Gwangju Institute of Science and Technology
Official Press Release — https://www.gist.ac.kr

Section of Public Relations	Hyo Jung Kim Section Chief 062-715-2061	Nayeong Lee Senior Administrator 062-715-2062
Contact Person for this Article	Professor Youngjune Park School of Earth Sciences and Environmental Engineering 062-715-2836	
Release Date	2020.12.28	

Professor Youngjune Park's joint research team proposes high-efficiency carbon dioxide mineralization technology using household waste

▫ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Earth Sciences and Environmental Engineering Professor Youngjune Park research team proposed a high-efficiency resource circulating carbon mineralization* process using organic acids generated from biomass waste in collaboration with Columbia University Professor Ah-Hyung Park.

> * Carbon mineralization: A technology that can store and utilize carbon dioxide at the same time, extract alkali metals (calcium and magnesium) from natural minerals or solid industrial wastes to form solid carbonate such as calcium carbonate or magnesium carbonate through reaction with carbon dioxide. Solid carbonate, which is made like this, not only stores carbon dioxide, which is a greenhouse gas, but can also be used as various types of construction materials such as cement, concrete, and aggregates.

◦ In the case of carbon mineralization using general inorganic acids, high solvent costs, low extraction efficiency, and difficulties in the post-processing process have put pressure on carbon dioxide storage efficiency and the process's economic feasibility.

- In this study, the extraction performance of alkali metals such as calcium was greatly improved by applying a mixture of organic acids generated from biomass* wastes discharged in large quantities, replacing existing high-cost inorganic acids in the carbon mineralization process. In addition, it was confirmed that various types of rare earth metal resources contained in industrial by-products can be selectively recovered.

  * biomass: Biomass (food waste, sewage waste, marine waste, etc.) form volatile organic acid compounds through an anaerobic digestion process. The formed organic acid compound can be used as an intermediate material in the production of petrochemical products such as fuels or plastics through the synthesis of alcohols and hydrocarbons.

  - Using volatile organic acids generated from biomass waste, the research team confirmed that biomass-derived organic compounds from steel slag (waste discharged from steelmaking processes) are more efficient in extracting alkali metals and rare earth elements than inorganic acids that are widely used.

- This phenomenon is due to the difference in the inductive effect and the stability constant of complex exhibited by cations (ligands) that can bind to the extracted metal elements. When the number of alkyl groups increases, the electronegativity of the ligand increases, and it can be strongly bonded to and stabilized with metalic elements.

- The first-author of this paper Sujin Hong, a Ph.D. student, said, "Using this technology, it is possible to effectively reduce the carbon dioxide generated by industry while converting large amounts of wastes to eco-friendly construction materials (cement, concrete, aggregate, etc.) to improve the economics of the carbon mineralization process. In subsequent studies, we expect to contribute to the 2050 carbon neutral economy by developing useful resources based on carbon mineralization technology."

- This research was led by GIST Professor Youngjune Park and Columbia University Professor Ah-Hyung Park and was conducted by Ph.D. student Sujin Hong (first-author) with support from the Korea Institute of Energy Technology Evaluation and Planning and was published on December 21, 2020, as the cover paper of *ACS Sustainable Chemistry & Engineering*, a journal within the top 10% of the field of chemical engineering.