

Mineral Carbonation with Ferrous Nickel Slag

Soochun Chae*, Youngnam Jang, Chiwan Jun, Seungwoo Lee, Junwhan Bang, Kyungsun Song, Hwanju Cho, Myungkyoo Lee

Geologic Environment Division, Korea Institute of Geoscience and Mineral Resources
Gwahang-no 124, Yuseong-gu, Daejeon, 305-350 Korea
chae@kigam.re.kr; crystal@kigam.re.kr; jcw@kigam.re.kr; swlee21th@kigam.re.kr; jhbang@kigam.re.kr;
kssong@kigam.re.kr; chohwanju@kigam.re.kr; ccomssei@kigam.re.kr

Kyoungwon Ryoo

Chungbuk National University, Department of Earth and Environmental Sciences
52 Naesudong-ro, Heungdeok-gu, Cheongju Chungbuk 361-763, Korea
rkwgarnet@naver.com

Extended Abstract

It is known that the global warming is caused the emission of greenhouse gases, especially CO₂ gas from the use of fossil fuel during the industrial activities. Accordingly, the sequestration of CO₂ gas is the major issue worldwide. The concept of the immobilization method of CO₂ into the crystal lattice, a mineral carbonation, was firstly proposed by Seifritz in 1990. Mineral carbonation can be divided into two methods, the direct method and the indirect method. The former is single process and the latter is multi process with dissolution, precipitation and carbonation.

This research is objected to study the feasibility of the mineral carbonation with the ferrous nickel slag containing about 30% of MgO as the major composition for the mineral carbonation, and forsterite and enstatite as the major minerals. In Korea the ferrous nickel slag is generated one million tones per year. If all ferrous nickel slag is used for the mineral carbonation, the sequestration effect of CO₂ will be 310,000 ton and we will obtain 600,000 ton of MgCO₃ as a valuable resource.

At first, the direct method was tested under the conditions as follows: 20g of slag, solid/liquid=0.1, 10bar of CO₂ pressures, reaction temperature at 290 °C, and the reaction time of 24hr. In this experiment, no mineral carbonation occurred with the slag. We think that the given experimental condition is not enough to decompose the slag consisted of high temperature minerals such as forsterite and enstatite.

Secondly, the indirect method was adapted for carbonation of the slag. For the leaching of magnesium from the slag, solutions with various moralities of strong acids including HNO₃, H₂SO₄ and HCl were tested with heating. After leaching, the slurry was subdivided into supernatant and precipitates, and the supernatant was analysed by ICP. In results, the leaching values were 65-100% at about 90 °C. The precipitation of Mg(OH)₂ was performed with NaOH solution. The carbonation of Mg(OH)₂ was tested under the conditions of 500-900 °C reaction temperature and 3hrs of reaction time with flowing CO₂ gas. But the carbonation for the slag did not occur.

In the third, we tried the mixed process of the direct and the indirect methods. Specifically, in the first step (indirect method), the mineral decomposition of the slag was carried with the strong acids and the supernatant was precipitated as Mg(OH)₂ added with NaOH solution. In the second step (direct method), the precipitates were heated in the range of 150-290 °C with pressured CO₂ gas. Finally we could form mineral carbonation with ferrous nickel slag.

References

Seifritz W. (1990). CO₂ disposal by means of silicates. Nature, 345, 486.