Cleaning Underground Coal Gasification Synthesis Gas, Prospects and its Challenges

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http://ucg3.coalconferences.org/ibis/UCG3/
The Potential Promise of UCG

• Underground Coal Gasification (UCG) gives the promise of turning many poor quality coal resources into exploitable reserves by delivering energy in the form of synthesis gas, potentially at very low cost.

• The synthesis gas can be used for generation of electricity and the production of fuels and chemicals by commercially proven technology.
The Challenges of UCG

• There are technical and environmental challenges that are still not fully resolved, a major one being:

• Continuity of production, i.e. flow & quality of syn-gas and another,

• Being the complexity and overall cost of syn-gas clean-up which has to be added to the cost of UCG production.
A Simplified UCG Production Scenario

- Oxidants Injection Well: Air, Oxygen and/or Steam
- Saturated Strata
- UCG Gas Extraction Well
- Coal
- An UCG Cell

- Syn-gas

- UCG Syn-gas use in Power Generation
- UCG Syn-gas use in Syn-crude Production
- UCG Syn-gas use in Chemicals/Fertiliser Production
### Comparative uses of UCG-gas, costs and risks

<table>
<thead>
<tr>
<th>Intended Use</th>
<th>Cost</th>
<th>Process Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-firing Coal Fired Power Stations</td>
<td>Low to moderate</td>
<td>Low to moderate</td>
</tr>
<tr>
<td>Firing Dedicated Gas Turbine Power Stations</td>
<td>Moderate to high</td>
<td>Moderate to high</td>
</tr>
<tr>
<td>Chemicals and Fertiliser requiring Catalysts</td>
<td>High to very high</td>
<td>High to very high</td>
</tr>
</tbody>
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A more realistic UCG Production Scenario

Syn-gas Flow, Well-head to Advanced Utilisation
Part of the answer?

The Oval, London, UK
Gas-holders/Gasometers

- A 19\textsuperscript{th} Century Gas Storage Device
- A device that operates at low pressure
- A gas storage system that can safely operate with high levels of hydrogen in the contained gas
- A gas storage device that can have a blending and averaging function
- A gas storage device that has a gas cleaning function (settling/precipitation)
- A convenient sampling point
Syn-gas clean-up an extended view
Managing UCG-gas to Achieve the Highest Use of Available Raw Energy - 1

<table>
<thead>
<tr>
<th>Syn-gas component</th>
<th>UCG</th>
<th>Surface Gasifier</th>
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<tbody>
<tr>
<td>Hydrogen</td>
<td>30.2</td>
<td>36.0</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>17.4</td>
<td>52.5</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>32.6</td>
<td>10.0</td>
</tr>
<tr>
<td>Methane</td>
<td>18.2</td>
<td>0</td>
</tr>
<tr>
<td>H₂ + CO</td>
<td>47.6</td>
<td>88.5</td>
</tr>
<tr>
<td>MJ/scm</td>
<td>13.3</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Note: UCG gasifier, O₂ blown; surface gasifier, O₂ blown, entrained bed type
Managing UCG-gas to Achieve the Highest Use of Available Raw Energy - 2

• Notes on the comparison:
  – Valuable syn-gas components H₂ + CO are much lower in UCG product,
  – Methane is high in the UCG product, but is inert in most chemical operations and adds to process costs,
  – UCG product contains significant tars and C2+ components, (not present in surface gasifier product) &
  – Both products contain H₂S, COS, NH₃ & HCN.
Managing UCG-gas to Achieve the Highest Use of Available Raw Energy - 3

- Methane here is put through a reformer to produce additional H₂ and CO, or
- The off-gas containing methane can be utilised in power generation.
Surface Wastes Management

• Managing the waste ponds from syn-gas cleaning will be both a challenge from a contents and safe containment points of view,

• Could recycling into active gasification cells be an answer, or

• Could a surface gasifier be utilised for rendering such wastes harmless?
Other developing risks

• Populist anti-coal sentiments will result in excessively strict environmental legislation,
• Coal will be made such a pariah of fossil fuels that project funding and permitting will become impossible, and
• Unconventional oil and gas will continue to make inroads into the fossil fuel business further displacing coal use in all its forms.
Conclusion

- UCG has the potential of being a major monetisation pathway for many stranded coal resources,
- UCG has the potential to be a major source of high value hydrocarbon products, however,
- UCG has challenges that must addressed forthrightly and be overcome.

THANK YOU