Hypolimnetic Oxygenation Mitigates the Effects of Nutrient Loading on Water Quality in a Eutrophic Reservoir

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First report of the successful operation of a side stream supersaturation hypolimnetic oxygenation system in a eutrophic, shallow reservoir

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ABSTRACT

Controlling hypolimnetic hypoxia is a key goal of water quality management. Hypoxic conditions can trigger the release of reduced metals and nutrients from lake sediments, resulting in taste and odor problems as well as nuisance algal blooms. In deep lakes and reservoirs, hypolimnetic oxygenation has emerged as a viable solution for combating hypoxia. In shallow lakes, however, it is difficult to add oxygen into the hypolimnion efficiently, and a poorly designed hypolimnetic oxygenation system could potentially result in higher turbidity, weakened thermal stratification, and warming of the sediments. As a result, little is known about the viability of hypolimnetic oxygenation in shallow bodies of water. Here, we present the results from recent successful tests of side stream supersaturation (SSS), a type of hypolimnetic oxygenation system, in a shallow reservoir and compare it to previous side stream deployments. We investigated the sensitivity of Falling Creek Reservoir, a shallow (Z_{max} = 9.3 m) drinking water reservoir located in Vinton, Virginia, USA, to SSS operation. We found that the SSS system increased hypolimnetic dissolved oxygen concentrations at a rate of ~1 mg/L/week without weakening stratification or warming the sediments. Moreover, the SSS system suppressed the release of reduced iron and manganese, and likely phosphorus, from the sediments. In summary, SSS systems hold great promise for controlling hypolimnetic oxygen conditions in shallow lakes and reservoirs.

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1. Introduction

Hypolimnetic hypoxia (defined as dissolved oxygen concentrations <2 mg/L; Wyman and Stevenson, 1991) in lakes and reservoirs degrades water quality and can prevent recovery from eutrophication (Cooke and Kennedy, 2001; Cooke et al., 2005; Wetzel, 2001). Maintaining an oxygenated environment in the bottom waters prevents the release of nutrients and

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