Initial results from the CIUDEN CPU
CO₂ Capture on oxy CFB flue gas


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Agenda

- CRYOCAP™ OXY CPU roadmap
- CIUDEN CPU – overview
- Review of specific technologies and results
- Conclusions
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CRYOCAP™ OXY CPU roadmap

Initial Studies

Individual Technology Testing

Comprehensive Pilot testing

Large Scale testing

SASKPOWER STUDY

CALLIDE
75 mtpd CO₂

CIUDEN
165 / 10 mtpd CO₂

FUTUREGEN 2.0
3200 mtpd CO₂

TOTAL LACQ
Driers - 240 mtpd CO₂

SBS 2
Dust filtration

Step-by-step approach with extensive pilot testing
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CIUDEN CPU Overview – key facts & figures

- Supplied by ISOLUX using Air Liquide design and technology

- Warm part capacity: **160 mtpd CO₂**

- Cold part capacity: **10 mtpd liquid CO₂**

- Warm part accumulated operating hours: ~**2500**

- Cold part accumulated operating hours: ~**1500**

- A range of ‘upscalable’ technologies
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Flue Gas Quench and Scrubbing - process

Technology
- Initial column for quench
- Scrubbing with Na₂CO₃ solution
- Double plastic column for scrub

Results
- <1ppm SO₂
- Short spikes when inlet SO₂ rises
- Significant dust removal
- Very low CO₂ loss
- Waste pH : ~6-7
- Reagent solution pH : ~11-7
Flue Gas Quench and Scrubbing - materials

**Technology**
- Corrothane™ XP coating on flue gas inlet
- Hastelloy for quench
- Plastic for scrubbing towers

**Results**
- Acid condensates in inlet during transients
- No materials degradation on inlet/quench/scrubber and downstream due to effective scrubbing
Filtration

Technology
- Regenerable pleated cartridges
- Regenerated by back-pulsing
- Target of ~10µg/Nm³ at outlet

Results
- Negligible dust build up
- Dust almost 100% removed by quench and scrubber
- Care must be taken in transient phases to avoid condensation
Dryers

Technology
- 3 vessels cycle
- Regeneration using dried gas
- Relatively low pressure
- Inexpensive materials

Results
- Dew point ~-100°C

- Condensates upstream: low acidity (pH ~3-4) due to limited NO to NO₂ conversion at low pressure
- Condensates in dryers: similar pH
Cold Box

Technology

- CO₂ recovery by partial condensation
- O₂ and NOₓ removal by distillation
- Cold from separate CO₂ cycle
- Operation close to CO₂ triple point

Results

- No issues with CO₂ freezing
- CO₂ purity >99.9%
- Very low NOₓ and SOₓ content

<table>
<thead>
<tr>
<th>Compound</th>
<th>Purity</th>
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<tbody>
<tr>
<td>CO₂</td>
<td>&gt;99.9%vol.</td>
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<tr>
<td>SO₂</td>
<td>&lt;0.1ppmv</td>
</tr>
<tr>
<td>NOₓ</td>
<td>&lt;10ppmv</td>
</tr>
<tr>
<td>H₂O</td>
<td>&lt;1ppmv</td>
</tr>
<tr>
<td>O₂</td>
<td>&lt;10ppmv</td>
</tr>
</tbody>
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Conclusions

- **Significant operating hours** accumulated

- High level of **dust** and **SO₂** removal by scrubber

- **High purity liquid CO₂** production from oxycombustion gas

- **Optimal operation** close to **CO₂ triple point**

An important step in **qualifying CPU technology**
End of presentation
Thank you for your attention