Process optimization of boron removal by ettringite from hot spring wastewater

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Ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$) is well known as a good adsorbent for boron removal by exchanging sulfuric acid in structure and boric acid in solution [1]. Objective of this study was to optimize the boron removal process for hot spring wastewater which contains silicate and carbonic acid.

Although ettringite can be formed in alkaline pH of 10 to 12, high efficiency for boron removal could be achieved only at pH 11.5. This is because formation of aluminium hydroxide below pH 11 and formation of calcite above pH 12 inhibited formation of ettringite. Additionally, above pH 12, hydroxide ion inhibits ion exchange reaction between sulfate and boron. Carbonic acid disturbed boron removal by formation of calcite, however, when the solution was strongly stirred after addition of aluminium sulfate which resulted in acidic pH, carbonic acid could be removed from the solution and boron removal could be improved.

Under high temperature, a part of ettringite was transformed to monosulfate which has low ability for boron removal. In addition, precipitation amount of ettringite decreased due to increase of solubility product. However, precipitation amount of ettringite could be increased when reaction time was extended under high temperature.

In conclusion, boron removal efficiency was decreased in hot spring wastewater which coexists silicate and carbonic acid under high temperature, however, it could be improved by optimum addition of agent and extension of reaction time.

[1]Iizuka et al. (2011) *The Chemical Society of Japan* 40, 1269-1271.