Effects of Citric Acid on The Formation of Highly Reactive Siderite and Adsorption of As(Ⅲ) in Reducing Environment

SEON YONG LEE[1], BONGSU CHANG[1], KYOUNGSU SEO[1], AND YOUNG JAE LEE[1]*

[1]1Department of Earth and Environmental Sciences, Korea University, Seoul 02841, Korea
*Email address: youngjlee@korea.ac.kr

Arsenic (As) is a toxic harmful substance that adversely affects human health and aquatic ecosystem. Excessive exposure to drinking water contaminated with arsenic is a major cause of skin cancer. In an anoxic groundwater system, most of arsenic species exist as As(Ⅲ) which is more toxic as well as difficult to be attenuated than that of As(Ⅴ). Siderite ($FeCO_3$) is stably formed under such as reducing environments and can be used for an eco-friendly sorbent in anoxic aqueous media. It is known that citric acid is reducive and sufficient in functional groups (-COOH and -OH). In this study, a high-reactive siderite (hereafter is called organo-siderite) was successfully synthesized for enhancing As(Ⅲ) sorption in the presence of citric acid. Siderite was synthesized under the extremely anerobic condition (O_2 < 3 ppm) in the absence or presence of citric acid. As citric concentration increases, crystal morphology of siderite is gradually changed from spherical aggregates composed of many small rhombohedral crystals to three-dimensional flower-like structures showing many micropores. The content of citric acid in the synthesized siderite was increased up to ~7.0 wt.%, indicating that citric acid can be favorably incorporated into the structure of siderite. Compared to pure siderite, As(Ⅲ) sorption on the organo-siderite was significantly improved due to its favorable functionality and porosity. Based upon XPS, As(Ⅲ) is strongly sorbed on the surface of the organo-siderite. Interestingly, As(Ⅴ) is not observed. Our results indicate that citric acid has a great influence on the formation and physicochemical properties of siderite and As(Ⅲ) can be effectively sorbed on the organo-siderite even in the reducing environments.