

Climate Change 2019: Mineralization of CO₂ for Carbon Sequestration using Flue Gas Desulphurization Gypsum - Jonathan Riddle, The University of Alabama

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Abstract

Past efforts for carbon sequestration using CO₂ mineralization have proven effective for long-term stable storage of CO₂ but were prohibitive due to slow reaction rates and high cost. Recent mineralization studies reacting flue gas desulphurization (FGD) gypsum (CaSO₄·2H₂O) with CO₂ in an alkaline solution, have shown conversion of gypsum into calcium carbonate (CaCO₃) to be a rapid and effective method for carbon sequestration. However, these studies used sodium hydroxide and ammonia to increase solution pH. The use of ammonia makes this mineralization method inefficient due to the production of ammonia being a significant CO₂ source. The goal of this study was to obtain high FGD gypsum-to-calcite conversion percentages at ambient temperature while eliminating the need for ammonia. A stirred reactor was utilized to study the effects of PCO₂ (10, 30, 60, and 250 psi), solution pH (12, 13, 13.5 and 14), solid-to-solution ratio (1:100, 1:80, 1:40, 1:100), and reaction time (10, 15, 30, and 120+ minutes) variation on the rate of conversion. The amount of carbonate produced was calculated from Rietveld refinement of XRD patterns to determine the impact of each variable. Experimental results showed varying degrees of FGD gypsum to CaCO₃ conversion. Solution pH was a primary control on conversion rates, with complete conversion occurring under all conditions at pH 13.5 and 14. Time also played a significant role in conversion rates, from 0% conversion at pH 13 after 360 minutes of reaction time, to approximately 75% conversion at pH 13 after 15 minutes of reaction time. The most cost-effective conversions took place at low PCO₂ (10 psi), pH 13 and a reaction time of 15 minutes, with a conversion rate of around 75%. The results of this study demonstrate that FGD gypsum can serve as a viable feedstock for CO₂ mineralization, potentially providing an inexpensive method for carbon sequestration.

Bottom Note: This work is partly presented at 6th World Conference on Climate Changes September 02-03, 2019

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