Integrally Geared Compressors for Supercritical $\text{CO}_2$

René Dittmer
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Integrally Geared Compressors for Supercritical CO$_2$

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# Integrally Geared_compressors for Supercritical CO₂

<table>
<thead>
<tr>
<th></th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CO₂ Sources and Properties</td>
</tr>
<tr>
<td>2</td>
<td>CO₂ Compression Systems</td>
</tr>
<tr>
<td>3</td>
<td>Product Development</td>
</tr>
</tbody>
</table>

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[Image of a 3D model of compressors]
Integrally Geared Compressors for Supercritical CO₂

Industrial Application

Cement and steel industry, petrochemicals

Conventional Power Plant

Coal

Air

Boiler

Power generation steam turbine

Flue gas treatment

CO₂ separation

Integrated Gasification Steam Cycle (IGSC)

Air

Air separation

Gasifier

Power generation steam turbine

Flue gas treatment

CO₂ separation

Oxyfuel

Air

Air separation

O₂

Boiler

Power generation steam turbine

Flue gas treatment

CO₂ separation

Integrated Gasification Combined Cycle (IGCC)

Air

Air separation

Gasifier

Shift reactors

CO₂ separation

Power generation gas turbine

XTL, Coal Gasification

Air

Air separation

Gasifier

Shift reactors

CO₂ separation

Product gas

Storage

CO₂ compressor
High-Pressure CO₂ means:

- Discharge pressure > 100 bara
- Very low compressibility factors at moderate pressures
- Compression from gas-phase to supercritical phase
- Very high density

Applications:
EOR / CCS / UREA
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Pressure-Density-Chart

Compressor Discharge pressure in bara

Compressor Discharge Density in kg/m³

Density of CO₂ @ 130 bar = Density of CH₄ @ 700 bar
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Integrally Geared Compressors for Supercritical CO₂

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>CO₂ Compression Systems</td>
</tr>
<tr>
<td>3</td>
<td>Product Development</td>
</tr>
</tbody>
</table>
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Different compression concepts:
Compression from gas-phase to 200 bara (above critical point)

Gas phase only

Gas & liquid
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# Integrally Geared Compressors for Supercritical CO₂

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
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</tr>
<tr>
<td>3</td>
<td>Product Development</td>
</tr>
</tbody>
</table>
Integrally Geared Compressors for Supercritical CO₂

More than 20 years of experience, 450,000 operating hours and dedicated research.
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Discharge pressure in bara

Massflow in Million tons per year

- UREA
- EOR / CCS
- R & D
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R&D project CORA (CO$_2$ Research Rig for Advanced Compressors)

- Liquid-CO$_2$ from tank
- High pressure closed loop
- Single lift unit
- 2 Stages
- MAWP: 250 bara
- 1 Cooler

CO$_2$-Supply
Test Rig
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Integrally Geared Compressors for Supercritical CO₂

R&D project CORA (CO₂ Research Rig for Advanced Compressors)
- High-pressure tests for CO₂-compressor components
- Development of stages for CO₂-compressors
- Investigation of CO₂-compressor behaviour in the region of the critical point
- Development of inlet guide vanes for very high inlet pressures
- Full load testing of gear components
- Improving:
  - Bearing design
  - Static seals
  - Shaft seals
  - Maintainability
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- HP-CO$_2$-compression is a complex task
- Integrally geared compressors (RG’s) are very flexible, save investments and operating costs
- 450,000 operating hours with RG-type in HP-CO$_2$ compression
- A dedicated HP-CO$_2$ test rig for further design improvements
Questions please

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