NORTH SEA BALLAST WATER

The Interreg IVB North Sea Region Programme

Investing in the future by working together for a sustainable and competitive region

Algae viability measurement over time

Stephan Gollasch
GoConsult

Matej David
University of Ljubljana

March 2010

><((((°>
GoConsult

David Consult

ALGAE VIABILITY MEASUREMENT OVER TIME

Stephan Gollasch
GoConsult
Grosse Brunnenstrasse 61
22763 Hamburg
Germany

Matej David
University of Ljubljana
Faculty of Maritime Studies and Transport
Pot pomorscakov 4
6320 Portoroz
Slovenia

Reporting period 3, Mar 2010 to Aug 2010
08-04-2010

This report should be quoted as follows
Gollasch S, David M, 2010. Algae viability measurement over time. Final report. Prepared for Interreg IVB North Sea Ballast Water Opportunity project:6 pp.

TABLE OF CONTENTS

1 INTRODUCTION

To proof compliance with ballast water discharge standards, as set forth in Regulation D-2 of the IMO Ballast Water Management Convention, the viability of organisms has to be evaluated. This is particularly challenging for the organisms size group below 50 and above 10 µm in minimum dimension. Organisms in this group are mainly phytoplankton.

One of the logistical problems when undertaking shipboard tests of ballast water treatment systems is that only a limited amount of gear can be brought onboard the test vessel. This is due to costs and weight limitations in cases the sampling team and gear needs to use air travel to get to the vessel, especially in intercontinental flights.

2 METHODS

This study was undertaken in September 2009 on the Pure Car and Truck Carrier *Toronto* with the support of Wilhelmsen Ships Equipment (Lysaker, Norway) and Resource Ballast Technologies ltd (Cape Town, South Africa) (see Acknowledgements at the end of this report).

The vessel particulars are IMO Number 9302205, DWT 19628 t, cargo capacity 6350 car units on 12 car decks, maximum ballast water capacity 9669 t in 19 tanks. The vessel voyage took place in November 2009 between Baltic and North Sea ports with the sample being taken on the 24th of November 2009 when the vessel was off Skagen, Denmark.

The sampling team comprised of Dr. Stephan Gollasch (GoConsult, Hamburg, Germany), Prof. Dr. Matej David (University of Ljubljana, Faculty of Maritime Studies and Transport, Portoroz, Slovenia) and Mariusz Slotwinski (Wilhelmsen Ships Equipment, Poland).

The sample was taken from the ship's ballast water line during the uptake of ballast water. The in-line sampling points design is shown in Fig. 1 and the sampling point was located in a straight section of the ballast water pipe.

The tests were independent from any possible onboard performance tests of the Resource ballast water treatment system. However, as ships currently are lacking in-line sampling points, this vessel was selected as such sampling points were installed on this vessel to test the performance of the treatment system in the future.

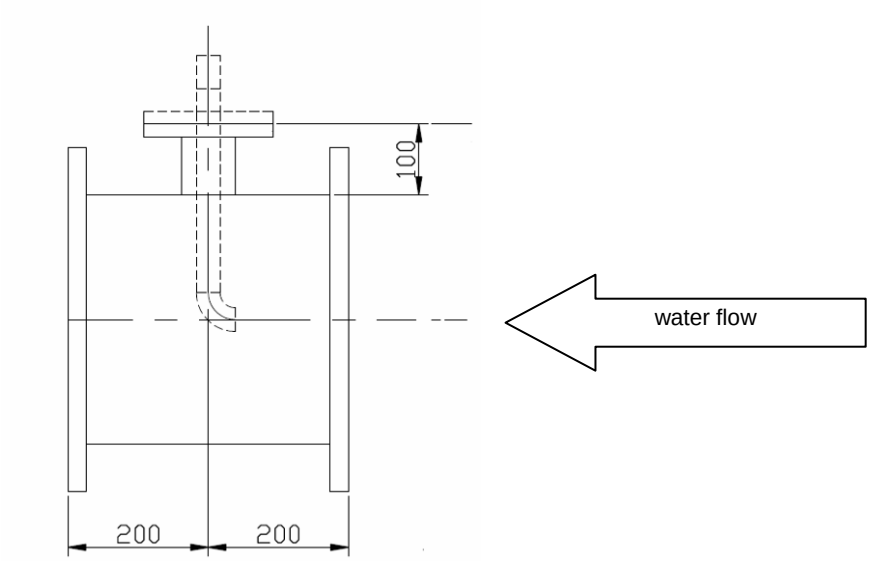

Figure 1: Design of the in-line ballast water sampling point (Courtesy of Mariusz Slotwinski).

The algae viability was measured with a red laser Pulse-Amplitude Modulated fluorometer (PAM-fluorometry) device purchased from Walz[1], Germany. The PAM user protocol as provided by Walz was followed. At least three measurements were made and the mean value was calculated and reported as viability value (Fv/Fm value).

The sample of 5 litres volume was put in a 10 litre bucket, covered with a lid and placed in a fridge onboard the vessel.

The sample water was mixed prior each PAM measurement and measurements were undertaken daily at approximately the same daytime until leaving the vessel on the 27th of November 2009. Having left the vessel the sample was brought to the laboratory at GoConsult, Hamburg and stored in a fridge. Daily measurements continued on land until the 10th of February 2010.

During the first sampling period (24th of November to 24th of December 2009) the sample was kept in the 10 liter bucket. On the 24th of December 2009 the sample was split into three transparent 1 litre bottles of which one was kept in the fridge, the second placed in a dark environment at room temperature and the third put in front of a window with natural light exposure at room temperature.

[1] http://www.walz.com/

3 RESULTS

Starting with the 24th of November 2009 daily measurements were made until the end of the observation period on the 10th of February 2010, i.e. 79 days.

Figure 2 shows the viability measurements over the entire observation time. Phytoplankton in the sample put in the fridge showed a reduced viability value over the entire observation time until it reached a level of 0,200 Fv/Fm value indicating that the organisms are affected/dead and do not show any recovery potential. This viability reduction over time increased in scale towards the end of the experiment.

The organisms in the sample stored without light at room temperature showed the strongest reduction of the viability measurement.

In contrast organisms in the sample stored at room temperature with light exposure increased in their viability measurement from the first day after they were taken out of the fridge and with one exception (5th of February 2010) the viability values were always above those of the other two samples which were stored in the dark.

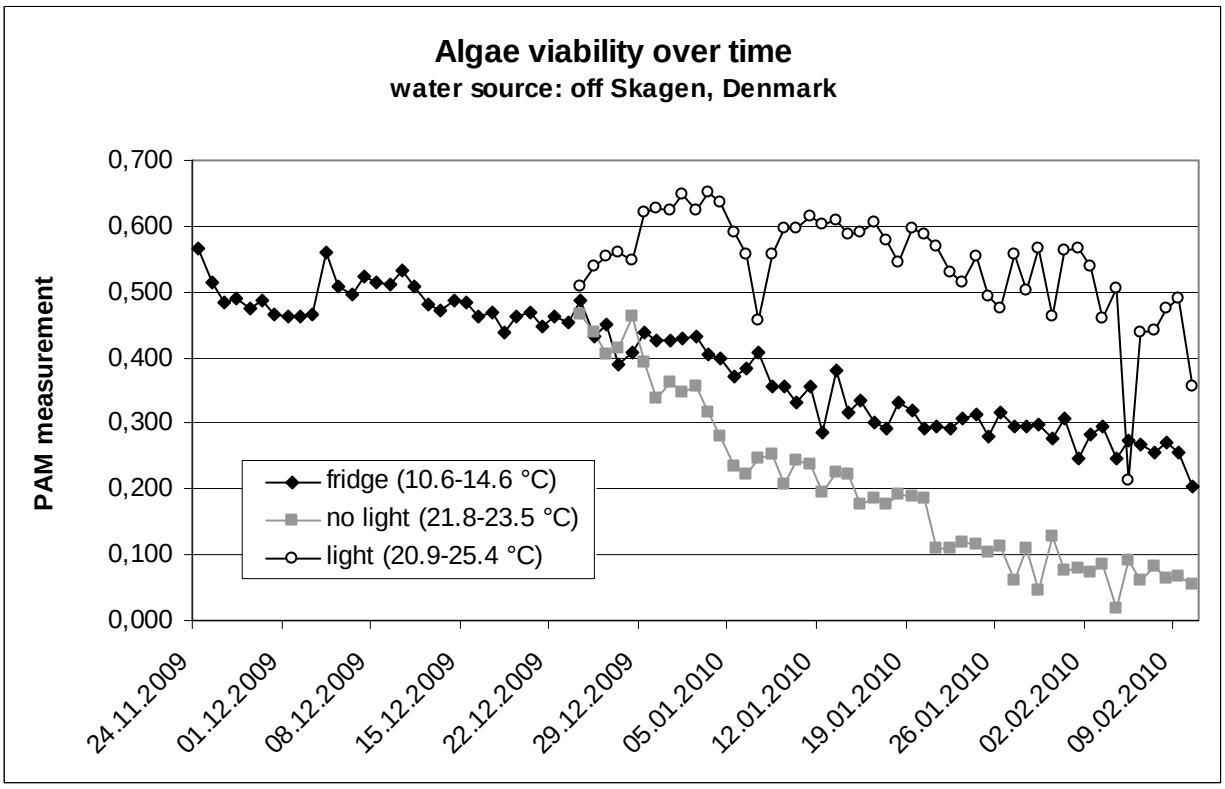

Figure 2: Long-term algae viability of a ballast water sample.

4 DISCUSSION

It should be noted that the findings of this study are based upon one sample only which indicates that the conclusions should be handled with care as no statistical data analysis is enabled.

However, algae survival was documented in this experiment to last up to 79 days. It seems that during the first 4 weeks of the experiment, when the sample was stored in the larger volume bucket (5 liters) in the fridge, the viability remains almost unchanged with a slight downwards trend. In the continuing period all three samples showed a stronger downwards viability trend after they were put in smaller sample bottles (1 liter) for storage. The strongest viability reduction was measured for the sample stored without light at room temperature.

The reduction in viability is probably to a large extent caused by the long exposure time of the samples in this experiment. However, the transfer from the 5 liter sample volume to the 1 liter volume on the 24th of December 2009 may also have had an influence.

It may be concluded that a sample storage time of up to two weeks in a larger volume bottle stored in a dark and cool environment has little influence on the organism viability. This indicates that a two week time duration between sample taking and viability measurement may not be very critical. Consequently, and especially for shorter voyages, the PAM may not be needed for direct onboard sample analysis as the viability of the organisms may be measured later on land.

ACKNOWLEDGEMENTS

This ballast water sampling event would not have been possible without permission and the essential support of Thamba Rajeevan (Technical Manager-BWT Wilhelmsen Ships Equipment, Norway), Filip Svensson, Vice President Marin Operations (Whil. Wilhelmsen ASA , Norway), Sarah Walsh (Vessel manager, WLCC, United Kingdom) and Bernard Jacobs (Resource Ballast Technologies ltd (Cape Town, South Africa)). Further grateful thanks are expressed to the vessel crew and especially the Captain Eric L. David, Chief Officer Almer C. Samaniego and Chief Engineer Daniel N. Berondo.

NORTH SEA BALLAST WATER

European Union The European Regional Development Fund

The Interreg IVB North Sea Region Programme

Investing in the future by working together for a sustainable and competitive region