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Enhanced mineral carbonation of slag wastes for CO_2 sequestration in Kazakhstan

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According to the Bureau of National Statistics of Kazakhstan, greenhouse gas emissions have recently reached a value of 22 tons of CO_2 per capita. The country relying heavily on fossil fuels as its main energy source now needs to implement CCUS technologies that effectively mitigate the negative effect of carbon emissions on the environment. The utilization of CO_2 for the production of solid carbonates could be a potential option for the permanent carbon sequestration in Kazakhstan. Industrial slag wastes can be used as a feedstock for the mineral carbonation.

In this study, the refined ferrochrome and high-carbon ferrochrome slags were investigated for an accelerated mineral carbonation for CO_2 sequestration. The selection of raw materials for the carbonation experiment was made based on higher contents of CaO (≤ 56%) and MgO (≤ 45%) in each different slag, respectively. The effect of operation factors (reaction time, liquid-to-solid ratio, temperature, and mixing rate) on the CO_2 sequestration capacity was investigated at atmospheric pressure. In addition to the characterization of products during the carbonation, geochemical parameters and equilibrium concentrations were estimated using PHREEQC-3.6.2 and compared to experimental results. The preliminary results of this study revealed that the CO_2 sequestration capacity of the steel slag from local industrial facilities could achieve 24.6 g of CO_2/100 g of slag. The production of ferroalloys in Kazakhstan exceeds 1.7 million tons per year and there has been no significant usage of the waste materials. The results showed the huge potential of Kazakhstan for the mineral carbonation leading to the effective reduction of greenhouse emissions to the atmosphere and successful utilization of the metallurgical waste.

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