CO₂ capture using adsorbents - summary and developments

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Timeline of Research Activities

[Dec. 2014] Air as a source of C for a P-t-G process

[May 2015] Direct air capture using adsorption / desorption cycle


[Dec 2015] Phase 1 consisting of two beds of adsorbent

[April 2016] Performance evaluation and capacity modelling of the adsorbent

[May 2016] Phase 2 consisting of 8 beds was delivered.

[Aug. 2016] Soletair Project spin-off project


Journals

Thesis

Conferences

http://soletair.fi/

3 weeks of experimental campaign to assess the technical feasibility of P-t-X system

- Renewable energy + hydrogen generation via electrolysis + direct air capture + synthesis unit.
- Determine the performance of the DAC in real ambient conditions.
- Identify how we can optimize the performance components and the system as a whole.
Performance of DAC

$E_{\text{flow}}$
Energy needed to push air thru bed is high.

$E_{\text{heating}}$
Heating of the bed is slow and takes a long time

$E_{\text{capture}}$
Heating of the bed is slow and takes a long time
New material for better DAC

Air in

Bed of fine beads

Air out

Monolith contactor

(Cheap, metallic, monolithic substrate)
Green & Facile Synthesis

A: Substrate preparation

1. Base etching
2. Glymo-silanization

B: Amine – coating preparation

3. GO reduction

Polyethylenimine (PEI)
Graphene Oxide (GO)

Glymo
((3-Glycidyloxypropyl)trimethoxysilane)
Dip Coating and Drying
Characterization

FTIR spectra of substrate and product

Ref: http://orgchemboulder.com/Spectroscopy/irtutor/aminesir.shtml
Characterization

Weight loss curve from TGA

Surface of the PEI:GO/Al-h at 500x magnification and 3000x (digitally zoomed)
Adsorption

Breakthrough curves of the blank and the PEI:GO/Al-h adsorbent
(Conditions: 20°C / 1% CO₂ in N₂ / 10 mL/min / 6 PEI:GO/Al-h)
Other activities

Retrofit to DAC
More robust gas compressor
Air ducts for inlet and outlet

Publicly available dashboard and data sharing
• Data from DAC logging and control computer is saved to a server.
• Server hosts the dashboard