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Outlook of alkaline-synthetic material for carbon removal

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Enhanced mineralization is one of the ways to absorb carbon dioxide (CO_2) through the process called mineral carbonation. There are several promising rocks for enhanced mineralization which are mostly composed of plagioclase, pyroxene, and olivine minerals such as peridotite (i.e., dunite) and basalt. Nevertheless, there is one alternative synthetic material for Carbon Dioxide Removal (CDR) via enhanced mineralization, i.e., steel slag [1], [2], [3], [4]. In this research, we assess and evaluate further the applicability of steel slag as a potential material for CDR purposes. We set columns and rock-aid experiments in short and long-term observation. In order to quantify CO_2 removal and its evolution with time, we analyze pH, conductivity, ions, and alkalinity in the leachate or mixture from the samples. Further, we also investigate the solid samples to observe the precipitation of secondary minerals under laboratory conditions. From the experiment, we found out that the leachate and mixture solution from the steel slag is highly alkaline (pH >10). Yet the depletion of $p\mathrm{CO}_2$ is detected in the combination with the presence of steel slag. We also found the presence of white particles at the end of the observation time - mostly calcium carbonate. Steel slag is consuming CO_2 faster compared to other minerals discussed for measures like Enhanced Weathering. The exact composition of steel slag depends on the specific steel production process used, the most common minerals that found in a steel slag consist of calcium, magnesium, silica, aluminum, and iron oxides. The potential of steel slag to contribute to CDR is significant given the global production of crude steel around 1.9 billion metric tons per year[5].

[1] Huijgen, WJJ, et al. Environ. Sci. Technol. (2005), 39, 24, 9676–9682. DOI: 10.1021/es050795f

[2] Pullin, H., et al. Environ. Sci. Technol. (2019), 53, 16, 9502–9511. DOI: 10.1021/acs.est.9b01265

[3] Mayes, WM., et al. Environ. Sci. Technol. (2018), 52, 14, 7892–7900. DOI: 10.1021/acs.est.8b01883

[4] Renforth, P., et al. Applied Geochemistry. (2009), 24, 9, 1757-1764. doi.org/10.1016/j.apgeochem.2009.05.005

[5] World Steel Association (2022) World Steel in Figures. https://worldsteel.org/steel-topics/statistics/world-steel-in-figures-2022 (accessed on February 20, 2023)