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AN ADAPTED FLOW INJECTION ANALYSIS METHOD OF PHOSPHATE FOR ESTUARINE SAMPLES AVOIDING MATRIX EFFECTS

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Abstract

A flow injection analysis (FIA) method, based on the molybdemun blue formation, has been adapted and successfully optimized in order to use it to measure phosphate in estuarine water samples. Matrix effects have been avoided using the highest peak, and the Schieleren effect (common in FIA analysis) has been minimized by injecting the ascorbic acid with the same sulphuric acid concentration as the molybdate reagent. The concentrations of the reagents have been optimized by a Central Composite Design. The measuring range used was 0.02 - 0.2 mg L^{-1} phosphate and both univariate and multivariate regressions have been compared using a random sample, reaching the same concentration (0.065 ± 0.002 mg L^{-1}). However, the univariate regression showed lower LODs, 7 µg L^{-1} (74 nM) in front of the 10 µg L^{-1} (105 nM) reached by the multivariate one. The effectiveness of the developed method was tested with real samples. For this, low-cost conventional equipment easily available to most laboratories has been used, with a LOD low enough to measure estuary samples, and high repeatability.

1. Introduction

Phosphate is a key nutrient in the marine environment and is essential for many biogeochemical processes, such as photosynthesis or phytoplankton growth [1]. As a weak base, it contributes to the alkalinity of seawater [2] and is one of the parameters to take into account for ocean acidification studies [3–5]. Therefore, quantification of phosphate in aquatic environments is crucial, as shown by the many efforts on developing accurate, precise, reproducible and reliable methods [6–10]. Different analytical techniques have been used for the determination of phosphate in seawater, including colorimetry and spectroscopy, photoluminiscence, atomic spectrometry, electrochemistry and separative techniques such as ion chromatography, capillary electrophoresis, liquid waveguide capillary cell and high performance liquid chromatography [8,9,11]. However, flow injection analysis (FIA) techniques remain the first choice for seawater analysis [12] because of their selectivity, sensitivity and accuracy.

Determination of phosphate by flow analysis is commonly based on the reaction with an acidified molybdate reagent, leading to the formation of a phosphomolybdate heteropolyacid, which is then reduced usually by ascorbic acid to a compound of intense blue colour (Molybdenum Blue, MB) [13] to improve the sensitivity [14]. Present day methods usually