Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28876

Effect of Salinity on the Aqueous Carbonation of Steelmaking Slag for CO_2 storage and valorization

YEJI OH AND WON SIK SHIN

Kyungpook National University

ABSTRACT

Carbonation technology has been extensively investigated as a promising method for capturing and storing CO_2. The process involves reacting CO_2 with specific metal ions such as Ca^{2+} and Mg^{2+} or compounds to form thermodynamically stable carbonate minerals. Moreover, industrial by-products, which are rich in alkaline metals, offer an economically attractive feedstock for carbonate mineralization due to their close proximity to CO_2 emission sources. This study evaluates the carbonation characteristics and CO_2 sequestration potential of steelmaking slag through an aqueous carbonation reaction under deionized and saline water conditions.

In this study, basic oxygen furnace slag(BOF) samples with particle sizes below 20 mm were utilized in both distilled water and artificial seawater (ASTM D1141-98)[1] environments. The experiments were performed at ambient temperature (25°C) using a continuously stirred tank reactor (CSTR)[2,3], with the slag samples immersed at a liquid-to-solid (L/S) ratio of 37.5 g/100 mL. High-purity CO_2 was directly injected at 1 bar with flow rates of 2, 4, and 8 mL/min. During the carbonation reaction, calcium concentration, heavy metal leaching, and carbonation efficiency were evaluated using total organic carbon (TOC), ion chromatography (IC), thermal gravimetric analysis (TGA), X-ray diffraction (XRD), and scanning electron microscope (SEM).

The results provide insights into the potential utilization of steelmaking slag for carbonation and its effectiveness in CO_2 reduction. This study aims to contribute to the development of sustainable carbonation strategies for industrial by-products.

Keywords: Steelmaking Slag, CO_2, Aqueous Carbonation, $CaCO_3$, Industrial by-products, Artificial Seawater

References

[1] ASTM standard for Standard Practice for the Preparation of Substitute Ocean Water, Designation: D 1141-98 (Reapproved 2003), ASTM International, United States of America.

[2] Y. Li, H. Mehdizadeh, K.H. Mo, et al. Co-utilization of aqueous carbonated basic oxygen furnace slag (BOFS) and carbonated filtrate in cement pastes considering reaction duration effect, Cement and Concrete Composites, 138, 104988, 20232.

[3] Ho Young Jo, et al. Evaluation of factors affecting mineral carbonation of CO_2 using coal fly ash in aqueous solutions under ambient conditions, Chemical Engineering Journal, 183, 77-87, 20123.