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Arctic shipping and the performance of ballast water management systems

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Introduction

Global warming has resulted in a dramatic decrease of sea ice during the Arctic summer, thereby facilitating commercial shipping and offshore activities in hitherto pristine areas. IMARES Wageningen UR has initiated a research programme to study effects of shipping activities in the Arctic. Very little is known about the sensitivity of these areas to the introduction of non-indigenous species (NIS). Climate warming and biological invasions may have synergistic negative effects that threaten the delicate Arctic ecosystems, as well as the livelihoods of those communities that rely upon the natural resources of the Arctic.

This poster presents results of studies exploring limitations of the use of the current ballast water management systems (BWMS) in the Arctic. BWMS are typically evaluated for Type Approval purposes at land-based test facilities, located in the temperate climate zone where during spring and summer organism densities in the water are high enough to meet IMO requirements (G8). It is known that temperature may have a profound effect on the performance of some of the techniques applied in BWMS and that organisms' sensitivity to, as well as stability of active substances used, is temperature dependent. Hardly anything is available on how these interact and what the consequences are for the performance of BWMS in the Arctic.

Review of Ballast Water treatment techniques

A literature search was performed using public publications on the Internet and databases of peer-reviewed literature for information about the most commonly used ballast water treatment techniques.

Increasing shipping activity results in more transport of NIS via ballast water exchange, hull fouling etc.

The process of each technique was described along with advantages and disadvantages when known, with a focus on the possible environmental impacts. The techniques were separated into three treatments types; mechanical systems, physical disinfection and chemical treatments. In practice, complete BMWS in general involve a combination of two or more of these techniques.

Overview of techniques used in the currently known BWMS (Loyds Register, 2012).

Mechanical treatments	No. BWMS	Physical treatments	No. BWMS	Chemical treatments	No. BWMS
Filtration	45	UV	21	Electro-chlorination	22
Hydro-cyclones	1	Cavitation	8	Ozone	6
None	12	Ultrasonic	4	Chlorine based	3
Not clear	10	De-oxygenation	5	Other chemicals	7
		Heating	1		
		Coagulation	1		

Potential risks identified for ballast water treatment in the Arctic:

- Loss in flexibility of filters
- Ice blocking filters/hydro-cyclones
- Low pressure UV sensitive for temperature changes
- De-oxygenation less effective
- Electro-chlorination temperature depended
- Chemical reactions slower
- Arctic organism sensitivity unknown

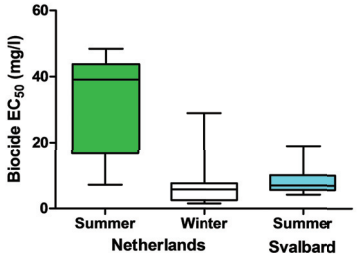

Figure 1 Relative sensitivity of marine organisms (different trophic levels) for a ballast water biocide under different conditions.

New invasive species?

Testing

Laboratory testing were performed using standard test organisms and local (Dutch and Svalbard) organisms. Sensitivity of these organisms for a relevant ballast water biocide were tested. Organism communities 10-50 and >50 µm were tested separately, but are presented together. The biocide tested seems to be more effective at lower temperatures.

Value of this project for industry and policy makers

The results of the project are directly relevant for the shipping industry providing information on the effectiveness of biocides in BWMS in the Arctic region.

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Disappearing glacier on Svalbard, Arctica.

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