Fundación Ciudad de la Energía CIUDEN

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CIUDEN s CO$_2$ Transport Rig

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Transport test rig - CO$_2$ sources (commercial and captured)
Transport test rig - Tube coil description
Transport test rig

- **CO₂ from CPU**
- **Pure CO₂**

**Tube coils**

- (3.000 m)
- **P**: 80-110 bar
- **T**: 10-31 °C

- De-pressurization
- Pressure drops
- Contaminant dosing
- Corrosion
- Instrumentation testing
- Available
- Elastomer testing

**Experimental areas**

**MIR-FT**
- Chromatograph
- Spectroscopy UV-vis
### Transported CO₂ composition – Dosing capabilities

<table>
<thead>
<tr>
<th>Compound</th>
<th>Concentration limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂S</td>
<td>200 ppm</td>
</tr>
<tr>
<td>CO</td>
<td>2000 ppm</td>
</tr>
<tr>
<td>SOx</td>
<td>100 ppm</td>
</tr>
<tr>
<td>NOx</td>
<td>100 ppm</td>
</tr>
<tr>
<td>H₂O</td>
<td>500 ppm</td>
</tr>
<tr>
<td>O₂</td>
<td>Aquifer &lt; 4 vol% (all non cond. gases), EOR &gt;100 ppm</td>
</tr>
<tr>
<td>CH₄</td>
<td>Aquifer &lt; 4 vol%, EOR &lt;2 vol% (all non cond. gases)</td>
</tr>
<tr>
<td>N₂, Ar, H₂</td>
<td>&lt;4 vol% (all non cond. gases)</td>
</tr>
<tr>
<td>CO₂</td>
<td>&gt; 95%</td>
</tr>
</tbody>
</table>

**SOURCE:** ECOFYS STUDY

**New components from CO₂ capture processes**
## Transport test rig - Design parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating P (barg)</td>
<td>80 - 110</td>
</tr>
<tr>
<td>Operating T (°C)</td>
<td>10 - 31</td>
</tr>
<tr>
<td>Pipeline size (inch)</td>
<td>2</td>
</tr>
<tr>
<td>Total pipeline length (m)</td>
<td>3,000</td>
</tr>
<tr>
<td>Recirculation Pump (m³/h)</td>
<td>15</td>
</tr>
<tr>
<td>High Pressure Vessel (m³)</td>
<td>4.5</td>
</tr>
<tr>
<td>Pressure Drop (bar)</td>
<td>30</td>
</tr>
<tr>
<td>Building (m³)</td>
<td>23x18x8.5</td>
</tr>
<tr>
<td>Pipe material</td>
<td>CS (2 SS tube coils)</td>
</tr>
</tbody>
</table>
Transport test rig - Experimental areas

- Pressure drops
- Instrumentation testing
- De-pressurization
- Corrosion and material testing
- Leaks
- Available one

The tests can be carried out with different CO$_2$ qualities and at different P & T
Transport test rig pictures (I)
Transport test rig pictures (II)
Transport test rig pictures (III)
CO₂ properties– Phase diagram

![CO₂ Phase Diagram]

<table>
<thead>
<tr>
<th>Property</th>
<th>Gas (g/cm³)</th>
<th>Supercritical</th>
<th>Liquid (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>≈0,001</td>
<td>0,2 – 1,0</td>
<td>0,6 – 1,6</td>
</tr>
<tr>
<td>Diffusivity</td>
<td>0,1</td>
<td>0,001</td>
<td>0,00001</td>
</tr>
<tr>
<td>Viscosity</td>
<td>0,0001</td>
<td>0,001</td>
<td>0,01</td>
</tr>
</tbody>
</table>
CO₂ pipeline composition

- Source of CO₂
- Pre-treatment Process
- HES Toxicity
- CO₂ composition
- Economic Evaluation
- Pipeline Integrity
- Material Selection
- Corrosion
- Flow assurance
  - Phase diagram
  - Density
  - Compressibility
  - Hydrates
- Operation
  - Compression
  - De-pressurization
  - Training

CIUDEN’S CO₂ transport test rig

+ Partner (funding, collaboration agreement)

Theoretical studies
Basic research
Applied research
Experimentation capabilities in Transport TDP (WP2): Impurities (composition), corrosion - material testing, different P&T, pressure drops, instrumentation testing and de-pressurization

**TEST MATRIX SUMMARY - CO2 TRANSPORT TDP**

<table>
<thead>
<tr>
<th>Test/Week</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>S1</td>
<td>S2</td>
<td></td>
</tr>
</tbody>
</table>

**Operation Range**

P: 60 to 100 bar

T: 12 to 27 ºC

Fluid: dense phase

These tests have run for one week and the results obtained will give us the information and the know how on the operation of the unit and the capabilities of the installation. Commercial CO2 has been used, with different P and T values.

Parametric tests have consisted of different tests with real CO2 from the CPU at different P and T values. On a second stage, the fluid has been dopped with different contaminants.
Operational SCADA of the Transport test rig
Transport test rig - Tests
Transport test rig - Tests
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THANK YOU VERY MUCH FOR YOUR ATTENTION

For further information, please contact
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