

**STANDARD OPERATING PROCEDURE
Bench-Scale Procedure for Determining Chemical Degradation
of a Primary Treatment or Its By-Products**

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RECORD OF AMENDMENTS:

<u>No.</u>	<u>Date</u>	<u>Type</u>	<u>No.</u>	<u>Date</u>	<u>Type</u>
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STANDARD OPERATING PROCEDURE

Bench-Scale Procedure for Determining Chemical Degradation of a Primary Treatment or Its By-Products

BACKGROUND

The Great Ships Initiative (GSI) is a collaborative effort to end the problem of ship-mediated invasive species in the Great Lakes-St. Lawrence Seaway System through independent research and demonstration of environmental technology, financial incentives and consistent basin-wide harbor monitoring. To that end, the GSI has established a shore-based high-flow Research, Development and Technology Evaluation (RDTE) facility in Superior, Wisconsin to provide intensive testing services to vendors of ballast treatment prospects suitable to Seaway-sized vessels. Laboratory space within the University of Wisconsin-Superior (UW-S) and University of Minnesota-Duluth is utilized to meet GSI bench-scale test objectives, as well as for non-time sensitive analysis of samples from the shore-based and shipboard scale tests. The UW-S has space in several of their research labs dedicated to the GSI project. Bench-scale experiments are conducted in the university's Aquatic Toxicity Laboratory which maintains active cultures of zooplankton, phytoplankton, and aquatic invertebrates. The laboratory contains a series of mini-diluters for water-only acute and chronic toxicity tests and is equipped to run static, intermittent renewal, and flow-through tests. A variety of meters are available for monitoring water quality including conductivity, salinity, pH, dissolved oxygen, temperature, and select ions.

INTRODUCTION

This bench-scale procedure investigates the chemical degradation of a primary ballast water treatment or its associated by-products. In general, this 96 hour maximum test monitors the break down of the primary treatment/by-product under several different test conditions including light, temperature, concentration, and source water and determines how they influence the rate of degradation of the treatment/by-products.

EQUIPMENT LIST

- Thermometer
- Dissolved oxygen meter
- pH meter
- Analytical instrumentation to measure treatment of concern
- 300 mL high form glass beakers
- Filter apparatus
- 0.45 μm pore size filters
- Glass fiber filters
- Light meters
- Vacuum source

- Constant temperature environment
- Synthetic salt water salts

PROCEDURE

1. Conduct procedure in a vented work area, taking appropriate health and safety measures.
2. Document that instrumentation has been calibrated prior to water quality measurements. Ensure that instruments have had proper warm up and equilibration time prior to measurements.
3. Obtain the four different water types as follows: 1) laboratory water with its source originating from Lake Superior (the incoming water is treated by passing it through an activated charcoal column followed by injection a solution of sodium sulfite to remove any residual chlorine); 2) salt water (made by adding enough of a commercially prepared mixture of salts to distilled water to obtain a salinity of 32 ppt measured by a refractometer); 3) Duluth-Superior Harbor water (collected from a depth of approximately 11 feet below the surface of the water near Barker's Island, Superior, Wisconsin); and 4) filtered Duluth-Superior Harbor water (collected the same way as Duluth-Superior Harbor water but the water is filtered through a 0.45 μm filter).
4. Prepare enough sample volume of three treatment levels (three concentrations or levels of treatment that span two orders of magnitude) and a control for each water type to complete all required measurements and determinations.
5. Measure and record the rate of degradation of the treatment levels and the control at two temperature levels (15 and 25 $^{\circ}\text{C}$), and at two light regimes (complete darkness and an 18 hour light/6 hour dark cycle where the intensity of the light is approximately 962 lumens/ m^2 visible light, 152 $\mu\text{W}/\text{cm}^2$ UVA and 8.44 $\mu\text{W}/\text{cm}^2$ UVB¹). Measurements may be conducted on a geometric or other time scale as to provide a measure of degradation. Record all data. Record method used for analysis. Identify and record chemical(s) used for the ballast water treatment technology during treatment and indicate details for analysis.

QUALITY ASSURANCE/QUALITY CONTROL

It is recommended that 10 % of samples be collected and analyzed in duplicate to document sampling and analytical variability. It is also recommended that 10 % of samples be spiked with the test chemical and spike recovery be determined. Duplicate agreement will be considered acceptable when agreements are >80 % and spike recovery acceptability ranges from 75 – 120

¹ This light description is ambient bench top lighting under full spectrum fluorescent lights.

%. When applicable a certified standard may be purchased and analyzed to document performance of analytical instrumentation. All instrument data output (e.g. chromatograms, absorbance scans and/or measurements) must be kept in a project specific binder.

REFERENCES

Cangelosi, A.A. 2006. RDTE Facility for the Great Ships Initiative (GSI) (OAR-SG-2006-20000364). Project Proposal to the National Oceanic and Atmospheric Administration/U.S. Fish and Wildlife Service.

Great Ships Initiative Standard Operating Protocols: <http://www.nemw.org/GSI/protocols.htm>.

Great Ships Initiative website: www.greatshipsinitiative.org.

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