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Creation of Desalination Materials by Modification of Natural Minerals to Avoid Food Crisis and Global Warming

Takaaki Wajima

Chiba University

Summary

This study aimed to create a new desalination material from a low-cost, abundant natural zeolite for salt capture. The desalination performance of mordenite-type zeolites modified with calcium, aluminum, and iron was evaluated, and conducted cultivation experiments using seawater desalinated with modified zeolites for the cultivation of radish sprouts and bean sprouts.

Na-type mordenite zeolite was treated with solutions of calcium, aluminum, and iron to prepare Ca-zeolite, Al-zeolite, and Fe-zeolite. The desalination capacity of the prepared zeolites was evaluated by treating artificial seawater. Cultivation experiments of radish sprouts and bean sprouts were conducted using artificial seawater treated with the prepared zeolites.

The pH of artificial seawater treated with Na-type and Ca-type zeolites was neutral at pH 6.8 – 6.9, while the pH of artificial seawater treated with Al-type and Fe-type zeolites became strongly acidic at around pH 2. The salt concentration decreased in Na-type zeolite, Ca-type zeolite, and Al-type zeolite compared to Fe-type zeolite. When artificial seawater treated with a mixture of Ca-type including 0 – 2.5% Al-type zeolites was used, the pH remained neutral, and the salt concentration decreased. It is noted that this desalination reaction did not change significantly with temperature. Radish and bean sprouts, which did not germinate in artificial seawater, germinated in artificial seawater treated with a mixture of Ca-type zeolite and Al-type zeolite.

After treatment of artificial seawater, Ca-type zeolite and Al-type zeolite showed no changes compared to before desalination, but in the mixture of Ca-type zeolite and Al-type zeolite, plate-like crystals consisting of a layered complex hydroxide of Ca, Al, and Cl were observed. This suggests the potential for developing effective desalination materials by optimizing the preparation conditions to efficiently generate layered complex hydroxides.