heat

SCHEMATIC DRAWING OF LEAN OIL ABSORPTION PROCESS
PHASE DIAGRAMS

• Representation of dewpoint, bubblepoint and liquid fractions versus pressure and temperature for a gas composition
• Quickly visualize the level of liquid formation for selecting the desired operating conditions of pressure and temperature for refrigeration
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Dry Gas, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 50 % Liquid
Sales Gas, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 50 % Liquid

Pressure [kPa]

Temperature [°C]
Rich Gas, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 50 % Liquid
Rich Gas, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 50% Liquid
WHY EXTRACT NGL?

• Meet Sales Gas Specifications (TCPL)
  – -10 degrees C (at 5 000 kPa)

• Make Money
  – Demonstrate NGL value with Excel Spreadsheet
WHAT ABOUT RESERVOIR CYCLING?

• Reservoir pressure will drop with production
• Pressure will drop below dewpoint pressure at reservoir temperature, resulting in loss of heavy components
• Enhance recovery of NGL’s by reservoir cycling
Wet Gas, Reservoir Composition, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 30 % Liquid
Wet Gas, Reservoir Composition, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 30 % Liquid
Gas Treating Plant
- Inlet separation
- NGL recovery
- Dry gas compression and injection

Well production and gathering system

Gas injection wells

SCHEMATIC OF TYPICAL RESERVOIR CYCLING SYSTEM
RESERVOIR CYCLING SCHEMES

• Major reservoir cycling schemes of the past
  – Kaybob Units 1, 2 and 3
  – Carson Creek
  – Windfall
  – Brazeau

• Requirements
  – Wet (hydrocarbon) gas
  – Reservoir quality
  – Large price difference between gas and NGL’s
CONCLUSIONS

- Different methods are available for extracting NGL’s from natural gas
- All of the highlighted methods are being used in Alberta
- At current price difference between oil and gas it is profitable to extract NGL’s
- Energy equivalence: 1 Bbl of oil $\approx$ 6 Mscf of gas (BOE)
- Monetary equivalence: 1 Bbl of oil $\approx$ 20 Mscf of gas (currently).
THE END