Goldschmidt2020 Abstract

Directing Accelerated Carbonate Formation and H_2 synthesis with Integrated CO_2 Capture

Greeshma Gadikota *, Meishen Liu, Tianhe Yin, and Xun Gao
School of Civil and Environmental Engineering
Cornell University, Ithaca, NY
*correspondance: gg464@cornell.edu

Carbon mineralization is a versatile chemical pathway for the removal and reuse of CO_2 as carbonates of Ca, Mg, Na, K, and Li. Designing targeted multiphase reaction pathways now allows us to reduce the number of process configurations for CO_2 removal via carbon mineralization. This approach allows us to enhance several limiting steps including CO_2 solubility in water, Ca and Mg extraction into the aqueous phase and Ca- and Mg-bearing carbonate precipitation. Specifically, amine- or amino-acid bearing solvents can be used to capture CO_2 from distributed and point source emissions. These CO_2-loaded solvents are then reacted with solutions bearing the alkaline cations to produce insoluble carbonates while regenerating the solvents. Complete conversion of CaO to $CaCO_3$ is achieved using these pathways at 50 ^oC in 3 hours using 10-50 wt% monoethanolamine or 0.2 M - 1 M Na-glycinate. Further, we explore the directed synthesis of sodium bicarbonate and lithium carbonate using these approaches. In another configuration, carbon mineralization pathways are combined with the water gas shift reaction to direct the synthesis of H_2, while removing CO_2 via carbon mineralization. Our results show that the complete conversion of alkaline sorbents such as the oxides and silicates of Ca and Mg to their respective carbonates is achieved at 200 ^oC and pCO_2 of 20 atm in 3 hours or less in 1.0 M $NaHCO_3$. These data show that carbon mineralization can be successfully coupled to the water gas shift reaction for CO_2 removal with the potential to enhance H_2 evolution.