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Carbon Dioxide Capture and Utilization by Using Seawater-Based Industrial Wastewater and Alkanolamine Absorbents

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Abstract : Since industrial revolution, energy usage by human-beings has been drastically increased resulting in the enormous emissions of carbon dioxide into the atmosphere. High concentration of carbon dioxide is well recognized as the main reason for the climate change by breaking the heat equilibrium of the earth. In order to decrease the amount of carbon dioxide emission, lots of technologies have been developed. One of the methods is to capture carbon dioxide after combustion process using liquid type absorbents. However, for some nations, captured carbon dioxide cannot be treated and stored properly due to their geological structures. Also, captured carbon dioxide can be leaked out when crust activities are active. Hence, the method to convert carbon dioxide as stable and useful products were developed. It is usually called CCU, that is, Carbon Capture and Utilization. There are several ways to convert carbon dioxide into useful substances. For example, carbon dioxide can be converted and used as fuels such as diesel, plastics, and polymers. However, these types of technologies require lots of energy to make stable carbon dioxide into a reactive one. Hence, converting it into metal carbonates salts have been studied widely. When carbon dioxide is captured by alkanolamine-based liquid absorbents, it exists as ionic forms such as carbonate, carbamate, and bicarbonate. When adequate metal ions are added, metal carbonate salt can be produced by ionic reaction with fast reaction kinetics. However, finding metal sources can be one of the problems for this method to be commercialized. If natural resources such as calcium oxide were used to supply calcium ions, it is not thought to have the economic feasibility to use natural resources to treat carbon dioxide. In this research, high concentrated industrial wastewater produced from refined salt production facility have been used as metal supplying source, especially for calcium cations. To ensure purity of final products, calcium ions were selectively separated in the form of gypsum dihydrate. After that, carbon dioxide is captured using alkanolamine-based absorbents making carbon dioxide into reactive ionic form. And then, high purity calcium carbonate salt was produced. The existence of calcium carbonate was confirmed by X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) images. Also, carbon dioxide loading curves for absorption, conversion, and desorption were provided. Also, in order to investigate the possibility of the absorbent reuse, reabsorption experiments were performed either. Produced calcium carbonate as final products is seemed to have potential to be used in various industrial fields including cement and paper making industries and pharmaceutical engineering fields.

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