Project no: **TST5-CT-2006-031529**
Project acronym: **BAWAPLA**
Project title: Sustainable Ballast Water Management Plant

SPECIFIC TARGETED PROJECT

REPORT

PUBLISHABLE SUMMARY

Project period: 15.11.2006 - 14.05.2010
Submission date: 14.08.2010
Start date of the project: 15th November 2006
Duration: 42 months

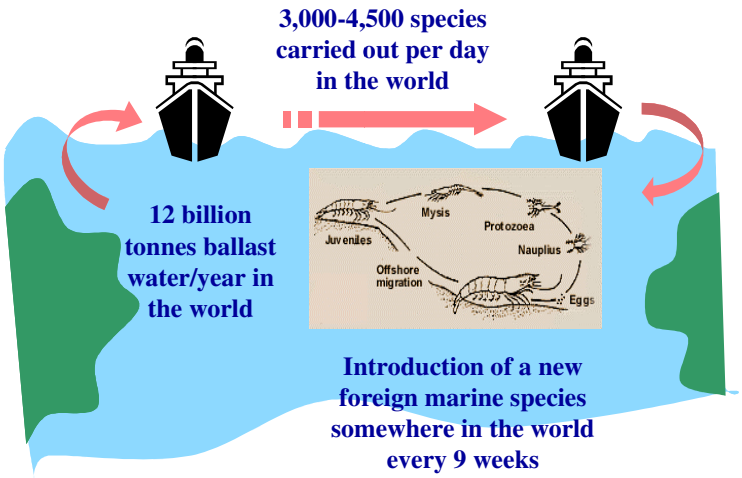
PROJECT COORDINATOR NAME: **ERIK KÖSTER**
PROJECT COODINATOR: Verein zur Förderung des Technologietransfers an der Hochschule Bremerhaven e.V. (ttz Bremerhaven)

Revision: [08-10]

PUBLISHABLE SUMMARY

Maritime transport is of fundamental importance to Europe and the rest of the world. More than 90% of the European Union's external trade goes by sea and more than 1 billion tonnes of freight a year are loaded and unloaded in EU ports [EMSA]. This makes shipping the most important mode of transport in terms of volume and - as a result of its geography, its history and the effects of globalisation - maritime transport will continue to be the most important transport mode in developing EU trade in the foreseeable future.

Transfer of species in ballast water started as early as shipping trade. The movement of some **3 to 12 billion tonnes of ballast water** in ships internationally each year has been responsible for the settlement of about 100 million tons of sediments [1]. Its cleaning and the disposal of the ballast sludge produced involve enormous costs, (approximately 30.000 € for a small bulk carrier), as well as job hazards and time. Furthermore, as the sediment cannot be removed, the freight capacity of the ship decreases with time and stability problems arise.



In addition to these economic aspects, ballast water has been recognised as a major vector for the **translocation of aquatic species** across biogeographical boundaries. It is estimated that as **many as 10,000 alien species** of plants and animals are transported *per day* in ships around the world [2]. As ships travel faster and world trade grows, organisms are better able to survive the journey - using the settled sediments as a substrate - and the threat of invasive species from ballast water increases. It is due to this fact that a reduction of sediment settlement in ballast tanks, could significantly reduce the danger of alien organisms can be expected.

[1] IMO Resolution A.868(20), "Guidelines for the Control and Management of Ship's Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens"

[2] Cohen, "Ship's ballast water and the Introduction of Exotic organisms in to the San Francisco Estuary- Current Status of the Problem and Options for management", California Urban Water Agencies, October 1998.

The Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) adopted guidelines for ballast water exchange. At its 53rd session in July 2005, IMO's Marine environment Protection Committee (MEPC) adopted Guidelines for uniform implementation of the *International Convention for the Control and Management of Ships' Ballast Water and Sediments (BMW Convention)*. The guidelines adopted cover ballast water management equivalent compliance; approval of ballast water management systems; development of ballast water management plans; ballast water exchange and the procedure for approval of ballast water management systems making use of Active Substances.
The *BMW Convention* will require all ships (new and existing) to implement a Ballast Water and Sediments Management Plan, to carry a Ballast Water Record Book and to lift Ballast Water Management Procedures to a given standard.

Various ballast water treatment options have been considered in the last 10 to 15 years, including biological, chemical, physical and mechanical treatment techniques or a variation thereof. However, it is generally agreed that a single treatment methodology would not be sufficient to achieve IMO standards for all sea waters and all ship types. Meanwhile, various projects dealing with ballast water treatment were initiated and different treatment systems have been developed and tested in one way or another; a single treatment system which is able to comply with IMO guidelines is however still being investigated for.

Chemical solutions for treatment of BW may consist of ozone, chlorine, hydrogen peroxide, free oxygen and other disinfectants. By producing these active substances using Electro Chemical cells which use sea-water as their operation media, will remove the space, hazard and cost associated with such chemicals onboard vessels.

The **aim** of the „*BaWaPla*“ project was the implementation of an **innovative hybrid ballast water (BW) treatment** system, utilising some known BW treatment technologies such as **UV** and **filters** in addition to an innovative sea-water based electrolysis (**Electro Chemical** or El-Chem). Each individual treatment system would contribute to a particular biological target set out at IMO and MEPC and will form a completely self-controlled/automated ships' BW treatment system.
To achieve the objectives of the BaWaPla project, expertises and resources of the partners were matched with the work to be carried out. The work was divided into seven workpackages (WP) with the objectives described below:

WP No.	WP name	Objectives
WP1:	Technological and regulatory review	Definition of requirements of the BaWaPla prototype technology and functionality
WP2:	Electro-chemical technology	Survey, design, model, simulate and complete overall biological assessment of El-Chem technology at laboratory/small scale.
WP3	Development of full-scale BaWaPla system	Design, assemble and installation of a large/full-scale BaWaPla treatment system and optimise the system with the help of intensive field test
WP4	Automation and integration of BaWaPla system	Design, simulation, development and assembly of a control and monitoring system which is capable of integrating with existing selected ship's automation and control facilities.
WP5	BaWaPla ship installation requirements and land base tests	Requirements and case studies for Installation of the BaWaPla onboard a ship and full-scale land base trials
WP6	Dissemination and exploitation	Dissemination and exploitation activities and results as well as create awareness among the shipbuilding industry
WP7	Project Management	Control the projects objectives, achievements, assimilation of knowledge by the partners, milestones, deliverables etc.

Table 1: Description of the seven workpackages

The BaWaPla project will help the EU to fulfil Article 6 of the Convention, which requests the parties to endeavour, individually or jointly, to (a) promote and facilitate scientific and technical research on ballast water management, and (b) monitor the effects of ballast water management in waters under the parties' jurisdiction.

The broad area of research for an optimised electrochemical treatment stage comprised:

- Construction of electrochemical generator running on sea water, without by-products
- Investigations of half-life with respect to harm free discharge and re-growth
- Examination of effects on materials and risk of corrosion
- Parameter identification for system's control and monitoring purposes

The main objectives of this project for the marine sector were:

- To provide a safe, economically viable, and technically competitive alternative for onboard ballast water management
- To develop an optimised seawater based electrochemical treatment system
- Reduction of ballast tank cleaning costs
- Reduction of sludge disposal costs
- Adaptation of BW treatment system to a specific ship and her mission profile

The main environmental objectives of the project were:

- To develop an efficient ballast water treatment system which allows the reduction of non-indigenous marine species transfer according to IMO convention and guidelines
- To develop an environmentally acceptable and cost-effective treatment system.
- To develop an automatic control/monitoring system which provides an unattended operation

In the first stage of the project an extensive survey on the latest developments for Ballast Water treatment system design, as well as the existing regulations and future indication of EU directives and international bodies such as IMO has been carried out. Other relevant and crucial issues like the system's conformity to risk and safety regulations, cost effectiveness and compatibility with the ship's mission profile, size and design requirements have been identified and clearly quantified. A hybrid approach with particular attention to electro-chemical treatment techniques and their complementary role with other chemical or mechanical treatment systems have been performed. Finally, an objective rationale for overall assessment and evaluation of Ballast Water treatment systems has been reported. The single treatment systems were intensively tested and optimised in lab scale before combined tests were carried out.

The optimised BaWaPla system was finally scaled-up to a full/large-scale plant and intensive land-base tests at different locations were carried out.

Initially the BaWaPla treatment system considered three technologies in series to provide the required treatment level of ballast water. Based on the project knowledge gained and the improvements in the secondary treatment systems the course of the project – *one hybrid treatment system* - was turned into **two** viable treatment systems:

1. **Filter + UV**
2. **Filter + Electrochlorination**

Last but not least it is worth mentioning that both tested BaWaPla systems fully met the IMO Ballast water performance standard D2.

The **BaWaPla** consortium consists of partners from research and development sector with outstanding expertise in maritime technology and naval engineering, marine biology and chemistry, mechanical and process engineering, professional education in knowledge and information management and technical communication and partners from marine industry. This multidisciplinary team collaborated in several working groups on technical and scientific and marketing levels. This multidisciplinary approach ensured an optimum performance and effective communication between partners and finally it resulted in the development of two new hybrid treatment systems as well as invaluable contribution to the enforceability of new guidelines put forward by IMO.

List of Participants:

Participant Role*	Participant No	Participant Name		Participant short name	Country
CO	1	Verein zur Förderung des Technologietransfers an der Hochschule Bremerhaven e.V.	ttz Bremerhaven	**ttz**	D
CR	2	University of Newcastle upon Tyne	UNIVERSITY OF NEWCASTLE UPON TYNE	**UNEW**	GB
CR	3	Centro Internacional de Investigación de los Recursos Costeros		**CIIRC**	E
CR	4	Istanbul Technical University		**ITU**	TR
CR	5	Bureau Veritas	BUREAU VERITAS	**BV**	F
CR	6	The Ballast Safe Filtration company	BallastSafe Filtration Company	**BSFc**	IL
CR	7	LVPG International GmbH	lvpg focus on fluids	**LVPG**	D
CR	9+	BALance Technology Consulting GmbH	BALance Technology Consulting	**BALance**	D
CR	10	Atg UV Technology	atg UV Technology	**atg**	GB
CR	11	LISNAVE Estaleiros Navais SA	LISNAVE ESTALEIROS NAVAIS, S.A.	**LISNAVE**	P
CR	12	Business Corlett - Three Quays Ltd.		**BCTQ**	GB

*CO = Coordinator; CR = Contractor; + Partner 8: *Optimarin* from Norway left the project on 11-15-2008

Table 2: List of all Bawapla consortium members