Development of Novel Chitosan Resin for Recovery of Boron from Seawater

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Summary

This study aims to develop an environmentally-friendly resin for boron recovery. Chitosan resins modified by various saccharides were prepared in anticipation of the interaction between borate and the hydroxy groups of the saccharides. The adsorption characteristics of boron on the chitosan resins are quantitatively investigated in detail for the purpose of the removal of boron from a boron mine and the desulfurizing equipment in coal-fired steam power stations, and compared with those of a commercial chelating resin with N-methyl-(polyhydroxyhexyl)amino group (Duolite ES371).

Chitosan derivatives containing various saccharides are synthesized by reductive N-alkylation, and the products are crosslinked with ethylene glycol diglycidil ether. The adsorption characteristics of boron on the chitosan resins chemically modified by saccharides (SMC resins) are investigated and compared with those of commercial resin, Duolite ES371. The following information is obtained.

1) The number and pK_a of amino groups in the resins are determined by potentiometric titration. The number of amino groups per dry-weight of the chitosan resins is found to be larger than that of Duolite ES371. Values of pK_a of amino group modified by saccharide and a free amino group are considered to be similar.

2) From adsorption experiments on SMC and Duolite resins, it is found that the adsortion mechanism is a complex formation between boron which exists as boric acid or borate in an aqueous solution and the vicinal diol groups of the branched saccharide. The apparent adsorption equilibrium constants of boric acid-diol complex and borate-diol salt complex are determined. The adsorption isotherms of boron correlate well with the Langmuir equation, and the order of the saturated adsorption capacity of boron on the SMC resins corresponds to that of the degree of substitution on SMC resins.