Typical Raw Syngas

- H2: 30 - 50%
- CO: 30 - 50%
- Ar: 0.5 - 1%
- N2: 0.7 - 1.5%
- CO2: 5 - 19%
- H2S: 0.5 - 2%
- COS: 200-1000 ppmv
- Ni & Fe Carbonyls
- HCN, NH3...

Applications:
- Power
- Chemicals
- Hydrogen
- Liquid Fuels
- etc
Solvent Loading Comparison

![Graph showing Solvent Loading vs. Partial Pressure for Chemical and Physical processes. The graph indicates a higher solute loading for the Chemical process compared to the Physical process at lower partial pressures.]
## Acid Gas Removal Unit Options
### Gasification Syngas

<table>
<thead>
<tr>
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<th>$CO_2$</th>
<th>$H_2S$</th>
<th>$COS$</th>
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</thead>
<tbody>
<tr>
<td>Chemical solvents</td>
<td>✔️</td>
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<tr>
<td>Physical solvents</td>
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<td>Membranes</td>
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<td>Molecular sieves</td>
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*UOP 4685A-41*
Selexol for Sulfur Removal & CO₂ Capture

- Used for hydrogen, chemical, coal to liquids and IGCC with CCS applications
- Independent absorbers with common solvent regeneration

**Diagram: CO₂ Absorber**

**Diagram: Sulfur Absorber**

**Diagram: CO₂ Stripped Feed Gas**

**Diagram: H₂S Stripper**

**Diagram: Lean Solution Filter**

**Diagram: H₂S Concentrator**

**Diagram: Packinox Exchanger**

**Diagram: Reflux Pump**

**Diagram: Reboiler**

**Diagram: Export Water**

**Diagram: Makeup Water**

**Diagram: Acid Gas**

**Diagram: Treated Gas**

**Diagram: Shifted Feed Gas**

**Diagram: Reflux Accumulator**

**Diagram: Export Water**

**Diagram: Stripper Reboiler**
**Selexol Features**

**Sulfur Removal & CO$_2$ Capture**

CO$_2$ is partially released at elevated pressures.

Converted metal sulfides are captured by the solvent filtration system.

Export water contains absorbed trace components HCN, NH$_3$...

- CO$_2$ Absorber
- Lean Solution Filter
- Shifted Feed Gas
- Sulfur Absorber
- Cool to atmospheric temperatures or mild chilling
- Packinx Exchanger
- H$_2$S Concentrator
- Reflux Pump
- H$_2$S Stripper
- Export Water
- Treated Gas
UOP Selexol™ Process
Commercial Experience

• 57 operating units
  - Both Natural Gas and Gasification applications

• 4 Recent Gasification Applications in Operation
  - Sarlux – Italy – IGCC Power plus H₂
  - API – Italy – IGCC Power
  - Coffeyville Resources - USA -NH₃/UAN
  - OptiCanada – Oil Sands Canada – H₂ plus fuel

• Multiple large units in engineering phase
  - Residue gasification for H₂ production, Oil Sands Canada
  - Other gasification projects
    • Power - USA, Europe
    • NH₃ - USA
    • Coal to Liquids - USA
    • Methanol – USA
    • CO₂ from Natural Gas - USA
Project Considerations That Impact Acid Gas Removal Technology

- **Gasifier pressure**
  - Acid gas component partial pressures in syngas
- **Product quality requirements**
  - Treated syngas
  - CO$_2$ product
  - Acid gas – H$_2$S, hydrocarbon, H$_2$, CO
- **CO$_2$ Capture requirements**
  - Recovery
  - Purity – CO$_2$, CO, H$_2$
  - Destination
Syngas Processing Issues

- Required process blocks are application specific and dependent on:
  - Desired treated syngas product slate
  - Syngas product quality objectives
  - CO₂ separation or capture targets
  - Acid gas specifications

- A gasification project requires collective optimization of all process blocks in the complex
Gasification Syngas Treating
Typical Project Drivers

• Treated syngas product sulfur
  – Less than 1 ppmv total sulfur from Selexol
  – Sulfur guard bed for downstream catalytic processing

• CO₂ separation or capture
  – Treated syngas CO2 content optimized in conjunction with downstream processing
  – 90 % recovery typical when CO2 capture is part of project
  – Have designed up to 97% CO₂ recovery
  – CO₂ purity and sulfur requirements can impact cost
Solvent & Flow Scheme Improvements & Complex Optimization

- Improvement examples
  - Power recovery systems
  - High efficiency equipment
    • Packinox Heat Exchangers
    • Column Internals / Packing

- Complex optimization
  - CO shift location
  - Tail gas recycle streams
    • Eliminates a portion of Claus Tail Gas Treatment (TGTU)
    • Maximize CO₂ capture
  - Product stream purification alternatives
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Selexol Integration Opportunities

• Integrating streams across the gasification complex can result in significant project savings
  – Minimization of off gas streams, such as PSA tail gas, SRU tail gas, flash gas, etc
    • Recycling to the right location
  – Maximization of sulfur removal and recovery
    • Minimizing treating requirements downstream
  – Maximization of CO$_2$ removal and recovery
    • Targeted CO$_2$ destination and recovery level can impact complex design
Solvent & Flow Scheme Improvements & Complex Optimization

• Improvement examples
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  – High efficiency equipment
    • Packinox
    • Column Internals / Packing
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Summary

• Selexol has clear process and economic advantages over other technology options for power, H2, and chemical applications

• Integrated solutions provide the best opportunities to maximize margins

• UOP can drive optimization discussions and assist in maximizing the value of the gasification project

• UOP has commercial experience for gasification applications
UOP Selexol™ Technology
Applications for CO₂ Capture

3rd Annual Wyoming CO₂ Conference
June 23rd and 24th

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