InnoSepra

Transformational Sorbent-Based Processes for a Substantial Reduction in the Cost of CO_2 Capture

August 2019

Ravi Jain

ravi.jain@innosepra.com

www.innosepra.com

908-450-9840 (o)

908-672-7395 (c)

Executive Summary

- InnoSepra's process utilizes physical sorbents with low heat of adsorption (~0.8 GJ/MT)
  - Can produce CO_2 at high purity (>99%) and recovery (>90%) for coal and natural gas-based power plants, and industrial sources
  - The estimated absolute energy required, excluding compression, is 1.5 GJ/MT, about 57% lower than MEA for coal-based plants
  - Heat needed at about 100^{o}C compared to >140^{o}C for amines
  - Lower absolute amount of heat needed and lower steam extraction temperature leads to ~78% lower power loss due to steam extraction
  - Potential for 50% reduction in the capital, and 78% reduction in parasitic power compared to MEA leading to >50% reduction in capture cost for EOR grade CO_2 (<1 ppm H_2O, <1 ppm SO_X, <10 ppm O_2)

The First Generation InnoSepra Process

- Demonstrated at 100-scfm scale at a coal-fired power plant
  - 8-10.5 wt% net CO_2 capacity in the field (much higher than steam regenerable sorbents)
  - >94% CO_2 recovery, 98.5- 99.5% CO_2 purity
  - The total heat requirement is 2.1 GJ/MT of CO_2
    - The power loss due to steam extraction is about 50% of amines due to lower steam extraction temperature
    - 18% reduction in total plant output due to steam extraction and CO_2 compression compared to 25-28% reduction for amines
  - About $38/MT capture cost, 48% lower than MEA

Adsorption Skid at NRG's Indian River Plant

The Second Generation InnoSepra Process

- A novel regeneration method and sorbent combination developed for the second generation process allows
  - Reduction in non-heat of adsorption part of parasitic power from 1.3 GJ/MT to 0.7 GJ/MT for a total parasitic power of 1.5 GJ/MT
    - The power loss due to steam extraction is 78% lower than MEA
  - <16% loss in total power output due to steam extraction and CO_2 compression
  - A projected capture cost of $32/MT and a pathway for a capture cost below $30/MT with no increase in LCOE

The DOE Project

- Major project tasks
  - Material and process development at lab scale through lab scale testing, isotherm measurements and Monte Carlo simulation
  - Adsorption process modeling and process Intensification
  - Testing at TCM at >100-scfm scale
  - Detailed engineering design including modular design to maximize shop fabrication, a techno-economic analysis to show the benefits
- Project Partners
  - Technology Center Mongstad (TCM), Arizona State, Main Line Engineering, Plant Process Equipment
- Performance Period and Project Budget
  - Two budget periods totaling 36 months
  - Total project budget is $4.02 M including cost share

Summary

- The InnoSepra technology has the potential for a significant reduction in CO_2 capture cost for a variety of sources
- It is possible to obtain very high recovery (>90%), and high purity (>99%) CO_2 with physical sorbents while meeting the EOR/sequestration product specifications.
- Potential to reduce the parasitic power required by about 78%, and the capital required by about 50% leading to >50% reduction in the CO_2 capture cost for the coal-based power plant flue gas
  - **A potential capture cost below $30/MT with no increase in LCOE**