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NORTH SEA BALLAST WATER

THE BALLAST WATER TIMES

Dear Reader,

A lot has happened in the ballast water world since the start of the NSBWO project, although the IMO BWMC is still not in force. But the expectation is that the required 35% tonnage mark will be reached soon and, moreover, the US Coast Guard has now stated definite dates for enforcement of ballast water treatment. Although the NSBWO project has been funded by the EU Interreg IVB Programme with a focus on the North Sea region, it has established a global contact network, and this is the right choice in the globally operating shipping world. This issue of The Ballast Water Times shows that there are still items to be tackled. Therefore it seems appropriate that the NSBWO project has been granted a 1/2 year extension till 30 June 2014.The NSBWO team trusts it can continue to provide its services to you under this extended contract.

Jan Boon (NIOZ), NSBWO Project Manager

Ballast water legislation and its practical implications as perceived by the KVNR

Niels van de Minkelis,
Senior Policy Advisor

The Royal Association of Netherlands Ship-owners (KVNR) has carefully followed the development of ballast water legislation throughout the years and has been actively involved where needed. Although the KVNR wholeheartedly embraces the management of ballast water in order to avoid the transfer of invasive aquatic species, concerns over the practical implications are remaining. Some issues still remain at IMO and in the USA, requiring full attention.

IMO

Issues still remain with respect to the robustness of existing type-approval standards for the new equipment and sampling for port state control purposes. Furthermore, for several special ship types (e.g. unmanned seagoing barges) no solutions have been found yet to meet the provisions of the 2004 IMO International Convention for the Control and Management of Ships' Ballast Water and Sediment (BWMC). On the other hand, the ship-owners would welcome an adoption of the draft Assembly Resolution during the IMO Assembly meeting in November 2013 which would relax the implementation schedule (Regulation B-3).

USA ballast water requirements

The implementation schedule of the USCG ballast water final rule entitled "Standards for Living Organisms in Ships' Ballast Water Discharged in US Waters" requires ships to comply with the IMO D-2 discharge standard already during its first scheduled dry-docking in 2014 (or 2016, depending on the ballast water capacity of the ship). New ships constructed after 1 December 2013 have to comply immediately upon delivery. While these compliance dates are rapidly nearing, unfortunately no USCG type approved ballast water treatment system is available on the market. The only option is to install a temporary USCG accepted system (AMS). But will these temporary approved systems, and in particular the UV-light based systems, ever be fully Type Approved?

Applying for an extension to meet the USCG requirements would be an option, but unfortunately the EPA's Vessel General Permit 2013 ballast water provisions do not allow for an extension, while having the same implementation schedule as the USCG ballast water final rule.

All this leads to a situation where ship-owners have to deal with significant uncertainties when meeting the requirements. This is unfortunate, as the costs of installing a treatment system on-board are very high. The KVNR therefore continues to carefully follow the ballast water regulations and to be actively involved where needed.

www.kvnr.nl

Underwater alien invasion!

Annukka Pekkarinen,
Research Assistant &
Malin Pålsson, Illustrator

"While movies and comics have given many of us some idea about how space aliens might look, there are real sea aliens that come in all shapes and colours. They are not from outer space, but perhaps from another ocean. That is why they are called aliens, unfamiliar species that do not naturally belong in the North Sea. And these aliens do not need a space ship to travel; they use ordinary ships. We know more of our solar system than we know of our own oceans. At the time of writing this book there are 6 people stationed in outer space and none in the deep sea. Who knows what kind of aliens lurk in the depths of our oceans?"

This is how the children's public awareness book on alien species and ballast water begins. It looks at the issue of ballast water and invasions, trying to make it easily understandable with references to everyday phenomena. Some of us have experiences with fruit fly invasions in our kitchens and we know how annoying they can be; but, fruit fly invasions might not be all that different from marine invasions

The book explains what ballast water is and why it is transported around the world. Potential ecological and economic impacts of aliens are presented. Ballast water treatment methods are illustrated in the pages of the book in a fun, understandable way. Marine biology is a treasure chest for interesting and strange facts: ten exciting marine species are therefore chosen to represent alien species that have been found in the North Sea.

The book comes with a large, folded map of the North Sea containing information about the area.

The Aliens of the North Sea
© Malin Pålsson

www.wmu.se

NSBWO pro

NSBWO in its fifth year: highlights and spin off

Cato C. ten Hallers-Tjabbes, Director CaTO Marine Ecosystems, Member Project Group NSBWO project

In the fifth year of the North Sea Ballast Water Opportunity (NSBWO) project, we highlight project contributions achieving a regional framework for stimulating ratification and implementation of the BWMC and enhancing regional cohesion.

Most North Sea countries have now ratified the BWMC, although two have not acceded yet. The project has contributed substantially to IMO and regional policies. To name a few, the development of policies for port state inspection (IMO) benefitted from expertise, strategies and tools brought from NSBWO; the impetus for full transparency on ballast water management (BWM) certification and testing has been strongly promoted by input from project partners. Regional bodies (OSPAR and HELCOM) benefitted from strategies for exemptions developed by the project.

The performance of BWM systems benefitted from the interaction between developers of technologies and scientists investigating the performance of such technologies. Problematic issues and lack of clarity in the procedures for testing BWM and in interpreting the results were discussed in dedicated workshops attended by scientists, technical experts and policy makers. The results were brought to IMO and regional policy platforms. Strategies for early warning and assessing risks of transfer of invasive species are being developed and have inspired a lively debate on recognising underlying processes to develop more effective prevention strategies.

Representatives from both shipping and ports were encouraged to participate in the project and in target meetings organised for the sectors. Experiences from non-project partners in mounting and applying BWM systems were highlighted in the 1st NSBWO Europort Conference (2011). The project has attracted public attention, through demonstrations, such as the BWM test site in 2011 and through many reports in the press and other media.

The project has also generated spin off with a promising future. Several new technologies were investigated and communicated to the wider world, while two new BWM test sites have branched off from project experiences.

www.northseaballast.eu

The *Waddenvereniging* and the NSBWO project

Ellen Kuipers, Project Leader Shipping Safety

Globally, we have agreed that the effects of the introduction of alien species by ballast water should be avoided. For this reason, the BWMC was adopted in 2004. The purpose of this convention is that from 2016 all ships are required to deal with their ballast water in a proper way.

The Wadden Sea is one of the last major tidal areas in the world. The Wadden Sea is unique in its kind and for this reason UNESCO awarded it the World Heritage status in 2009. One of the recommendations of the World Heritage Committee is to develop a monitoring program for alien species which threaten the Wadden Sea. The arrival of exotic species in the Wadden Sea may lead to a reduction of biodiversity, with negative environmental and economic consequences.

For the *Waddenvereniging* the NSBWO project was a great platform to work with scientists, policymakers, port authorities, shipping companies and industry on a coherent, innovative and feasible policy for treating the ballast water of ships.

The NSBWO project has brought the *Waddenvereniging* a large network and a lot of knowledge about ballast water. Also, it is extremely inspiring to learn about the complexity from adoption of a convention about ballast water to national ratification. It takes many years to finally achieve the objective of the BWMC, namely to prevent the spread of invasive species through ballast water. These are very tough processes involving many different forces.

The Waddenvereniging has learned that the role of non governmental organizations can be essential. By targeted communication, such as articles, workshops and training, they can transfer knowledge and bring parties together. This will consolidate the process and finally helps to reduce the risk of introduction of unwanted species in the Wadden Sea.

www.waddenvereniging.nl

Participation of Copenhagen-Malmö Port in the NSBWO project

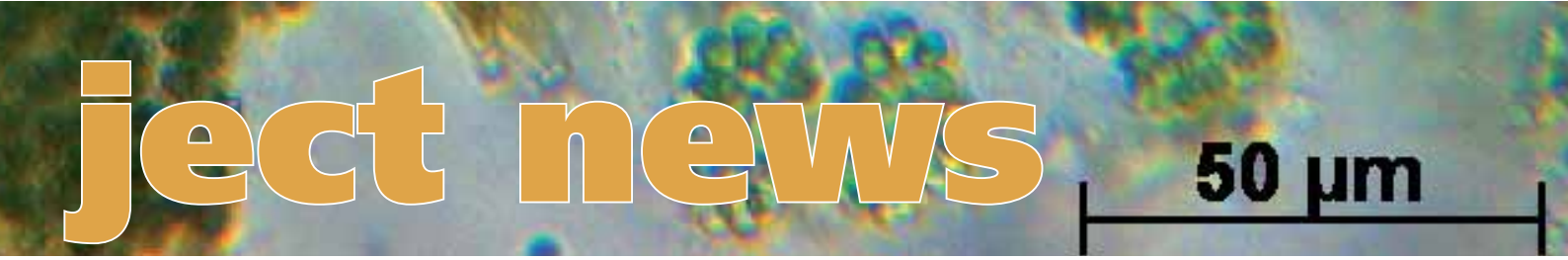
Jens Hess Haugsöen, Oil Harbours Manager

Copenhagen – Malmö Port (CMP) has been a sub partner of the NSBWO project ever since the project has started. As a port, it is most interesting to gain more information about BWM. Regarding BWM we are, like most other ports, waiting to see what will happen. A big moment now would be the ratification of the BWMC (2004). It is not clear what our future role will be in ballast water treatment. Will there be ballast water treatment plants in the area? We do worry about the environmental aspects and have control programs for outlets to the sea. The sea and groundwater in Malmö Oil harbour is very clean, as CMP has for many years enjoyed excellent cooperation with the companies in the harbours.

But at the same time we also have to think about the costs, like everyone else!

What I appreciated most about the NSBWO project were the conferences and meetings. Also networking with a lot of knowledgeable people is very helpful. It was interesting to participate at the Annual Meeting 2013 at the WMU in Malmö. I would like to attend more conferences to gain knowledge; therefore I will also be present at the Europort conference 2013.

www.cmport.com



BWM Convention underway

Maurits Prinssen, Project Manager Sustainable Development & Ron van Gelder, Senior Advisor

The port of Rotterdam keenly followed the discussions and the submissions concerning the BWMC and her Guidelines in IMO/MEPC. The ship owners are responsible for the ballast water and the treatment. Presently, it is still not clear when the convention will be ratified. It can be expected in the near future, but at present some questions have not been answered yet:

- What proportion of the vessels calling at port will not have an adequate ballast water treatment system?
- At this moment approximately 5% of all sailing vessels already have an adequate treatment system on-board.
- Which vessels want to obtain an exemption? Within the OSPAR and HELCOM countries a draft procedure will be written for exempting particular vessels. We expect approximately 25 vessels regularly visiting the Port of Rotterdam, this seems to be a good solution.
- What proportion of the calling vessels are in favor of a mobile treatment system in the port?

The European NSBWO project was started to answer the increasing amount of questions regarding the Convention. Although the work of the NSBWO project is impressive, the focus on possible impacts for ports was underestimated. With a proposal to postpone the obligation to fully comply with the Convention, all stakeholders bought some time to work on the answers.

Now that we see the end of the project, it would be good to discuss a follow-up for this topic. For this, the European Sea Ports Organization in close cooperation with ECSA, seems to be a good platform to address the topic and investigate the questions. The BW dossier is already a lively topic and it is likely to remain so in the coming years!

www.portofrotterdam.com

Ballast water, still a lot of work

Dick Brus, Senior Policy Advisor

In 2004 IMO members agreed on the BWMC. In 2009 we finished in the IMO with the accompanying 14 Guidelines under the Convention. In 2010 the Netherlands ratified the Convention. As a policy maker, I then reported to my director that I expected that the workload of the ballast water programme would soon decrease. How wrong could I be!

Together with my colleagues of the Dutch Inspection, we are still very busy with:

- Ratification of the Ballast Water Convention for the Dutch islands in the Caribbean area
- Consultation with Dutch producers of ballast water treatment systems and application to the IMO for basic and final approval
- Informing IMO on type approval of Dutch ballast water treatment systems
- Consultation with Dutch producers of ballast water reception barges/facilities on national and international legislation
- Consultation with the Dutch maritime industry on the possibilities of the use of drinking water/potable water, making proposals to IMO MEPC
- Consultation with the Dutch ship owners association and asking attention of the IMO for special type of ships OSPAR proposal to ballast water exchange areas in the North Sea
- OSPAR/HELCOM proposal on exemptions for specific routes in the North Sea and Baltic Sea
- Consultation in the IMO on a testing period for sampling
- Consultation in the IMO on self-monitoring standards
- Consultation in the IMO to relax the implementation schedule stipulated in regulation B-3
- Consultation in the IMO on reporting information for type approved ballast water treatment systems

Much of this work was and still is supported by the work of the NSBWO project. For me especially bringing together the stakeholders and available knowledge on all the different aspects of this complicated dossier was a great help. Thanks!

www.rijksoverheid.nl/ministeries/ienm

Key achievements of Work Package 4

Stephan Gollasch, Independent Consultant & Matej David, Professor at University of Ljubljana

The first author was responsible for NSBWO Work Package 4 “Detection for monitoring and compliance control” and this contribution highlights the key achievements of this work package. A substantial amount of work was jointly undertaken with Prof. Dr. Matej David, a ballast water expert from Slovenia with nautical expertise and he co-authored this summary.

Several reports were prepared to summarize the work package activities and these reports are available from the NSBWO project homepage and were also published at the author´s accounts.

Organism Detection Technologies

The majority of the work was related to screening potential organism detection technologies to prove compliance with ballast water management requirements and to evaluate such technologies for practical work by Port State Control. It became clear that organism detection technologies are available today to enable both an indicative and detailed inspection of ballast water samples. This conclusion was also based upon practical work conducted at the NSBWO project partners NIOZ, CytoBuoy, Ovizio and Zebra Bioscience, and candidate technologies were tested on board commercial vessels. In summary, for an indicative sample analysis it was recommended to use Pulse-Amplitude Modulated (PAM) fluorometry to check for living phytoplankton, to use enzyme-chemistry with selective media for bacteria analysis and to use a stereo microscope for the analysis of the zooplankton organisms above 50 micron in minimum dimension. It should be noted that the PAM and bacteria methods do not deliver organism counts, but give a semi-quantitative measurement so that the higher the reading of the instruments, the higher the biological content. The instruments for this application are portable and, with the exception of the microscope, of hand-held design and deliver results in less than 5 minutes so that Port State Control could check for compliance whilst still on board the inspected vessels. Further methods are developing to meet the ballast water sample processing demands and these include a new ATP method, currently in its final development at NIOZ. For a detailed sample inspection, the recommended methods are more cumbersome and include flow-cytometry for the analysis of phytoplankton, with a viability test using stains. Zooplankton should be analyzed by a microscope either using gentle poking or a stain to check the organism viability. For bacteria analysis it is recommended to use selective media and it seems that an incubation time of at least 24 hours is needed to prove compliance with the D-2 Standard.

Ballast Water Sampling

To support the project BioMarKs, an ERA net program funded by BiodivERsA’s national partners and under the Framework Programme of the European Commission, a ballast water sampling event was carried out in the Port of Rotterdam. The planning of the vessel sampling events was done by NIOZ, GoConsult guided the French sampling team during sampling and joined the sample processing.

Risk Assessment

A ballast water management related risk assessment approach for intra North Sea shipping was prepared. This risk assessment is based upon the relevant IMO Guideline G7. The three different risk assessment approaches as outlined in G7 were evaluated for their applicability in the region. The first approach, i.e. the biogeographic risk assessment approach, is not directly applicable as the ballast water movements considered here are limited to intra North Sea shipping, i.e. not undertaken between different bioprovinces, but may be integrated in the species specific assessment.

It became clear that essentially needed data (i.e., on species in the North Sea ports) are missing, but would be required to undertake the second risk assessment approach, i.e. a species specific risk assessment based on target species. At best this should be achieved by biological port baseline surveys. However, a target species selection process may be conducted based upon the selection criteria in G7. Target species can thereby be identified, but a risk assessment based upon target species is only possible with the knowledge on their occurrence in ballast water donor and recipient areas. This highlights the need for baseline surveys and monitoring in ports.

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NSBWO pro

Workshops for German shipping companies: 'Shipping and the ballast water challenge'

Marieke Verweij, Project Manager

Ballast water management is one of the biggest environmental challenges facing the shipping industry today. With the upcoming ratification of the BWMC (another 5% of the world's tonnage is needed), all ships must treat their ballast water in the near future, so that the risk of introducing invasive species is minimized. On the 11th and 12th of September, in Leer and in Hamburg, German shipping companies attended a one day workshop about this topic. Many experts tried to answer the most pressing questions of participants, including those about 'enforcement and control', 'US regulations', and 'the retrofit challenge'. The workshop was offered to shipping companies by the NSBWO project and organised by ProSea and the VDR. This article gives an overview of what was addressed during these workshops.

After a word of welcome from Wolfgang Hintzsche (VDR) and Marieke Verweij (ProSea), the day started with an introduction to the NSBWO project by Jan Boon (marine biologist at NIOZ and NSBWO project leader). In this project, North Sea countries are working together to tackle the ballast water challenge by bringing together the expertise of scientists, ministries, classification societies, ports, and ship owner associations. Then, Verweij gave an update of the convention status and upcoming regulations and time frames. In total, 40 participants (23 shipping companies) attended the two workshops.

Then the actual workshop started: participants split up in small groups and discussed their main concerns about the ballast water challenge. The participants were asked to jointly make a top 5 of these concerns, ranking the most pressing concern number 1. After the brainstorm session, each top 5 was presented by a group member. This way, the experts could prepare themselves for possible questions for the afternoon session. The top 5s were merged and summarised by ProSea and contained the following main topics: costs, choice and availability of systems, retrofitting, US rules, enforcement and control, training of crew, and implementation time.

Workshop objectives

- Create awareness of the marine invasive species problem;
- Prepare for the forthcoming entry into force of the BWMC;
- Address main concerns of the shipping industry about upcoming ballast water regulations.

After the workshop about main concerns, the workshop focussed on the problem of invasive species: the reason why ballast water management is an issue in the first place. Verweij shortly introduced some basic ecological principles needed to understand the problem of invasive species, including food chains and food webs, after which the problem was further illustrated by the movie 'Invaders from the Sea' (an IMO-BBC documentary, can be viewed at: http://globallast.imo.org).

After lunch the focus shifted towards the solutions. First, Boon presented a general overview of available ballast water treatment systems (as of today, 37 systems have received type approval according to IMO guidelines). He also provided the shipping companies with a very practical list of questions 'that you should or could ask before you decide what system to buy'. Then, Ramona Zettelmaier updated the attendees about the class perspective on installation.

This was followed by 'café meetings' having experts on three different topics: (1) compliance monitoring and enforcement (CME), (2) US regulations and (3) retrofit and special requirements for certain vessel types. The participants split up in three groups and visited each café for 30 minutes, asking the experts all their questions. Below is a summary of the addressed topics.

We hope that this workshop has contributed to prepare the shipping industry to the forthcoming entry into force of the Ballast Water Convention and wish all the shipping companies good luck with the ballast water challenge.

These workshops were offered by the NSBWO project and were sponsored by Verband Deutscher Reeder and Bureau Veritas.

www.prosea.info
www.reederverband.de
www.bureauveritas.de

Three main topics discussed during the café meetings:

Café 1: Compliance, monitoring and enforcement

Experts Holger Steinbock (BG Verkehr / Port State Control), Sabine Reuland (national administration, BSH) and Birte Clason (biologist, GEA Westfalia)

- How will Port State Control test? PSC will check certificates, no regular sampling (yet)
- Test and trial period. For a period of 2 to 3 years, there will be no prosecution in case a BWTS fails, the results will be used for IMO evaluation, so please use installed systems (gain experience)
- Failure system. maybe perform D1 (exchange) – load or unload, negotiate with port

Café 2: US regulations, AMS (Alternate Management System). What does it entail? Validity?

Experts Debra DiCianna and Stamatis Fradelos (ABS) and Jan Boon (NIOZ);

- USCG type approval. No systems so far. Any systems in the process?
- No discharge of ballast water in US waters. Then you are compliant, how to verify this?

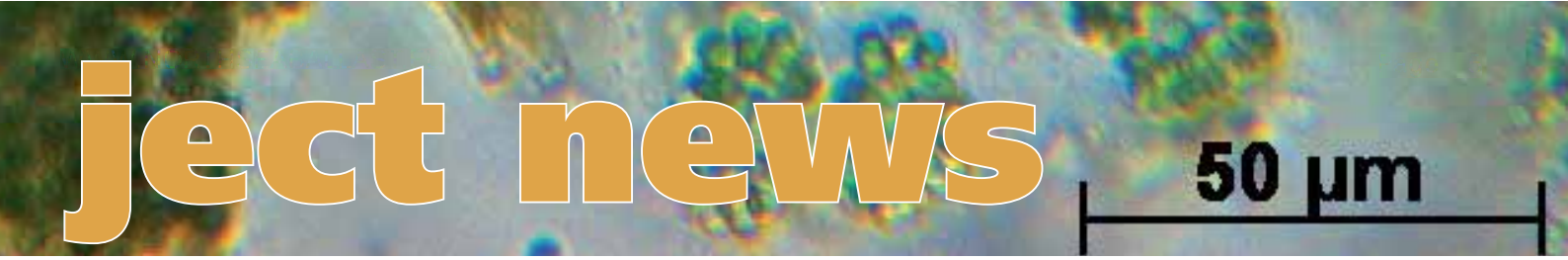
Café 3: Retrofit

Experts Jurrien Baretta (Goltens Green) and Ramona Zettelmaier (Bureau Veritas)

- Additional engine room space and 3D imaging. Expand engine room into cargo area?
- Risk assessments. To be carried out for retrofit and use of systems (e.g. use of chemicals?)
- What does class look for? No leakage, safety.

Some responses from attending shipping companies:

- My expectations of this workshop were exceeded
- It was quite refreshing, all topics were openly discussed
- Very useful for individual questions and discussions
- I have obtained a lot of new info
- Many points have been clarified
- I have to start to think about solutions to meet the BWMC requirements



The outline of Work Package 2 - Coherence, Harmonization and Transparency

Stefan Kacan, Scientific Advisor and NSBWO Coordinator at BSH

Introduction and administrative organisation

To reduce the introduction of alien species into the North Sea area - and hence to decrease their impact on the ecosystem, ships' ballast water has to be treated. The NSBWO project aims to improve the North Sea environment and economy by facilitating the ratification of the BWMC. The NSBWO project encourages the ratification of the BWMC through reducing a major barrier: providing proposals for treatment and detection technologies.
Finally, the results gained in the project could result in harmonisation and transparency of compliance, control, and enforcement measures. Mainly the Work Wackage 2 (WP2), led by the German Federal Maritime and Hydrographic Agency (BSH – Bundesamt für Seeschifffahrt und Hydrographie), is acting in this field. At the end of the project, WP2 could provide common certification standards for BWTS. Above that it is important to improve the knowledge on ship-born BW and BWT risks and to develop risk assessment approaches. Of course, WP2 is strongly interlinked with the other work packages in the project.

Initially, 20 sub partners from six countries around the North Sea jointly worked together with the BSH in WP2. The sub partners represent different national authorities, ports, universities and test institutes as well as other scientists and experts. Following, you'll get an overview of the partners still associated with WP2:

Germany
Federal Maritime and Hydrographic Agency (BSH), Federal Environment Protecting Agency (UBA), Federal Institute for Risk Assessment (BfR), and Marena Ltd.

Belgium
Federal Public Service for Mobility and Transport

Denmark
Danish Nature Agency, Port of Copenhagen-Malmö

Norway
The Norwegian Maritime Directorate, NIVA

Sweden
Swedish Transport Agency, Port of Gothenborg

United Kingdom
Lloyd's Register London

The initially created sub partner structure causes a major effort in administration. In the frame of an Interreg programme this was an unusual and a beneficiary – sub partner constellation which was too big. More serious was the fact that the German accounting corporation BDO carrying out the first level controlling was not responsible for controlling the non-German sub partners. In a close and fruitful cooperation with all WP2 sub partners, the lead beneficiary NIOZ, the project management and the JTS, the structural organisation was changed followed by a WP2 internal budget change. So, we got a new reliable basis for continuing the technical and scientific work within NSBWO.

Some major results gained in WP2

The very creative and cooperative working atmosphere among all the partners and sub partners in WP2 and the strong interlinkage with all the other work packages was reflected in important results gained in the NSBWO project. Together with the TU Harburg, UBA developed a guidance document for an environmental emission scenario document (ESD) to harmonise different approaches in use so far and to address a worst case scenario for a standardised environmental risk assessment. Main idea in this study was to calculate an emission scenario for pollutants in a standardised harbour basin and, additionally, for the proximity of the point where ballast water is discharged. The report of this study was published as an INF-paper at MEPC62 (MEPC 62/INF.19). On the basis of this study Deltares from the Amsterdam University incorporated the ESD for ballast water in the MAMPEC calculation.

Analogous to the environmental ESD, the BfR developed an exposure scenario for assessing the impact of treated ballast water on humans (HES). Meanwhile the HES is a standard requirement for evaluating a BWTS in the G9 approval process. Furthermore, BfR published several scientific papers regarding the production and the impact of disinfection by-products in treated ballast water.

For granting exemptions from BWT, a risk assessment was developed in close cooperation with WP4. This RA was the basis for a proposal for a regionally harmonised framework in the HELCOM and OSPAR area.

The IMO BLG sub-committee classified the topic "sampling and analysis" as a high priority issue in its 15th meeting. The aim was to encourage the development of a BWM circular to provide ballast water sampling and analysis protocols. To follow the call-up of BLG 15, the BSH conducted a "Competition to identify promising technologies to conduct efficient controls on board ships to assess the compliance with the regulations of the International Convention for the Control and Management of Ships' Ballast Water and Sediments and its relevant guidelines". This competition aimed to further develop existing sampling approaches. The main focus of the competition was to develop a practical procedure for sampling and analysis of treated ballast water and to develop a system that delivers unambiguous results for gross non-compliance. Participants were invited to submit a method, product or procedure by the end of November 2011. The first, second and third ranked participants received a reward for their proposals for an isokinetic sampling device and for rapid analysis using FAD and ATP. Following the results of this competition the BSH awarded a substantial research contract on sampling and analysis. The aims of the project (which is still going on) are:

1. to evelop an on-board sampling system, which allows quick representative sampling on board ships and delivers unambiguous results
2. to develop a rapid, analytical on-board method, which generates reliable data that indicatively define "compliance" or "gross non-compliance" of the ballast water treatment systems. The project will be finished by the end of this year.

Germany proposed to develop a common understanding for exercising the discretion of Port States for BWMS installed during an interim period in document MEPC 64/2/15. Germany also proposes in this document common standards for self-monitoring of BWMS as a practical way forward in the implementation of the BWMC. Germany suggested detailed self-monitoring standards for BWMS in more detail at BLG17. The outcome of BLG 17 regarding this issue was discussed additionally at a workshop held at the BSH in July 2013. Participants from the USA and Korea were connected to this workshop via video conference. The resulting document was circulated worldwide for commentary.

The above mentioned results are representing only a small selection of the outcomes in which WP2 was involved. Accumulating several results from this project, WP2 submitted and will submit further documents to IMO. A lot of excellent work already has been done since starting the NSBWO project in January 2009. However, there is still a lot to do until the end of the project. BSH currently is working on finalising the manual for the certification process of BWTS, effectively as a comprehensive summary of the work that was done in WP2 and in cooperation with the other work packages and external experts.

www.bsh.de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Continued from page 3.

Thirdly, the risk assessment based upon an environmental match is enabled. When considering this option it should be noted that water salinity is the key feature in this approach. It is important to note that the more environmental parameters are included, the more likely it is that unreliable parameters are included, resulting in less robust and reliable risk assessments, which is in conflict with the precautionary principle. The salinity is believed to be a relatively solid indicator for species compatibility and survival in a new environment. At the same time this information is relatively easily available for ballast water donor and recipient areas. A high risk is assessed should the salinity match between ballast water donor and recipient regions, e.g., marine to marine, marine to brackish or freshwater to brackish environments. A mismatch of salinity is assumed when ballast water is moved between freshwater (< 0.5 PSU) and fully marine conditions (> 30 PSU), indicating a low risk. This general approach however needs some caution with regards to human bacteria, which in general do not survive in high salinity water, but may survive in a host animal or debris.

A combination of both, the target species approach together with an environmental match, are to be considered. Should the selected target species occur in the ballast water donor area, and the ballast water donor and recipient ports show matching salinities, a high risk is assessed. However, if a mismatch of salinity is identified between source and recipient ports, the ballast water may be identified as low risk. All low risk scenarios are acceptable only provided the ballast water is in no instance mixed with ballast water from other sources.

As per IMO agreements, the risk assessment based exemptions are given for a maximum of 5 years and may be revoked if the risk situation changes. This may happen when, e.g., new species occur in the ballast water donor port.

Generating the biological port baseline studies may be seen as costly, but these costs are far below the costs of a ballast water treatment system (capital and running costs) so that risk assessment based exemptions become a profitable option for the ship owner. It was further agreed that regional risk assessment approaches are needed in order not to confuse shipping by different requirements in, e.g., North and Baltic Seas.

The risk assessment background prepared during NSBWO was taken as a starting point to develop the HELCOM risk assessment in the project ALIENS1 in which both authors were involved. HELCOM agreed that this risk assessment is the most suitable for the region and it clearly follows IMO requirements and agreements. As a next step OSPAR and HELCOM exchanged views and agreed that a joint approach would be beneficial. This approach was developed by considering risk assessment reports prepared earlier, but some basic principles were changed so that the new OSPAR/HELCOM risk assessment approach is not fully in line with IMO requirements and in addition it is not fully integrating the precautionary principle as recommended by the European Commission.

Suggested changes of G8

The IMO Guideline G8 addresses the test requirements for ballast water treatment systems. It was adopted at IMO in 2005 and marginally edited once in 2008. This guideline requires that the performance of treatment systems should be challenged in land-based and shipboard tests. Approximately ten test teams are involved in these shipboard tests worldwide, and GoConsult is the one with the longest lasting history and experience from more than 70 test voyages conducted since 2004 on which more than 1000 samples were taken. This experience was used in NSBWO to consider possible adjustments and improvements of G8. A report summarizing these changes will be released by the end of the project in summer 2014. Aspects considered are the abiotic challenge water conditions in land-based tests, the biological challenge water conditions in shipboard tests, the number of samples to take and the sample volume and duration. This work will probably also result in a re-negotiation of the D-2 Standard as this standard currently excludes organisms below 10 micron in minimum dimension and many critical species were recognized to belong to this category.

Algae survival

According to G8 test requirements the samples should be analysed as soon as possible after sampling, and analysed live within 6 hours or treated in such a way so as to ensure that proper analysis can be performed. This becomes particularly challenging for the shipboard analysis when the sampling team sails with the test vessel. A vessel voyage between ballast water uptake and discharge during the shipboard tests seems essential as the treatment system needs to prove its reliability in normal ship operations so that this can only be simulated during a voyage. In these situations laboratory equipment needs to be flown to the departure port. GoConsult is experienced in working this way, but we have not yet found a reliable, robust and portable method for phytoplankton analysis which does not need to be re-calibrated in a laboratory environment after transport. The easiest way to overcome this problem would seem to be the use of a microscope with larger magnification. However, there are difficulties to operate this on-board as the ship's main engine generates vibrations so that in larger magnifications the objects in the sample (debris, sediment, living and dead algae) become indistinguishable. All other instruments are either too sensitive to be routinely transported, too heavy for air travel or insufficiently accurate. Instead of bringing the sample processing equipment to the vessel the sampling team may take the sample to be processed to the laboratory. In this approach a question arises as to how the storage time and conditions would influence algae survival. During NSBWO, GoConsult in cooperation with NIOZ undertook several experiments to address this point and it became clear that the samples should be stored in the dark in a slightly cooler environment than the original sample temperature to slow down the metabolism of the organisms. It was also found that when properly stored, a storage time of 10 to 14 days has little influence on organism viability.

In conclusion, the work in this work package documented that (a) ballast water sampling methods are available, (b) risk assessment based exemptions, when an appropriate risk assessment model and reliable data are used, are a suitable way not to overburden shipping with unnecessary ballast water treatment systems, (c) changes of the test guideline G8 would be beneficial, and (d) organism detection technologies to prove compliance with ballast water requirements are available today. It is hoped that these facts will stimulate more countries to ratify the BWMC so that it comes into force soon.

© Johan Ramberg

For further reading we recommend:

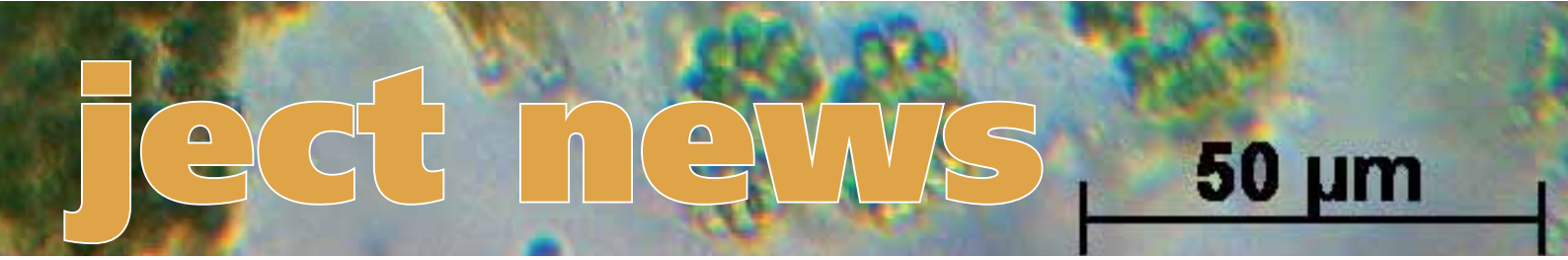
EU Commission, 2000. Communication from the Commission on the Precautionary Principle. Com.(2000)1. Brussels, Belgium: 29 pp.

David M, Gollasch S, 2010. Ballast water risk assessment for intra North Sea shipping. Final report. Prepared for Interreg IVB North Sea Ballast Water Opportunity project: 33 pp.

David, M, Gollasch, S, Leppakoski, E. 2013. Risk assessment for exemptions from ballast water management – The Baltic Sea case study. Marine Pollution Bulletin. In print.

David, M. 2013. Ballast water sampling for compliance monitoring - Ratification of the Ballast Water Management Convention. Final report of research study for WWF International: 66 pp.

www.gollaschconsulting.de
www.researchgate.net/profile/Matej_David/



The risks of ballast water treatment

Sangeeta Banerji, & Thomas Höfer, Unit International Chemicals Programmes

The German Federal Institute for Risk Assessment (BfR) evaluates health risks from chemicals, articles and food. BfR is a sub-partner in the NSBWO project and involved in this project from the very beginning. While most of the other project members are looking at the benefits of ballast water treatment, developing new treatment and detection methods or sampling strategies we hold a unique position because we are looking at the risks that ballast water treatment may pose to the health of the ship's crew and the general public. Our aim was to develop criteria for the health risk assessment of BW treatment systems. We analyzed the prevailing treatment methods and found that the majority of treatment technologies used oxidative chemical principles like chlorination and ozonation for disinfection. Similar technologies are also used in drinking water disinfection. Their main health risks result from disinfection by-products generated inadvertently. These low molecular weight chemicals are often halogenated, with diverse structures. They are formed by the reaction of the oxidant with organic matter present in the treated water. More than 600 different by-products have been reported in the scientific literature but the majority has not been toxicologically characterized. One group of by-products that have been evaluated by toxicologists are the trihalomethanes. Many of them have been shown to cause cancer in laboratory animals and recent epidemic studies have shown that drinking water concentrations in the range of 21-50 ppm increase the risk of bladder cancer in exposed human populations. The European Union has set a limit of 100 µg/l for the total trihalomethane concentration in water intended for human consumption. The lack of toxicological data may account for the fact that only about 40-60 disinfection by-products have been analyzed by all manufacturers of ballast water treatment systems to date, the numbers of identified by-products in individual application dossiers being much lower. With regard to the low number of chemicals analyzed during the approval process of ballast water treatment systems we developed a more comprehensive approach for hazard identification based on the type of oxidant, the water quality and the toxicity of compounds potentially released into the aquatic environment. We also proposed a classification scheme for disinfection by-products similar to a hazard evaluation procedure used for maritime transport. Furthermore, we were the first to compose a detailed list of anticipated exposure situations for the ship's crew and the general public. To promote discussion and knowledge exchange regarding risk assessment between experts from the ballast water field and experts from other areas, e.g. drinking water and pool water treatment, the BfR organized a conference titled 'Emerging Risks from Ballast Water Treatment' in 2011.

It is well known that the chemistry of reactive oxidants like chlorine and ozone in seawater with its relatively high bromide concentration is very different from non-saline fresh water. While ozonation of fresh water with a low bromide concentration does not generate significant concentrations of brominated by-products it does lead to relatively high concentrations of brominated chemicals in seawater. There is still a lack of understanding on the kinetics of secondary oxidant formation under seawater conditions, i.e. in the presence of bromide, chloride and iodide. To advance knowledge on oxidative seawater treatment the BfR is funding a research project by Urs von Gunten, a leading water treatment expert from Switzerland. Von Gunten's team is looking at the formation of secondary oxidants and by-products in natural and synthetic seawater by chlorination, ozonation and treatment with peracetic acid. The goal is to develop a kinetic model to predict secondary oxidant and resulting by-product formation under varying water quality conditions.

We published our results from the NSBWO project in several papers and presented them at many national and international conferences. We found the work within the NSBWO project very stimulating because it fostered the co-operation with other scientists. The annual project meetings were always well organized with an excellent scientific and social programme providing a very good opportunity to connect with other members of the project. Therefore we would have welcomed even more networking events. Since we have just started to answer some of the open questions regarding health risk assessment of ballast water treatment we would love to continue with our research in this area and welcome all who are interested in a future (EU) project to contact us.

BfR Publications within the NSBWO project:

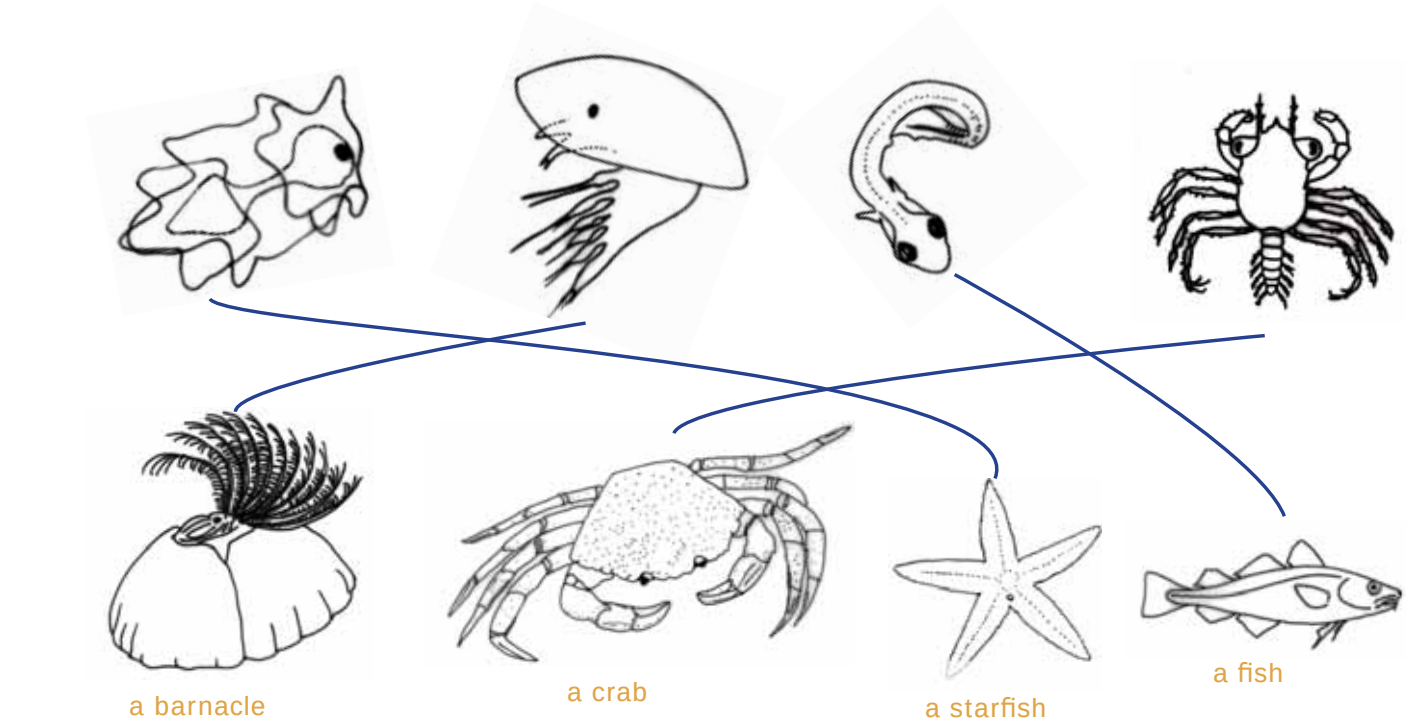
Banerji, S., Werschkun, B., Höfer, T., 2012. Assessing the risk of ballast water treatment to human health. Regul. Toxicol. Pharm. 62, 513-522.

Werschkun, B., Höfer, T., Greiner, M. (Eds.), 2012a. Emerging Risks from Ballast Water Treatment. BfR Wissenschaft, Federal Institute for Risk Assessment, Berlin. http://www.bfr.bund.de/cm/350/emerging-risks-from-ballast-water-treatment.pdf

Werschkun, B., Sommer, Y., Banerji, S., 2012b. Disinfection by-products in ballast water treatment: An evaluation of regulatory data. Water Res. 46, 4884-4901.

www.bfr.bund.de

When I'm grown up I will be:



Land-based testing: for compliance and confidence

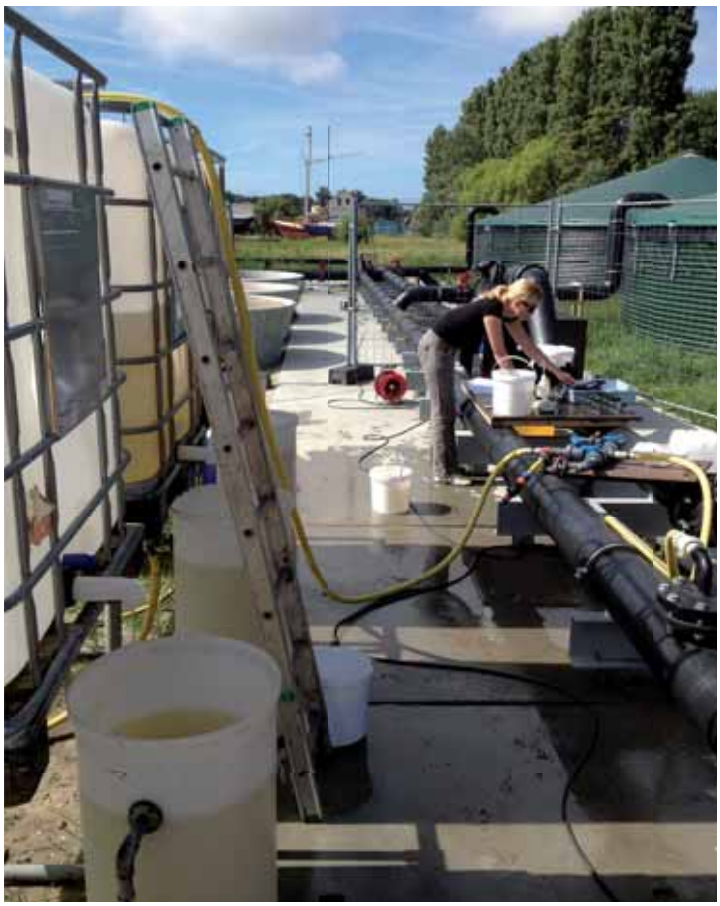
Klaas Kaag, Researcher & Andrea Sneekes, Researcher

The adoption of the BWMC by the IMO in 2004, has boosted the development of BWMS worldwide. During the course of the NSBWO project, numbers increased from 9 BWMS of which 3 were Type Approved in 2008 to 68 BMWS and 26 Type Approved in 2012 (Lloyd's Register 2012). New systems are still being developed. Land-based testing for Type Approval is confined to approximately 20 test locations worldwide. Most of these locations are located in temperate marine areas.

Land-based testing for Type Approval certification aims at fulfilling the minimum requirements stated in IMO guidelines (G8) and also the US Coast Guard ETV protocols. This is difficult enough. In particular, the requirements for minimum organism densities in the water before treatment may pose problems at times. It is, therefore, not surprising that land-based test facilities are concentrated in the most productive coastal areas and that most testing is confined to the productive season, i.e. spring and early summer.

For conditions for which no minimum (or maximum) requirements are specified, conditions that are optimal for the performance of the BMWS under test are accepted. This is not without risk with regards to the intention of the BWMC in reducing the spread of potential invasive species by ballast water, as shipping activities are not restricted to waters with favourable conditions. Recent years have, for instance, seen a boost in Arctic shipping facilitated by the ongoing reduction of sea ice during the summer. Low temperatures inhibit electrochemical chlorine production and also have a clear influence on chemical processes, such as degradation of biocides. The effects on organisms and efficacy of BWMS are yet unknown. Similarly, the performance of UV-based BWMS may be hampered by low UV-transmittance of the water.

IMARES is now addressing these issues. In Den Helder, The Netherlands, a new land-based test facility has been realised. At the test location, very productive fresh water is available that for a large part of the year is characterised by a low UV transmittance. Fresh water with high UV transmittance, as well as brackish and marine water with varying salinities are available locally. The test facility has a 750 m^3 feed tank, enabling the creation of stable test water with the required conditions for the tests. IMARES has ample experience with mass culturing of marine and freshwater organisms throughout the year, which makes it possible to continue land-based testing throughout the winter period. These features enable a manufacturer to gain confidence in the performance of a BWMS under conditions that exceed the requirements for certification.



Sampling at the IMARES Land-based test facility in Den Helder, The Netherlands

IMARES team collecting organisms at Svalbard

IMARES closely co-operates with NIOZ in land-based testing projects. Furthermore, IMARES has initiated a research programme to investigate the sensitivity of organisms at temperatures close to zero. Research is conducted using winter communities cultured at the IMARES mesocosm facility in Den Helder, but also by collecting and testing Arctic species. For these tests, IMARES co-operates with Evonik Industries GmbH and the Department of Fisheries and Oceans, Canada.

www.imares.nl

Quantifying ATP in ballast water: a simple compliance method

Tom Wijers, Student & Cees van Slooten, PhD Student

With the approaching implementation of the BWMC and the corresponding D-2 standard, the demand for a reliable, precise and fast compliance monitoring tool is needed. Because of the low quantities of permitted viable organisms (<10 viable organisms ≥ 10 < 50 µm in size) in the discharge water, the detection limit of such a compliance tool must be able to meet that limit.

During my master internship at NIOZ we evaluated the quantification of adenosine triphosphate (ATP) as a potential ballast water compliance tool. ATP is the universal energy currency present in every living organism, from the smallest bacteria to the biggest mammal. ATP can be quantified with the help of a firefly enzyme called luciferase. Luciferase catalyzes a reaction that emits a certain amount of light depending on the amount of ATP present in the sample. Measuring ATP in a ballast water sample is easy, no lab experience is required and the measurements can be done within 3 minutes. Our results showed that high salinity concentrations in seawater samples greatly inhibited the ATP signal. We applied a novel sample modification method to remove the salts and increase the sensitivity by two orders of magnitude. The method was called: Signal Increase Modification Protocol for Life's Energy (SIMPLE). Using the SIMPLE method to prepare the samples for ATP analysis, we were able to accurately detect 10 cells ml^{-1} of a marine phytoplankton species of 15 µm in diameter. During the G8 verification testing of a UV-based ballast water treatment system at the NIOZ harbor, we observed a 20 times reduction of ATP in the treated tanks compared to the control tanks when using the SIMPLE-ATP method.

It was concluded that the quantification of ATP is a promising compliance tool, provided that the samples are modified according to the SIMPLE-ATP method.

www.nioz.nl/ballastwater-en

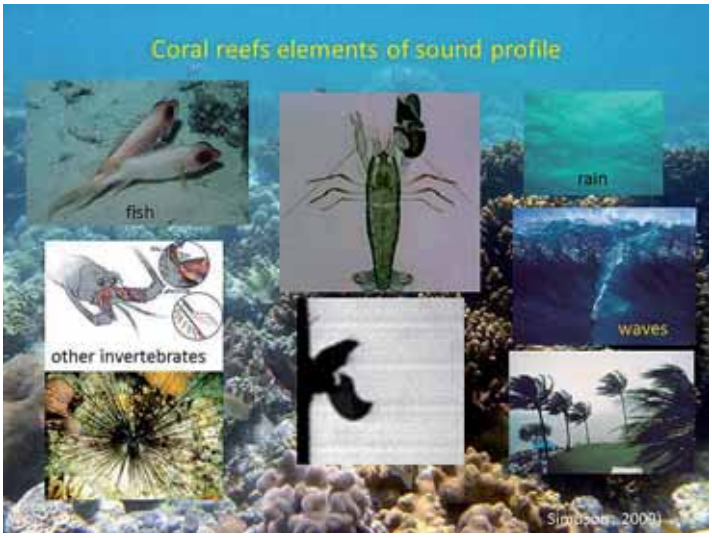
Ballast water treatment by acoustic means – Notes on environmental acceptablity

Cato C. ten Hallers-Tjabbes, Director CaTO Marine Ecosystems, member project group NSBWO project

Recently, acoustic means were introduced for ballast water treatment. So far supersonic sound is used, but that may change. A past fouling prevention strategy used sound within the human auditory range. Anthropogenic sound is input of energy into the aquatic environment.

The overarching UN Convention of the Law of the Sea (UNCLOS) recognises pollution of the marine environment as the introduction by man, directly or indirectly, of substances or energy into the marine environment. Energy from anthropogenic sources such as BW treatment can lead to adverse effects, which would be contrary to Article 2 of BWMC (2004). There are many examples of marine life affected by human-generated under-water noise, and not only for cetaceans. Juvenile coral reef fish grow up in open sea away from the reef. For migrating back they orient towards the specific sound profile of the parent reef. A human sound source between reef and juveniles can greatly hamper homing.

Ballast water treatment that uses physical instead of chemical means should be evaluated for environmental acceptability according to the BWM Guidelines for type approval (G8), as are other forms of ballast water treatment by physical means. Although treatment by acoustic means is new, embarking on the route to demonstrate environmental acceptability can draw on a well-documented field. The adverse impact of anthropogenic under-water sound has consistently been exemplified, albeit to a lesser extent than that of anthropogenic substances. Vital behaviours and life strategies in almost all groups of aquatic animals can be affected, with potentially long-lasting effects. Many aquatic animals orient by supersonic acoustic stimuli, including some fish. Not only is sound crucial in a world where vision is often limited; sound also travels fast in water (about six times faster than in air), and it behaves in a complex way due to boundary layers and hydrodynamics.



The IMO “Same Location” concept

Stephan Gollasch, Independent Consultant & Matej David, Professor at University of Ljubljana

Under certain and presumably rare circumstances vessels do not need to meet ballast water management requirements as stated in the BWMC. This refers to Regulation A-3 Exceptions and Regulation A-4 Exemptions. Exemptions are possible in cases when a risk assessment (RA), prepared according to the IMO G7 Guidelines, results in an acceptably low risk introducing species between the ports considered. These exemptions may be granted for up to five years, but can be withdrawn if the risk level becomes unacceptable during this period. In other cases, termed exceptions in the BWMC, no ballast water management is required when (1) ballast water uptake or discharge is needed to ensure the safety of a ship in emergency situations, (2) accidental discharge results from damage to a ship or its equipment, (3) uptake or discharge of ballast water is used to avoid or minimize pollution incidents, (4) uptake and discharge of the same ballast water is conducted on the high seas, or (5) uptake and discharge occurs at the same location, provided no mixing occurs with ballast water from other locations. The high seas and same location exceptions may apply permanently if this is a regular vessel operation. Should a risk assessment based exemption be granted, or a permanent exception applies, no BWTS needs to be installed on the vessel, thereby avoiding capital and operational costs as well as burdens associated with certification and inspections.

However, the BWMC does not define what a “same location” is. Thus, the concept is subject to different interpretations depending on the interpreters` approach, which may be based on one or a combination of the following: environmental parameters, hydrological regimes, biological meaningful parameters, or political aspects. The shipping industry would benefit from a larger same location, as it avoids ballast water management requirements on voyages inside each such location. In contrast, and to maximize environmental protection, a same location should be as small as possible. As a result, the same location may be of different dimensions, such as a mooring, port basin, port, anchorage, part of a sea, or even an entire sea with numerous ports. These different interpretations cause difficulties for a uniform implementation of the BWMC.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The same location concept was originally included in the BWMC to address the rare cases where vessels, in their normal operation, load and discharge ballast water in the same location. We believe that the proper interpretation of the same location is exactly the same harbor, mooring, or anchorage where the ballast water was taken up, because otherwise IMO would have prepared a guidance document to identify a same location. However, the lack of clarity on this matter may be a critically important but yet overlooked point in the BWMC. It should be avoided that this becomes an open field with different interpretations so that extensive areas also may be defined as same locations, where ballast water would be moved without any management requirements.

The identification of a same location is not an easy task because this should be port specific and each port has its unique situation regarding the number of port basins, its extension over different salinity regimes, and ports may well have different ballast water operation profiles. It gets even more difficult when the same location needs to be explained in a biologically meaningful way by addressing aquatic species introductions. To biologically identify the same location the species diversity and their abundance may be considered. This assessment should include indicator microbes and human pathogens as listed in the IMO D-2 Standard. Should all species, including indicator microbes and human pathogens, be identical and their abundance is very similar, this area could be considered as the same location and in such a case vessels discharging ballast water which originates from this same location may be excepted from ballast water management requirements.

Should the same location concept be applied we recommended to establish a monitoring programme on aquatic species because, should a new species occur in the ballast water uptake area which is not found in the ballast water discharge area, this cannot be considered as the same location any longer.

Considering the diversity of ships’ ballast operations and ports, as well as possible differences in environmental conditions and species composition among port terminals or basins, we recommend that an entire smaller port, possibly also including the anchorage, may be considered as same location. For larger ports with a gradient of environmental conditions, the same location should mean a terminal or a port basin. We also recommend that IMO considers the preparation of a guidance document to include concepts, criteria and processes how to identify a same location, whose limits should be clearly identified. Larger areas should not be identified as same location as this would seriously undermine the purpose of the BWMC, as unmanaged ballast water would continue to be transferred in this area.

For further reading we recommend:

Gollasch, S., and M. David. 2012. A unique aspect of ballast water management requirements—the same location concept. Marine Pollution Bulletin 64: 1774–1775

David, M., Gollasch, S., and M. Pavliha 2013. Global ballast water management and the “same location” concept: a clear term or a clear issue? Ecological Applications 23(2): 331–338

www.gollaschconsulting.de
www.researchgate.net/profile/Matej_David/

Discrimination of closely related species of microorganisms in ballast water by mass spectrometry

Kaveh Emami & Ehsan Mesbahi & Hossein Enshaei, Newcastle University

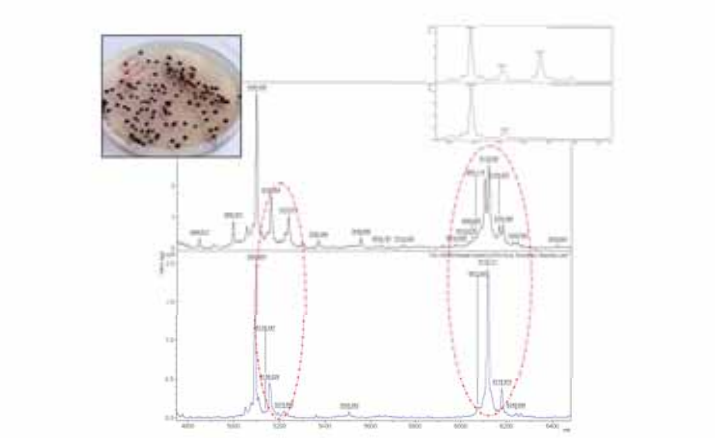


Figure 2. MALDI-TOF mass spectra of Pseudoalteromonas aurantia (top) and P. citrea (bottom) show discriminative differences between the two, whereas 16SrRNA gene sequences of these two species are quite similar.

If microorganisms are transported with ships' ballast water to a new destination, they may be released into a new environment to which they do not naturally belong. If they spread successfully there, they can be considered as invasive species. Therefore ballast water can accidentally introduce harmful or unwanted species, including microalgae, into new environments. In order to monitor trafficking of microorganisms via ballast water, it is important to identify and characterise them thoroughly. Matrix-assisted laser desorption/ionisation-Time of Flight Mass Spectrometry (MALDI-TOF MS) is a strong tool for identification of microorganisms (Figure 1).

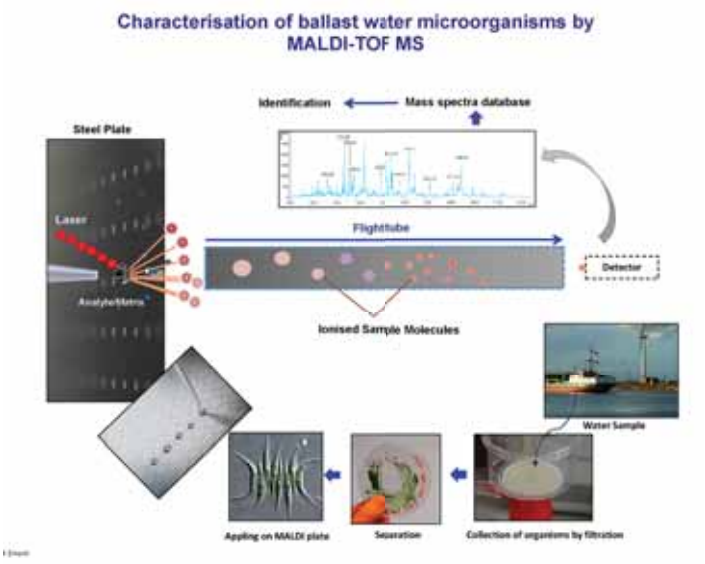


Figure 1. Graphic representation of MTB of ballast water microorganisms.

MALDI-TOF Bio-typing (MTB) of microorganisms started in 1975. Thereafter, the method was rapidly expanded to clinical and environmental bacterial species. The method also has the potential to separate harmful and harmless species from each other. In order to monitor the presence of different species in ballast water, we are constructing MALDI-TOF mass spectral databases for marine species. The significance of this method is more pronounced when other common methods such as 16 or 18S rRNA gene sequence analyses are not sufficient for the discrimination of closely related species (Figures 2 & 3). The genes coding for 16 or18S ribosomal RNA genes are referred to as16 or 18S rDNA. Currently, comparison of these genes is a common method for phylogenetic studies of organisms. In addition, compared to rDNA analysis, MTB is simpler and more cost effective.

In many cases interspecific rDNA similarity of these organisms is very high. Some species for example show rDNA identity of 99%. Over the course of the INTERREG project we established MALDI-TOF mass spectral databases for species of *Pseudoalteromonas* (Bacteria) and *Dunaliella* (microalga). This will assist with rapid and reliable identification of members of these genera.

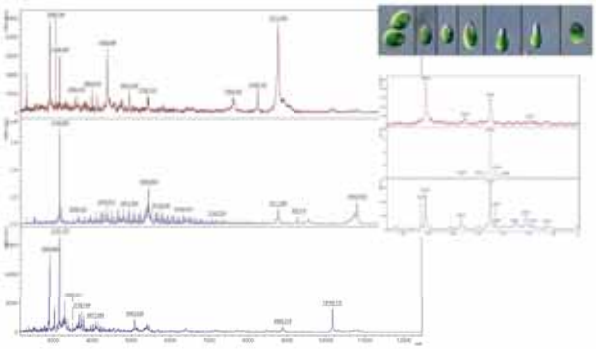


Figure 3. *MALDI-TOF mass spectra of three different strains of microalga with similar 18s rRNA gene sequences. In this case mass spectra are more discriminative than the rDNA sequence.*

www.ncl.ac.uk/marine

Implementation of the Ballast Water Management Convention

Benoit Loicq, Director Maritime Safety and Environment

The European Community Shipowners Associations (ECSA) recently reported that the concerns among Flag States and the shipping industry regarding the implementation of the BWMC eventually led to a positive outcome in the IMO in May 2013.

Notably, the implementation of the BWMC (not yet in force) will be staged over five years following the entry into force date by aligning the requirement with a ships renewal survey for the ship's IOPP certification (International Oil Pollution Prevention Certificate). In addition, concerning ballast water sampling and analysis, the IMO agreed on a 2-3 year trial period with the agreement that any non-compliance found by Port State Control alone will not result in criminalization nor detention of a ship. However, the non-mandatory application of a robust type approval process for ballast water management treatment systems (BWMTS) does not offer satisfactory certainty to ship owners purchasing such treatment systems. Confidence in BWMTS approval process is essential.

In order to avoid the introduction of invasive alien species in EU seas before the entry into force of the BWMC, vessels are requested to exchange ballast water in the high ocean. With this purpose, HELCOM-OSPAR-REMPEC have produced some general guidances on the Voluntary Interim Application of the Ballast Water Exchange Standard by vessels operating between the Mediterranean Sea and the North-East Atlantic and/or the Baltic Sea.

With regard to the possible granting of exemptions, ECSA welcomes the HELCOM/OSPAR guidelines including a proposal for a regionally harmonised framework for applying and granting exemptions from Ballast Water Management in the Baltic and OSPAR regions.

ECSA is of the opinion that the OSPAR/HELCOM initiative adopted a very pragmatic approach facilitating the granting of exemptions when justified. However, the overall process is complex, in particular regarding the decision-making procedures on granting exemption, time of validity of the exemption certificate and the opportunity of cost/data sharing - which may limit or deter ship owners from getting exemption.

Whilst full transposition of the BWMC into EU law may be expected in the foreseeable future, the European Commission is finalising a dedicated legislative instrument seeking to prevent the entry, establishment and spreading of invasive alien species in the EU.

www.ecsa.eu

"Evonik BWT System" – The BW treatment solution for bulkers and tankers

Jürgen Meier, Director BW Project & Stefan Leininger, Business Director Active Oxygens EMEA

PERACLEAN® Ocean, the biodegradable biocide developed and produced by Evonik for disinfection of ballast water, is known in the industry for its high biological efficacy in all types of aquatic environments. Although the biocide degrades naturally over time, in very cold water additional neutralization of the active substances may be necessary before the treated BW can be safely discharged.

Therefore, Evonik developed a neutralization technology for PERACLEAN® Ocean based BWMS (MEPC 61/Inf.16). This technology was verified in land-based tests at NIOZ as part of the NSBWO project. It was proven that the effectiveness of the neutralization of the active substances is more than sufficient even in very cold fresh water.

The "Evonik Ballast Water Treatment System" ("Evonik BWTS") consists of a two-step treatment during uptake of the ballast water - a 40 µm automatic self-cleaning filter unit and a subsequent disinfection with PERACLEAN® Ocean in combination with a catalase based neutralization of hydrogen peroxide. During de-ballasting, sodium sulphite can be injected into the ballast water to neutralize residual peracetic acid if necessary.

Besides other reasons, the system's low energy demand, its highly effective biocide in any aquatic environment and its simplicity of operation, makes the "Evonik BWTS" especially well-suited for large bulk carriers and tankers. Evonik is in the process of applying for Final Approval at the upcoming MEPC 66 which would allow the system to be launched on the market in 2014. Marketing, installation and after-sales services of the "Evonik BWTS" are planned to be provided in partnership with a company that has an established global

business in the shipping industry.

Evonik is one of the world`s largest producers of hydrogen peroxide and peracetic acid and the innovative leader in high quality products and services, offering more than a century of worldwide experience to its customers.

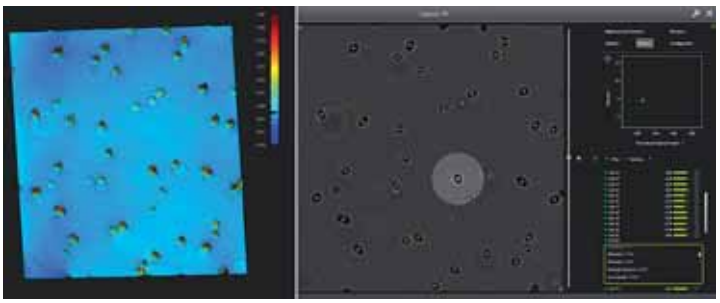
http://corporate.evonik.com

Blending flow analysis with microscopy – the 'oLine system' for ballast water monitoring

Joël Henneghien, Business Development Manager

Over the last three years Ovizio, a spin-off company of the "Université Libre de Bruxelles" (ULB) has been developing its technology and refining its approaches to contribute to the detection of ballast water organisms for monitoring and compliance control. This has been done in collaboration with the Laboratory for Analytical and Environmental Chemistry of the "Vrije Universiteit Brussel" (VUB). As the ballast water community's understanding of what will be required for the real analysis and monitoring of ballast waters has been growing over these past years, Ovizio has been adapting its so-called 'oLine' platform. The system – a digital holographic microscope – now aims to analyse organisms in the 10-50 µm range and is a robust blend between flow analysis and microscopy. Entire volumes of flow cells may be analysed with its ability of post-acquisition refocusing, and at the same time images of the sample and its inherent organisms and particles are captured. Current developments at Ovizio involve the production of a fluorescence module, which will combine digital holography with fluorescence. Given the problematic live-dead determination of phytoplankton and zooplankton organisms, adding this functionality will enable the application of currently recognised live-dead stains and thus enforce the oLine methodology for the future.

www.ovizio.com



Algal cells in a flow cell are imaged with Ovizio's oLine system. The digital holographic microscope lets us capture not only light intensity information but also phase information (optical density information) as shown on the left, which can later be used for cell classification purposes. The cells are enumerated with Ovizio's software "OsOne" providing total cell number counts but also characteristics for each individual cell (right).

The KBAL® approach to ballast water treatment (and monitoring)

Ingunn Alne Hoell, BallastFlow Project Coordinator & Sandra Schöttner, Post-doctoral Researcher

The international quest for cost-effective, user-optimized and environmentally friendly BWMS is still ongoing, challenging industrial, scientific and political stakeholders alike. One of the recent additions to the BWMS market is KBAL, a treatment system designed by Knutsen Shipping OAS in Norway.

Based on KVOC®, Knutsen's volatile organic compounds technology, KBAL combines the effects of depressurization and UV-radiation. While the harsh pressure-to-vacuum drop eliminates the majority of organisms, primarily those within the larger size range of >50 µm, the concomitant UV-treatment inactivates the remaining cells, including bacteria.

Advantages of KBAL include easy installation and maintenance, flexible yet fully automated operation during ballasting, voyage (recirculation) and de-ballasting, absence of filters or active substances, environmental friendliness, as well as reduced capital and operational expenditure due to optimized energy consumption. It can be used in a single- or multi-system setup on all types of ships with tank capacities of up to 3000 m^3/h, provided a >13 m-drop height is available.

After successful completion of both land-based and ship-board testing in 2010 and 2011, indicating excellent treatment efficiency according to the IMO D2 standard, KBAL was type-approved by DNV in November 2012 and is now available for installation. Directly linked to the optimization of KBAL is BallastFlow, an innovation-targeted research project aiming at the development of a standardized real-time method for ballast water monitoring.

BallastFlow research involves both UV-radiation experiments and KBAL treatment tests, and focuses on the flow cytometric analysis of phytoplanktonic and bacterial cells with viability and diversity markers. Respective live/dead-staining studies with *Tetraselmis suecica*, the test organism for the ≥10-50 µm group, clearly indicate a positive correlation between UV-radiation intensity and cell viability, with specific UV-doses causing either delayed or immediate lethal effects. Also bacteria, for which both FISH and antibody-staining protocols are tested, appear to be affected by UV-radiation intensity and, especially, post-treatment storage time.

www.ballastflow.com

B-box: world-wide ballast water compliance measurements at NIOZ

Louis Peperzak, Project Leader Ballast Water Research & Eva Immler, B-box Coordinator

A BWTS is a big investment. Once it is installed on-board of a ship, a concern for ship owners is its proper functioning under varying 'real-world' conditions. Type Approved BWTS have of course been tested in a land-based facility and on-board of a ship but there is no guarantee that they will function correctly all over the world.

Sailors aren't biologists and they already have many tasks at hand. One way to check a BWTS is by using a simple compliance tool that provides a rough positive or negative judgement on discharged water quality. Such simple tools could be used by sailors and port state control alike. An alternative new service which provides more detailed information, called B-box is provided by NIOZ.

The B-box is a specially designed "ballast water sampling box" containing sample bottles with reagents that is sent to a ship. After simply filling the bottles with discharge water the B-box is shipped from the harbour to NIOZ by air-courier. NIOZ then performs a suite of laboratory analyses that will reveal if the BWTS functioned properly. Eventually, anonymous data from all over the world will be collected and analysed to examine how BWTSs function under varying conditions in the real world.

www.ballastwaterbox.nl

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The Interreg IVB North Sea Region Programme

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