A New Method for the Determination of Iodide Ion in Seawater†

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1. Introduction

It was reported that marine organisms took up radioactive iodine differentially between iodide and iodate and that the rate of uptake and loss of radioactive iodine by these organisms were strongly influenced by the concentration of stable iodide ion in the marine environment1). Therefore, it is necessary to know the concentration of both stable and radioactive iodide in seawater in order to estimate the concentration factor of radioactive iodine by marine organisms.

The method of determining radioactive iodide and iodate discriminely in environmental waters was developed by Ikeda, et al.2) Although the methods were developed for the stable iodine species discriminally3) those methods required tedious processes and were time consuming. Since the ratio of I−/IO3− is fluctuated by many factors4) it is desirable to develop a simple and rapid method for the determination of iodide and iodate ion discrimnately.

2. Experiment and Results

Iodide ion is oxidized to elementary iodine, I2, in the aqueous solution by cupric ion as follows, 2Cu2++4I−→2CuI+I2. The resultant I2 was extracted into toluene. The distribution ratio of iodine between organic and aqueous phase is easily determined by counting the radioactivity of both phases if radioactive tracer such as 125I or 131I was added to the initial solution.

The test solutions were prepared by adding various amounts of potassium iodide or iodate solution into artificial seawater of Lyman and Fleming with 125I of the same chemical form. These test solutions were shaken in 50 ml separatory funnels with equal amount of toluene (5±10 ml) after 0.5 ml of 1 mol/l CuSO4 solution was added. The distribution ratios were determined from radioactivities of 1 ml of both aqueous and organic phases. In Fig. 1 the distribution ratios decrease with the increase of

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the iodide concentration in the artificial seawater within 40 minutes of shaking, whereas longer mixing time causes reverse trends. The phenomenon observed in the initial short period of the extraction is considered to represent the transition state where only iodide ion is oxidized to molecular iodine and extracted into organic phase and is utilized for determining the amount of iodide ion discriminated even if iodate ion existed in the same solution. In Fig. 2 the working curve for the determination of iodide ion in seawater was shown. The curve was obtained from the distribution ratios by shaking 10 ml of both artificial seawater containing various amounts of iodide ion with $^{131}$I and toluene in separatory funnels for 30 minutes at $20 \pm 0.5^\circ$C.

![Distribution ratio vs. Iodide concentration](image)

**Fig. 2** Working curve for the determination of iodide ion in seawater.

3. Discussion

This method is better than the usual methods using AgNO$_3$ to precipitate iodide ion from seawater in that if the working curve is once determined the time for the determination of iodide ion is very short, usually within 1 hour, and that only 5~10 ml of sample seawater is enough to determine the concentration of iodide ion.

Although range of the concentration is limited up to 40 $\mu$g/I/l to be determined in this method, the concentration of iodide ion in seawater which is usually below 30 $\mu$g/I/l can be determined satisfactorily by this method. When distribution ratios indicating the concentration of iodide around or above 40 $\mu$g/I/l were obtained the extraction procedure should be repeated after the sample was diluted with iodide-free artificial seawater. From the ratio of the dilution and the distribution ratios after the dilution the correct value of iodide concentration should be obtained.

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References

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