Experimental Study on Temperature Dependence of Nitrate Sensing using an ISE-based On-site Water Monitoring System

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Abstract

Recently, environmental problems have become an area of growing interests. *In-situ* monitoring of water quality is fundamental to most environmental applications. The accurate measurement of nitrate concentrations is fundamental to understanding biogeochemistry in aquatic ecosystems. Several studies have reported that one of the most feasible methods to measure nitrate concentration is the use of Ion Selective-electrodes (ISEs). The ISE application to water monitoring has several advantages, such as direct measurement methodology, high sensitivity, wide measurement range, low cost, and portability. However, the ISE methods may yield inconsistent results where there was a difference in temperature between the calibration and measurement solutions, which is associated with the temperature dependence of ionic activity coefficients in solution. In this study, to investigate the potential of using the combination of a temperature sensor and nitrate ISEs for minimizing the effect of temperature on real-time nitrate sensing in natural water, a prototype of on-site water monitoring system was built, mainly consisting of a sensor chamber, an array of 3 ISEs, an waterproof temperature sensor, an automatic sampling system, and an arduino MCU board. The analog signals of ISEs were obtained using the second-order Sallen-key filter for performing voltage following, differential amplification, and low pass filtering. The performance test of the developed water nitrate sensing system was conducted in a monitoring station of drinking water located in Jeongseon, Kangwon. A temperature compensation method based on two-point normalization was proposed, which incorporated the determination of temperature coefficient values using regression equations relating solution temperature and electrode signal determined in our previous studies.

Keywords

Water quality, On-site measurement, nitrate, ISE, Temperature effect

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