

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

Alexandra Beth Gerling

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in
partial fulfillment of the requirements for the degree of

Master of Science
In
Biological Sciences

Cayelan C. Carey, Chair
John C. Little
John E. Barrett

29 July 2015
Blacksburg, Virginia

Keywords: hypoxia, oxygenation, internal loading, external loading, water quality

From: Copyright Clearance Center rightslink@marketing.copyright.com
Subject: Thank you for your RightsLink / Elsevier transaction
Date: June 23, 2015 at 3:04 PM
To: alexg13@vt.edu

To view this email as a web page, go [here](#).

Do Not Reply Directly to This Email

To ensure that you continue to receive our emails,
please add rightslink@marketing.copyright.com to your [address book](#).

RightsLink



Thank You For Your Order!

Dear Ms. Alexandra Gerling,

Thank you for placing your order through Copyright Clearance Center's RightsLink service. Elsevier has partnered with RightsLink to license its content. This notice is a confirmation that your order was successful.

Your order details and publisher terms and conditions are available by clicking the link below:
<http://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=0dbdf171-6244-46dc-81b0-9a00782ea232>

Order Details

Licensee: Alexandra B Gerling
License Date: Jun 23, 2015
License Number: 3654921477456
Publication: Water Research
Title: First report of the successful operation of a side stream supersaturation hypolimnetic oxygenation system in a eutrophic, shallow reservoir
Type Of Use: reuse in a thesis/dissertation
Total: 0.00 USD

To access your account, please visit <https://myaccount.copyright.com>.

Please note: Online payments are charged immediately after order confirmation; invoices are issued daily and are payable immediately upon receipt.

To ensure that we are continuously improving our services, please take a moment to complete our [customer satisfaction survey](#).

B.1:v4.2

+1-855-239-3415 / Tel: +1-978-646-2777
customercare@copyright.com
<http://www.copyright.com>

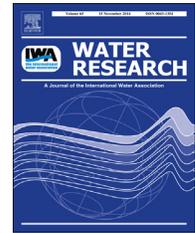


This email was sent to: **alexg13@vt.edu**

Please visit [Copyright Clearance Center](#) for more information.

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/watres

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



Alexandra B. Gerling^{a,*}, Richard G. Browne^b, Paul A. Gantzer^c,
Mark H. Mobley^d, John C. Little^b, Cayelan C. Carey^a

^a Department of Biological Sciences, Derring Hall, Virginia Tech, Blacksburg, VA 24061, USA

^b Department of Civil and Environmental Engineering, Durham Hall, Virginia Tech, Blacksburg, VA 24061, USA

^c Gantzer Water Resources Engineering, LLC, Kirkland, WA 98034, USA

^d Mobley Engineering Inc., Norris, TN 37828, USA

ARTICLE INFO

Article history:

Received 1 June 2014

Received in revised form

28 August 2014

Accepted 1 September 2014

Available online 10 September 2014

Keywords:

Hypoxia

Internal loading

Iron

Manganese

Phosphorus

Water quality management

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.

© 2014 Elsevier Ltd. All rights reserved.

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

* Corresponding author. Tel.: +1 540 231 6679; fax: +1 540 231 9307.

E-mail address: alexg13@vt.edu (A.B. Gerling).

<http://dx.doi.org/10.1016/j.watres.2014.09.002>

0043-1354/© 2014 Elsevier Ltd. All rights reserved.