Synthetic Calcium Carbonate Production by Carbon Dioxide
Mineralization of Industrial Waste Brines

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Background
Carbon dioxide mineralization converts CO2 into stable carbonates. Fine carbonates, such as precipitated calcium carbonate (PCC), are high-value commercial additives to a wide range of consumer and industrial products.

\[
Ca^{2+}_{\text{aq}} + CO_2(g) + H_2O(l) \rightarrow CaCO_3(s) + 2H^+_{\text{aq}}
\]

CO2 mineralization at atmospheric conditions is thermodynamically favorable but require,
a) Ca2+ source, b) Alkalinity

We are looking at two approaches to generate alkalinity and Ca concentration.

Problem statement
CO2 mineralization is intrinsically carbon negative and has potential to sequester CO2 at gigaton scale. However, to maximize CO2 capture and commercial viability, we need to develop mineralization processes with minimum life-cycle CO2 footprint and energy input.

Approach
In this project, we develop two CO2 mineralization methods.

Process A: Coal ash carbonation
Ca and alkalinity source: coal ashes non-compliant with ASTM C618

Process B: Produced water carbonation
Ca source: produced water from oil and gas operations; Alkalinity source: ion-exchange

Process A: Coal ash carbonation
Effect of Liquid-to-solid ratio (L/S) in de-ionized water for FA

Neutralization characteristics of FA in mineral acid

Solubility control on BA leaching:

Solubility control on FA leaching:

Process B: Produced water carbonation
IEX H+ exchange capacities & competitive ion exchange

Break-through curves for H+ exchange & regeneration characteristics

Commercial Ion-exchange resins tested:
- Weak Acidic Resins
  - Lewatit TP 207 (R1)
  - Lewatit TP 260 (R2)
- Zeolites
  - Zeolite 4A (Z1)
  - Zeolite 13X (Z2)

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