Transformational Sorbent-Based Process for Direct Air Capture

DE-SC0020740
(SBIR Phase I – Office of Science)

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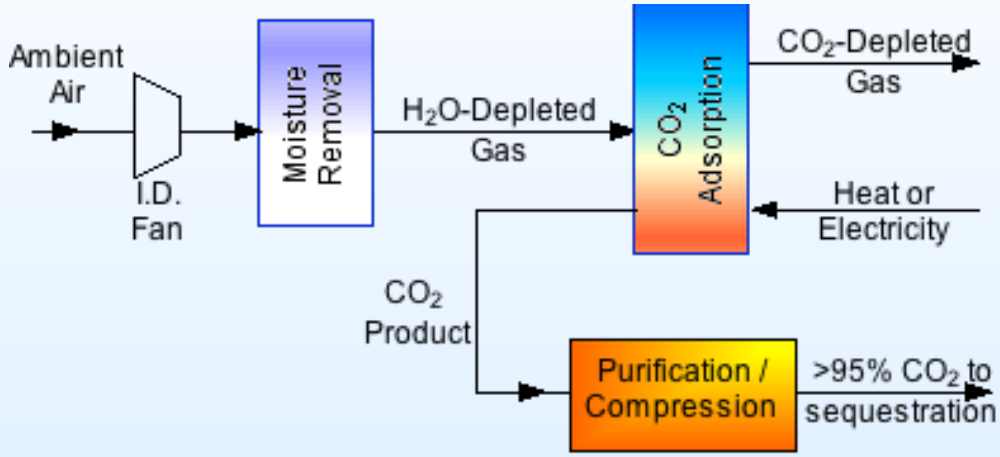
U.S. Department of Energy
National Energy Technology Laboratory
Direct Air Capture Kickoff Meeting
February 24-25, 2021

Project Overview

- Total DOE funding: $246,000
- Project Dates: 6/29/2020 to 3/28/2021
- Partners: InnoSepra, DOE and material suppliers
- Overall project objectives are to demonstrate the potential for a significant reduction in the cost of CO_2 capture directly from air based on lab scale testing and a techno-economic analysis

Technology Background



- Based on physical sorbents in structured form
- High CO_2 capacity at a p_{CO2} of 0.04 kPa (>4-wt%), low heats of adsorption (40-44 kJ/mol of CO_2)
- Materials are low cost, easily scalable to quantities needed for commercial use (thousands of tons), very stable (>5 year life)
- Challenges include fabrication of large quantities in structured form, process demonstration at a commercially relevant scale

Technical Approach/Project Scope

Work Plan

- Materials procurement, fabrication of lab test units
- Measurement of CO_2 sorption/desorption isotherms (0 to 100^oC)
- Moisture removal testing (up to 8 Nm^3/hr), CO_2 capture testing (up to 1.5 Nm^3/hr)
- Techno-economic analysis – ~100 tons/day CO_2 captured

Key Milestones

- Completion of lab testing – 1/31/21
- Completion of techno-economic analysis – 3/31/21

Project Success Criteria

- Techno-economic analysis showing a potential CO_2 capture cost of <$200/tonne after successful scale up

Team and Facilities

- DOE Project Manager: Mr. David Lang
- The InnoSepra Team (shown above), not shown Dr. Norberto Lemcoff, Dr. Stevan Jovanovic, Mr. Robert Ferrell
- Key equipment includes sorption microbalance, test units

Current Status of the Project

- Obtained materials for isotherm measurements, breakthrough and cyclic testing
- Built experimental units for moisture removal and CO_2 capture testing
- Measured CO_2 sorption/desorption isotherms at 0-100^oC
  - More than 4.5-wt% capacity at a p_{CO2} of 0.04 kPa (400-ppm CO_2 in air)
- Moisture removal to below <1,000 ppm with a very low pressure drop
- A cyclic CO_2 capacity of about 4-wt% with 400-ppm CO_2 in N_2, no sorbent degradation
- The performance is on target for a low cost DAC process

Opportunities for Collaboration

- The technology can be demonstrated quickly at scale through a synergistic combination of
  - Large scale fabrication of CO_2 capture materials
  - Fabrication and testing of the capture equipment incorporating capture materials in structured form at >2,000 Nm^3/hr scale
- InnoSepra would welcome opportunities to work with:
  - Companies involved in the fabrication of structured sorbents
  - Engineering companies for process scale up
  - Independent organizations involved in techno-economic analysis of Direct Air Capture
  - Companies interested in scale-up testing
  - Investors / business partners

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