Kinetic analysis of catalytic decomposition of chelate-chromoionophore for prompt and accurate determination of sodium in concentrated sea water

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Summary

1. Introduction

Precious and accurate analytical methods for sodium in concentrated sea water have been required in a manufacture process in salt plants. We have developed a direct analytical method for sodium ion in a concentrated sea water by a flow injection analysis (FIA) using a decompasition reaction of a chelate-chromoionophore. In this study, we investigated a kinetic analysis of the catalytic decomposition of the chelate-chromoionophore with sodium ion for the FIA analysis of sodium in concentrated sea water.

2. Experiment

Ammonium 1, 4, 7, 10, 13- pentaoxa- 16- azacyclooctadecane-*N*- carbodithioate (A18CC) was synthesized from 1-aza-18-crown-6 and carbondisulfide. Heavy metal-chelates of A18CC were synthesized from A18CC and chloride salts of heavy metal. Absorbance of heavy metal-chelates of A18CC was monitored at appropriate wavelength after mixing heavy metal-chelates of A18CC solution and alkali, alkaline earth metal chloride solutions.

3. Results and discussion

A specific catalytic decomposition of heavy metal-chelates of A18CC was observed in a combination of only Co^{II}-A18CC and sodium ion among various combination of heavy metal-ionophores and alkali, alkaline earth metal ions. Some oxidants, such as peroxodisulfide, prompted the decomposition, whereas some reductants, such as methanol, inhibited the decomposition. A kinetic analysis of the decomposition reaction of Co^{II}-A18CC with sodium ion indicated that the reaction was obeyed with first order for concentration of Co^{II}-A18CC and second order for sodium ion.

The resulting expression is as follows;

$$\frac{d[Co\text{-}A18CC]}{dt} = -7.4 \times 10^{-5}[Na^{+}]^{2}[Co\text{-}A18CC]$$