Low Regeneration Temperature Sorbent for Direct Air Capture of CO$_2$

DE-FE0031965

PI: Dr. S. James Zhou
Susteon Inc.

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National Energy Technology Laboratory
Direct Air Capture Kickoff Meeting
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Program Overview

a. Funding: $999,687 (*DOE and Cost Share*)

b. Overall Project Performance Dates: 10/2020 – 03/2022

c. Project Participants:
   a. Susteon Inc. (Prime)
   b. University of Wyoming (Professor Maohong Fan)
   c. SoCalGas

d. Overall Project Objectives: Development of catalyzed solid sorbents with fast kinetics and low regeneration temperature for direct air capture of CO$_2$. The catalyst will reduce CAPEX and reduce energy consumption for sorbent regeneration resulting in lower cost of DAC.
Technology Background

a. Catalyst has been used to improve CO₂ sorption and desorption rates by several orders of magnitudes amine solvent/sorbent based CO₂ capture applications.

b. Only ppm quantities of the catalyst need to be added to amine-based adsorbents. This has a potential to reduce the regeneration temperature to 80°C, thus lowering the overall cost of CO₂ capture.

a. Lab-scale data on proprietary catalyst in MEA solution confirmed 30% increase in desorption rate and reduction in regeneration temperature

b. TEA: Significant reduction in overall CO₂ capture cost

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<thead>
<tr>
<th>Metric</th>
<th>State-of-Art</th>
<th>Goal</th>
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<tbody>
<tr>
<td>CO₂ Adsorption Kinetics (gmol/min/kg)</td>
<td>1.0</td>
<td>2.0</td>
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<tr>
<td>Temperature of Regeneration (°C)</td>
<td>100-120</td>
<td>80-90</td>
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<tr>
<td>Energy of Regeneration (%)</td>
<td>100%</td>
<td>80%</td>
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Technical Approach/Project Scope

a. Planned Experimental and Process Modeling Work
   • Synthesis, characterization and testing of catalysts and sorbents
   • Measure rates of adsorption and desorption
   • Determine heat and mass transfer
   • Develop process model, process design with TEA

b. Project Schedule
   1. Initial Technology Maturation Plan (TMP) developed
   2. Catalyst and sorbent synthesis in progress

c. Project success criteria
   1. Development of a catalyst that can be added to amine doped DAC sorbents to increase adsorption and desorption kinetics
   2. An increase of at least 50% in adsorption and desorption rates as compared with un-catalyzed SOTA sorbents.
Team and Facilities

Raghubir Gupta
President

S. James Zhou
Senior Director

Cory Sanderson
Process Technologist

Jian Zheng
Sr. Engineer
Progress and Current Status of Project

• Preliminary TMP completed
• DAC process cost parameters analyzed
• Catalyst synthesis recipe defined
• Catalyst quality control procedures established
• Catalyst synthesis setup assembling in progress
• Sorbent testing setup assembly in progress
• Sorbent supports and amines screening in progress
Opportunities for Collaboration

a. In discussion with industrial partners about potential application of the catalyst in catalyzing CO$_2$ capture from natural gas, flue gas, and syngas streams.

b. Explore testing of catalyst with amines under realistic operating conditions

Susteen

University of Wyoming

SoCalGas

A Sempra Energy utility