

Engineering Scale Testing of A High-Performance Solvent for Natural Gas Combined Cycle (NGCC) Flue Gas Carbon Dioxide (CO₂) Capture

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SustenolTM NGCC Flue Gas CO₂ Capture





44% estimated reduction in regeneration energy



Key Challenges

- Process Turndown Ratio
 optimize with respect to NGCC power plant
 load-following operation
- Lean Loading

reduction to increase the driving force at the top of the absorber.

 Liquid Flooding Levels & Hold-Up investigate at different operating capacity factors (25% to 85%)

based on rich $\rm CO_2$ loading at 40°C and 4% $\rm CO_2$ in flue gas





\bigcirc High CO₂ capture rate

>97% CO_2 Capture at low L/G Low surface tension and high reaction rate

Low capital cost

High working capacity Low viscosity with high mass transfer rate

Low operating cost

Low regeneration energy Low oxidative, thermal and hydrothermal degradation



Pilot Plant Test Results (1 tCO₂/day Unit)





Pilot Plant Test Results (350 kg CO₂/day Unit)





Host Site - National Carbon Capture Center (NCCC)

- 0.5 MWe PSTU for solvent-based CO₂ capture absorber/stripper system
- 5,000 lb/hr of coal-derived or NGCC flue gas
- 2,000 to 4,000 gallons solvent inventory
- Up to 99% CO₂ capture
- An advanced flash stripper (AFS)

| | | Coal Flue Gas | Natural Gas Flue Gas |
|-----------------|------|---------------|----------------------|
| Component | Unit | Composition | Composition |
| CO2 | vol% | 9-12 | 4 |
| 02 | vol% | 5-8 | 12 |
| H₂O | vol% | 8-12 | 8 |
| N ₂ | vol% | Balance | Balance |
| SO ₂ | ppmv | < 1 | < 1 |
| NOx | ppmv | < 50 | < 12 |
| Pressure | psig | 1-2 | 1-2 |
| Temperature | °F | 140-180 | 110 |



Planned Sustenol[™] Testing at NCCC



View of 0.5-MW PSTU



Engineering Scale Testing of SustenolTM for NGCC Flue Gas CO_2 Capture

Test the drop-in Sustenol[™] solvent at NCCC using the pilot-scale solvent test unit (PSTU) - 0.5 MW NGCC

- \checkmark to confirm and validate its CO₂ capture performance (>95% CO₂ capture)
- ✓ to confirm reboiler duty for solvent regeneration
- ✓ to test and confirm carbon steel and 316SS corrosion rates
- ✓ to refine and update rate-based process model
- ✓ to determine optimum operating window
- ✓ to demonstrate stability and emissions for commercial demonstration and deployment
- ✓ to achieve NGCC flue gas CO₂ capture costs <\$45/tonne</p>

