A Sustainable Process for Brine Management and CO_2 Sequestration: An Experimental Study

Nafis Mahmud

Gas Processing Center, Qatar University, P.O. Box 2713, Al Tarfa Street, Doha, Qatar

Muftah H. El-Naas

Gas Processing Center, Qatar University, P.O. Box 2713, Al Tarfa Street, Doha, Qatar

Abstract:

A sustainable process scheme for extracting valuable minerals from desalination reject brine while simultaneously sequestering CO_2 has been evaluated. The first part of the proposed multistage scheme involves the removal of calcium ions through reaction with CO_2 in the presence of NaOH in an inert particle spouted bed reactor (iPSBR). At NaOH dose of 11 g/L and gas flowrate of 1 L/min, 96% of the calcium ions and 16% of the magnesium ions were removed with a CO2 uptake of around 10 g/L under ambient conditions. The solid products obtained from this step were filtered and analyzed confirming the formation of high-purity calcium carbonate, $CaCO_3$. Next, the filtrate from this reaction was reacted with NaOH to remove the magnesium ions. To accomplish this step, the magnesium ions present in the obtained calcium-free brine was precipitated through further addition of 8.22 grams of NaOH at ambient temperature. About 83% of the magnesium ions were removed in this step and the analysis of the solid products affirmed the formation of magnesium hydroxide, $Mg(OH)_2$. Both solid products obtained from the individual steps are commercially valuable. Moreover, the obtained Ca^{2+},Mg^{2+}-free brine effluent can be eventually reused as a feed for an electrolysis unit. The addition of an electrolysis unit will significantly improve the scheme's economic feasibility as it will lead to the production of NaOH required for the ion removal steps. Thus, creating a self-sustaining process for the sustainable management of reject brine and CO_2 sequestration.

Keywords:

Reject Brine, Ca^{2+} Removal, Mg^{2+}Removal, CO_2 Uptake, NaOH, CO_2 Sequestration.