



Extraction of phosphorus from sewage sludge ash by CO₂ blowing method

Takeshi Toyama

Department of Materials and Applied Chemistry, College of Science and Technology, Nihon University, 1-8 Kanda-Surugadai, Chiyoda-ku, Tokyo, Japan 101-8308

E-mail: touyama.takeshi@nihon-u.ac.jp

Phosphorus is an important element not only for use in fertilizers, but also for the manufacture of industrial products. However, depletion of this resource is a problem. Japan relies on imports for the entire amount of phosphorus it consumes. For this reason, there is an urgent need to secure a stable supply of phosphorus. On the other hand, there is waste containing a considerable amount of phosphorus. One of them is sewage sludge ash, but it also contains many heavy metals, extraction of only phosphorus is difficult.

Nevertheless, I had previously succeeded in preparing highly concentrated solutions of alkaline earth metal phosphates, M₃(PO₄)₂ (M=Mg, Ca, Sr, Ba), by CO₂ gas blowing [1]. The mechanism of the CO₂ gas blowing method involves the formation of soluble hydrogen carbonate salts (M(HCO₃)₂) upon blowing CO₂ into the appropriate solutions, which increases the solubility (Eq. 1).



The dissolution mechanism involves the formation of soluble hydrogen carbonate through the CO₂ blowing process. Therefore, only alkaline earth metal phosphate salts that form bicarbonate salts were dissolved. I attempted to extract phosphoric acid from sewage sludge ash by this method. The CO₂ blowing process facilitated the elution of phosphoric acid from sewage sludge ash, while the elution of heavy metal ions, such as iron, was minimized.

Sewage sludge ash suspended solution (0.5 mass %) was dissolved by blowing CO₂ at a flow rate of 1 dm³/min for 160 min at room temperature, and then, it was filtered. For comparison, this suspended solution was also dissolved in HNO₃ solution. The obtained samples were characterized by ICP analysis.

The results of the experiment were revealed that PO₄³⁻ ion was eluted about 40 ppm with HNO₃ acid treatment. CO₂ blowing method was lower than HNO₃ acid treatment, but it was eluted about 70% recovery of HNO₃ acid treatment (CO₂ blowing: about 30 ppm). On the other hand, large amount of Fe ions were eluted by HNO₃ acid treatment. In contrast, little elution of Fe ions is observed by CO₂ blowing method. Because, Fe ion such as heavy metal was not dissolved which do not form soluble hydrogen carbonate salts, and only dissolved which form hydrogen carbonate such as calcium and magnesium.

[1] N. Nakamori, T. Toyama, N. Nishimiya, B. Elouadi. *Ceramic Transactions*, 233, 153-158 (2012)