

## Measurement Method for Nutrient by Ultraviolet Spectrometry

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### ABSTRACT

Some of the environmental factors such as salinity, dissolved oxygen, chlorophyll concentration, and so on, can be measured by electric or optical sensor. It enables to measure these continuously and automatically with high resolution in time and space. It is very important for monitoring of marine environment. In order to understand ecosystem of sea in detail, distribution or change of nutrient concentration should be measured in terms of primary production. Generally, since seawater contains high concentrations of chloride, bromide and so on, nutrient must be extracted from these ions. It has brought difficulty of measuring automatically. The water sampling and chemical analysis in the laboratory has been always made.

In this paper, a simplified method for measuring nitroxide concentration in seawater using ultraviolet spectrometry is proposed. The present method is superior to the conventional one in terms of the non-necessary chemical processing. The effectiveness of the present method is shown by the field measurement in Seto Inland Sea.

**KEY WORDS:** nitrate; nitrite; ultraviolet; spectrometry; multi-wavelength; nutrient; monitoring.

### INTRODUCTION

Recently, eutrophication in coastal field has caused many kinds of environmental problems such as red tide, anoxic water and so on. In order to deal with these appropriately, it is important to measure these factors continuously and automatically with high resolution in time and space. It must give good understanding to ecosystem of coastal sea.

A particular electric or optical sensor enables us to measure some of the environmental factors such as salinity, dissolved oxygen, chlorophyll concentration and so on. It easily put into practical use of the continuous and automatic measurement in the field. However, the chemical parameters such as nitrate ( $\text{NO}_3^-$ ), nitrite ( $\text{NO}_2^-$ ) ions are always analyzed in a laboratory. It is very difficult to measure on site because of its time consumption and complexities of chemical process.

Degobbi et al. (2005) and Zou, et al. (2001), have analyzed many samples of the seawater and have expressed strongly their desire of "in

situ measurement" of nutrient, dissolved inorganic nitrogen (DIN). It must be useful tool for monitoring marine environment.

It is well known that the so-called flow injection analysis (FIA) is very effective to measure any chemical matters continuously (Gray et al. 2006 and Higuchi et al. 1999), and it is very conventional tool for monitoring quality of fresh water and of wastewater from factories. The authors (2005; 2006) have already developed a particular instrument for measuring nutrient of seawater, and have shown its effectiveness. However, in case of nitrate ion ( $\text{NO}_3^-$ ), the specific pre-processing has to be applied; it involves the reduction of nitrate to nitrite by using some dangerous chemicals. Since an appropriate reagent has to be used and also ones have to treat its wasted water correctly, it is not easy to develop the multipurpose tool.

On the contrary, spectrometry is very interesting method for measuring concentration of chemical matter without any chemical processing. Since nitrate and nitrite ions show particular absorption decay of radiation in the ultraviolet range wavelength as expressed by Armstrong (1963), its technique have been used for many years as useful one for monitoring nitrate in case of fresh water. It is already included in American Public Health Association for nitrate and Japanese Industrial Standards methods for total nitrogen analysis.

Ogura et al. (1966) have examined the absorption characteristic in UV range of the seawater sampled in the western Pacific Ocean and Sagami Nada. They have found remarkable results that the absorption of the seawater between 210nm and 230nm wavelength is almost equal to the sum of absorptions owing to bromide ( $\text{Br}^-$ ), dissolved organic matter (DOM) and nitrate ( $\text{NO}_3^-$ ). Collos et al. (1999) have measured nitrate and nitrite of the pseudo seawater. It is possible to determine them using the only one wavelength, 220nm, because the artificial seawater does not include any dissolved organic matter, DOM. Generally since there are many kinds of compounds in seawater, it is very difficult to extract nitrate accurately.

Finch et al. (1998) and Clayson (2000) has developed a particular instrument for the measurement of nutrient on site. This can determine the concentration of nitrate by the analyzing data at only six wavelengths. Its accuracy was not enough for practical use. The results show the necessity of measuring absorption at a number of