

Effect of roasting on the carbon dioxide fixation potential of mine tailings from lateritic nickel ore deposits

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To achieve a carbon neutral society, existing carbon dioxide emission reduction technologies alone will not be sufficient. This requires carbon dioxide absorption and removal. The 2050 Net Zero scenario estimates that the entire world will need to capture 7.6 billion tons of carbon dioxide per year in 2050. Mineral carbonation technology (MCT) is one known method of carbon dioxide fixation. This uses a chemical reaction between silicate minerals and carbon dioxide to fix carbon dioxide as a carbonate mineral. Although this reaction proceeds spontaneously, the reaction rate is slow. It is important to investigate methods to improve the reaction rate.

In this study, laboratory-scale experiments were conducted using nickel oxide ore waste (70 wt% lizardite and 30 wt% goethite) as a starting material of MCT. Pre-treatments such as sorting by color, roasting, and fine grinding were conducted on our sample.

In our experiments, sample, ultrapure water and a glass stirrer were placed in a Teflon vessel and stirred for a certain period under a certain CO₂ pressure up to 5 bars. After the reaction, centrifugation was performed to separate the solid and liquid. The solid samples were dried and the change in carbon concentration was measured with a TOC analyzer. The liquid was filtered and then analyzed by ICP-OES.

Assuming that carbon dioxide would be precipitated as MgCO₃, the amount of carbon dioxide fixation was calculated from the solution chemistry and solid sample analysis. When the waste ore sample was roasted at 700°C for 10 minutes, the carbon dioxide fixation amount reached 187 kg-CO₂/ton-rock within one week. This is more than 90% of the theoretical value of 210 kg-CO₂/ton-rock calculated from the chemical composition of the sample. Roasting treatment under 650°C did not affect CO₂ fixation amount, therefore we concluded that roasting over 700°C is necessary to improve the reaction efficiency of waste ore sample used in this experiment.

In the presentation, the effects of other parameters on the efficiency of CO₂ fixation will also be presented, and issues for practical application will be discussed.