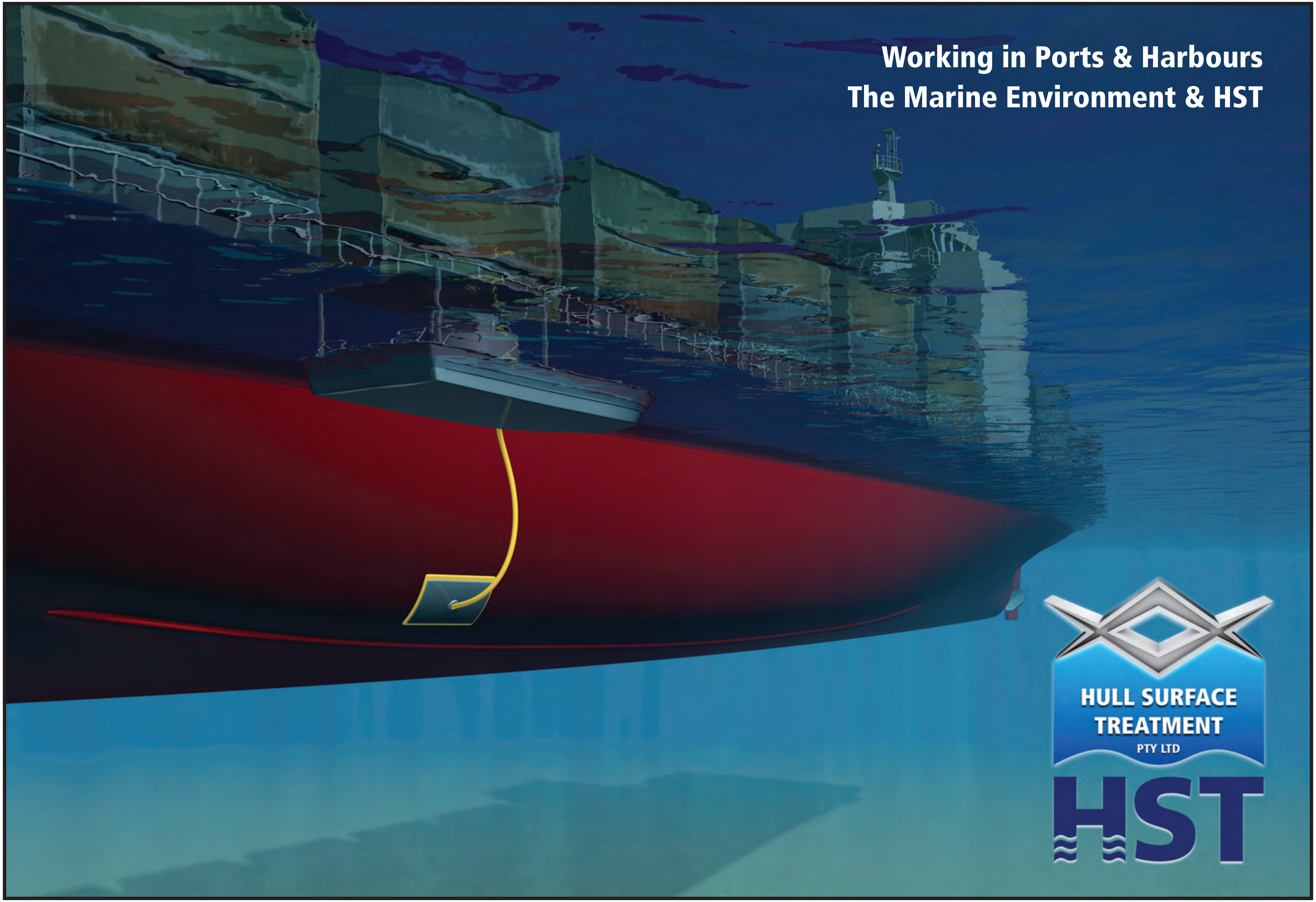
Working in Ports & Harbours
The Marine Environment & HST



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Working in Ports & Harbours
The Marine Environment & HST

HULL SURFACE TREATMENT
HST

1st

WINNER Future World Eco Innovation In Business
WINNER Best New Product - Australian Business Awards
WINNER Innovation - Australian Business Awards
WINNER Best Eco Friendly Product - Australian Business Awards
WINNER Innovation - Intergral Energy Business Awards

2008

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"It is the Simplicity that lies beyond the Complexity"

In support of the proposed use of Hull Surface Treatment (HST) technology within Australian Ports and Harbours the following research, legislation and determinations are relied upon:

Ships travel faster through water, consume less fuel and emit lower Green House Gases when their hulls are clean and smooth – free from fouling organisms, such as slime, algae, weed and/or molluscs. This in turn ensures that hull fouling on commercial shipping is eliminated as a vector for the introduction of Imported Marine Pests (IMPS).

In the early days of sailing ships, lime and later arsenical and mercurial compounds and pesticides were used to coat ships' hulls to act as anti-fouling systems. During the 1960's the chemicals industry developed efficacious and cost-effective anti-fouling paints using metallic compounds, in particular the organotin compound tributylin (TBT). By the 1970's, most seagoing vessels had TBT painted on their hulls.

However, it soon became clear there was a price to pay for the efficient anti-fouling paints containing TBT. Environmental studies provided evidence that organotin compounds persist in the water and in sediments, killing sea-life other than that attached to the hulls of ships and possibly entering the food chain. Specifically, TBT was shown to cause shell deformations in oysters; sex changes in whelks; and immune response, neurotoxic and genetic affects in other marine species.

In the 1970's – 1980's, high concentrations of TBT in shellfish on the coast of France caused the collapse of commercial shellfisheries in at least one area, and this prompted many States to act and enforce some restrictions on the use of TBT in anti-fouling paints.
In 1988, the problem was brought to the attention of the Marine Environment Protection Committee (MEPC) of the International Maritime Organisation (IMO), the United Nations Agency concerned with the safety of shipping and the prevention of marine pollution.

As a result, IMO in 1990 adopted a resolution recommending governments to adopt measures to eliminate anti-fouling paints containing TBT. In the 1990's, the MEPC continued to review the environmental issues surrounding anti-fouling systems, and in November 1999, IMO adopted an Assembly resolution that called on the MEPC to develop an instrument, legally binding throughout the world, to address the harmful effects of anti-fouling systems used on ships. The resolution called for a global prohibition on the application or organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition by 1 January 2008.

It has taken 20 years to establish an international response to harmful anti-fouling paint systems. It is clear from all available information that a technology similar to Hull Surface Treatment (HST) was never contemplated when the current legislation was introduced around the world. Albeit there are numerous references to the urgent need for an effective, environmentally safe anti-fouling process.

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In October 2001, IMO adopted a new **International Convention on the Control of Harmful Anti-fouling Systems on ships**, which prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.

Resolution A.895(21) adopted on 25 November, 1999
Anti-Fouling Systems Used On Ships

The IMO 21st Assembly on 25 November 1999 said among other things that...

"RECOGNIZING the need to continue to develop anti-fouling systems which are effective and environmentally safe,

HAVING CONSIDERED the recommendations made by the Marine Environment Protection committee at its forty-second session

At Resolution 3..."URGES ALSO Member Governments to encourage industries to continue to develop, test and use as a high priority anti-fouling systems which do not adversely impact on non-target species and otherwise degrade the marine environment".

In his 2007 address to the International Maritime Organisation, the Secretary-General Mr. Efthimios E. Mitropoulos delivered a paper entitled "Shipping's Environmental Credentials". He said, "My concerns in the area of the International Convention on the Control of Harmful Anti-fouling Systems on ships are three fold: **first**, that, by not bringing the instruments mentioned above and other relevant ones into force at a reasonable time after their adoption, their implementation is delayed, thereby depriving the environment of their beneficial effects; **second**, that any further delay in tackling the issues regulated by these instruments may motivate individual countries or groups of countries to develop unilateral or regional measures, with all the attendant negative repercussions such action entail; and, **third**, that any prolongation of the situation may lead to ambiguities, which, in the final analysis may count against seafarers, the maritime industry and the environment.

In the world of global business today, it is not unusual to find major commercial concerns freely embracing the notion that good environmental and social stewardship actually make good business sense. Companies are learning the value of their own environmental credentials as their markets and their customers become increasingly sensitized to environmental issues. Shipping is no different from any other industry in that, both collectively and individually, shipowners and operators need to protect their brand image.

However, there is an inherent quandary in the fact that, on the one hand, everybody, it seems, wants more for less – while, on the other, society's concerns about safety and the protection of the environment continue to grow. Of course, shipping needs to do whatever it can to solve this apparent conundrum; but, in the long term, society will need to address its own priorities and

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understand that nothing comes for nothing.

Shipping has to ensure that its activities are sustainable, which, in this context, is normally understood to mean that any negative impact an activity may have on the environment must be reduced to the point where it is clearly outweighed by the positive benefits that the activity brings. However, I believe we are rapidly approaching the time when we should move beyond this and understand that caring for our environment must become out top priority, even though that may come with an economic price.

One of the greatest challenges faced by anyone involved in environmental work is how to overcome the feeling that, because of the sheer scale of the problems to be addressed, individual efforts appear minuscule by comparison with the daunting tasks ahead. At such times, it is always helpful to remember that the efforts of each and everyone contribute to a bigger picture and that there are very capable, clear-sighted people and organisations that not only have a view of it all, but are also getting to grips with it."

Commercial Diving Services Pty Ltd has risen to the challenge in their development of Hull Surface Treatment (HST) technology.

APEC Marine Resource Conservation Working Group (November, 2001) in developing a Regional Risk Management framework for APEC economies for use in the Control and Prevention of Introduced Marine Pests.

The Australian Consultancy Group consisted of:

- Dr. Nic Bax, CSIRO Centre for Research on Introduced marine Pests (CRIMP).
- Dr. Keith Hayes CSIRO Centre for Research on Introduced Marine Pests (CRIMP)
- Dr. Marcus Haward Institute of Antarctic and Southern Oceans Studies (IASOS), University of Tasmania.
- Dr. Chad Hewitt CSIRO Centre for Research on Introduced Marine Pests (CRIMP).
- Dr. Alice Morris CSIRO Centre for Research on Introduced Marine Pests (CRIMP).
- Dr. Ron Thresher CSIRO Centre for Research on Introduced Marine Pests (CRIMP)
- Angela Williamson CSIRO Centre for Research on Introduced Marine Pests (CRIMP).

Responses which should be considered...The Rio Declaration notes that 'where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation'.

APEC economies ranked commercial shipping as the most important factor affecting the strength of pathways transporting introduced marine pests... Managing the threat of introduced marine species can be done effectively

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through a hierarchical approach similar to that used to manage infectious diseases. There are 6 essential elements to this hierarchy: prevention, detection, quarantine, eradication, control, and mitigation. Ideally managing the threat should occur at the earliest possible time in this hierarchy.

In their final statement they said, "The translocation of marine organisms and micro-organisms beyond their natural environment is a serious and escalating problem in the region, particularly given the environmental, economic, cultural and social impacts of marine pest species and the reliance of many APEC economies on their marine and coastal resources. Once a marine pest is established remediation is often not possible or extremely costly. Given the rapid spread of marine pests, urgent action is essential.

HULL SURFACE TREATMENT (HST) TECHNOLOGY is the long awaited solution to this serious problem, provided it is used in a programmed and pre-emptive maintenance regime eliminating the primary spore, slime and algal growth. A localised thermal sterilisation of primary fouling, effectively eliminating the opportunity for secondary and tertiary fouling to occur. A stitch in time.

In their subsequent PHASE II Consultancy Report in 2005 the Centre for Maritime Policy, University of Wollongong, in collaboration with APEC Economies further considered the management, prevention and control of Introduced Marine Pests in the APEC Region. Throughout the 86 page report the theme remained on tune, i.e. the critical nature of establishing an effective protocol to prevent and/or reduce the incursion of Imported Marine Pests.

Code Of Practice for Antifouling and In-water Hull cleaning and Maintenance

An ANZECC strategy to protect the marine environment. The Maritime Accidents and Pollution Implementation Group consisted of numerous state and federal agencies including:

- Ms Barbara Richardson from NSW Environment Protection Authority.
- Pauline Semple - Queensland Environmental Protection Agency
- Prue Gaffey - Environment Australia
- Paul Nelson – Australian Maritime Safety Authority
- Helge Pedersen – Dept of Land Planning and Environment Northern Territory
- Dr Paul Vogel – department of Environmental planning Western Australia
- Ian Kirkegaard – Department of Environment South Australia
- Phillip Johnstone – Victorian environment Protection Authority
- Jon Delaney – Royal Australian Navy Environment
- Dr John Volkman – CSIRO
- Jim Huggett – Queensland Transport maritime
- Jonathon Barrington – Australian Quarantine & Inspection Service

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- Rob Dineen – Department of Primary Industry, Water & Environment Tasmania

Their findings at Section 5, state... 'Hosing and brushing down activities, without the use of detergents or abrasives to remove weed and barnacles, generally do not require specialised treatment to retain and dispose of material removed. However, if the material includes live organisms from another country or a distant part of Australia, all debris should be collected for disposal as solid waste. Check with the port or marina management on controls on ballast or fouling organisms.'

Hull Surface Treatment (HST) Technology does not damage or remove any of the anti-fouling paint. Primary spore, slime and algae are terminated via thermal sterilisation and does not dissolve or come away from the vessel whilst in the sensitive coastal zone, harbour or port. And therefore does not breach any of the recommendations in the Code of Practice.

Eco Wise Environmental conducted independent water testing on behalf of the NSW Department of Environment and Climate Change whilst HST was being used in Sydney Harbour. A summary of their findings is attached at the rear of this document.

Section 7 states...'This code of Practice also includes other measures aimed at protection of the health of workers and of the environment.

When best practice improves on these measures, best practice should be adopted'.
HST is a vast improvement on current Best Practice and is the simplicity that lies beyond the complexity.

The International Convention on the Control of Anti-Fouling Systems on Ships, 2001 (HAFS)

Adopted by the IMO on 5 October 2001. On the 9 January 2007, Australia became a Party to the HAFS Convention, which has been implemented in Australian domestic legislation by the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* which commenced on 17 September 2008. Its purpose is to ban the use of organotin compounds which act as biocides in anti-fouling paints on ships, specifically tributyl tin (TBT) based anti-fouling paints. Australia is a Party to the Convention administered by the International Maritime Organisation (IMO). Article 8 (1) says, **'The parties shall take appropriate measures to promote and facilitate scientific and technical research on the effects of anti-fouling systems as well as monitoring of such effects. In particular, such research should include observations, measurement, sampling, evaluation and analysis of the effects of anti-fouling systems'.**

Hull Surface Treatment (HST) technology has undergone credible and exhaustive environmental testing in what is arguably the most beautiful harbour in the world. And after meetings with:

- *The Federal Department of Agriculture Fisheries and Forestry*
- *Australian Quarantine Inspection Services (AQIS)*

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- *The New South Wales Department of Fisheries*
- *New South Wales Maritime*
- *New South Wales Department of Environment and Climate Change(DECC)*

The Sydney Harbour Ports Authority has issued Commercial Diving Services Pty Ltd with approvals to operate Hull Surface Treatment (HST) technology within Sydney Harbour. The first such treatment was performed on Carnivals Pacific Dawn on 16 April, 2009.

- **Hull Surface Treatment (HST) technology uses no paints, chemicals, detergents, poisons or substances which are foreign to the marine environment.**

- **It does not perform any physical damage or harm to the marine environment.**

- **Hull Surface Treatment technology was not contemplated when current legislation was enacted and whilst technically, its application falls broadly within the definitions of an 'anti-fouling system', that definition was primarily directed at paint/chemical applications to the external hull of a ship.**

- **Hull Surface Treatment technology has evolved from a vast knowledge of the sea, thirty five years of underwater experience and a passion for green, environmentally sustainable technology.**

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Supporting Documents

- Australian Government - Department of Agriculture, Fisheries and Forestry
- Aquenal Pty Ltd - Aquatic Environmental Analysts - Marine, Estuarine and Coastal Assessment
- EcoWise Environmental - Report on effects of HST treatment on Harbour Water

Australian Government

Department of Agriculture, Fisheries and Forestry

Mr Keith Johnson
Managing Director
Commercial Diving Services Pty Ltd Australia
PO Box 126
DAPTO NSW 2530

Dear Mr Johnson

Thank you for providing us with a presentation at the Department on 12 January 2009 on the Hull Surface Treatment (HST) technology that Commercial Diving Services Pty Ltd is proposing to apply to the cruise vessel Pacific Dawn in the port of Sydney. While it is not possible for the department to specifically endorse the HST system I have provided some comments below on our assessment of the biofouling risks managed by the system.

As we understood from your presentation, the HST is only to be used for managing primary biofouling on the Pacific Dawn and is proposed to be applied to both vertical sides port and starboard to the bilge keel, to the lower turn at Fore and Aft of bilge keels, and also over all sea chest gratings encountered.

The marine pest risk assessments that we have completed to date indicate that the introduced marine species most likely to represent a significant risk to Australia's marine environment and the industries that depend on it are tertiary biofouling species. By tertiary biofouling we mean sponges, ascidians, mussels, oysters, clams, gastropods, crabs, shrimps, seastars, sabellid worms and sea anemones. Assuming it is effective, the HST system as demonstrated in your presentation provides a mechanism to address primary biofouling. The treatment of primary biofouling in this way with the HST system would not present a biosecurity risk of concern to the Department.

However, in our view, the HST system would need to be applied in a regular manner commencing soon after a dry-docking to ensure that the biofouling on the vessel did not have the opportunity to exceed a primary level. We also note that your system does not attempt to address biofouling in niche areas (such as within sea chests, bow or stern thrusters, rudder hinges and bilge keels). These areas can accumulate significant biofouling and may pose a greater risk of harbouring tertiary biofouling. Vessel owners should consider specific action or the application of other biofouling control systems in these areas to ensure they remain free of biofouling.

We would welcome updates on the HST of the Pacific Dawn and if an opportunity arises, to see this technology being applied. We have consulted the Australian Quarantine and Inspection Service in preparing this response and they concur with the views expressed in this response. Please give me a call on 02 6272 4975 or email andrew.johnson@daff.gov.au if you have any further questions.

Yours sincerely

Andrew Johnson
Manager
Invasive Marine Species Program
29 January 2009

Keith Johnson
Managing director
Commercial Diving Services Pty Ltd
PO Box 126
Dapto, New South Wales, 2530

27th February 2009

To whom it may concern,

Mr Keith Johnson of Commercial Diving Services Pty Ltd has requested my expert opinion surrounding whether his novel Hull Surface Treatment (HST) Technology poses a biosecurity and/or water quality risk through the introduction of biofouling pests and/or toxic biocides into the surrounding marine environment.

What qualifies me to provide this advice?

I have been researching the biosecurity risks associated with vessel biofouling for over 10 years. I began my interest in this area in 1996 by undertaking a Masters Degree in Applied Science with the Australian Maritime College, Tasmania where I investigated the biosecurity risks associated with biofouling on merchant vessels visiting northern Tasmania. In 1999, I joined Cawthron Institute in New Zealand as a Marine Biosecurity Scientist where I provided underpinning research for the development of policies and procedures for managing marine biofouling pests. Then in 2006 I joined the Australian Quarantine and Inspection Service as a Marine Pest Advisor to assist with the development of Australia's proposed Biofouling Management Requirements, including raising awareness of the issue through the International Maritime Organisation. It was during my pursuits for new environmentally-friendly technologies for mitigating the translocation of biofouling pests that I was first exposed to Mr Johnson's HST Technology during his visit to Canberra on 16 April 2008. I now work for Aquenal Pty Ltd in Hobart where I am responsible for managing marine pest related research and consultancy projects.

Biosecurity risk - biofouling pests

Removing and releasing biofouling into the marine environment through hull cleaning may facilitate the introduction of invasive marine pests. Hence, the Australian and New Zealand Environment and Conservation Council introduced a Code of Practice for antifouling and in-water hull cleaning and maintenance to discourage the practice (ANZECC 1997). However, these concerns largely surround the use of traditional rotational brush cleaning systems that are capable of removing high levels of biofouling (animal growth). Such high levels of biofouling are considered more likely to contain invasive biofouling pests, particularly in anomaly areas of vessels (e.g. bow thruster tunnels, underneath bilge keels, inside sea chests, and around rope guards, propellers and rudders) (Coutts 1999, Coutts and Taylor 2004; Coutts and Dodgshun 2007).

From my understanding, the HST uses thermal shock designed to treat only low levels of biofouling such as copper resistant algae that predominantly occur on the mainstream areas (i.e. flat-sides from the waterline to the turn of the bilge) of hulls that are responsible for causing significant hydrodynamic drag on vessels underway. While some vegetative stages of invasive marine algae can occur in these areas, they pose a low biosecurity risk relative to high levels of biofouling. However, the HST technology is capable of killing vegetative stages given the technology was originally based on treating juvenile stages of invasive marine alga (Wotten et al. 2004). More importantly, the HST does not clean or remove biofouling like rotational brush systems, but rather relies on thermal shock to kill the biofouling that remain attached to the hull until the vessel is underway. Therefore, in my opinion the HST is unlikely to pose a biosecurity risk because it: 1) treats low levels of biofouling that pose a relatively low biosecurity risk; 2) is capable of killing vegetative stage of invasive marine algae if present; and 3) sterilizes the hull surface without releasing defouled organisms into the surrounding environment.

Water quality – release of toxic biocides

Prior to the implementation of the ANZECC Code of Practice in 1997, it was common practice to remove unwanted biofouling while *in situ* using brushes. One study for example, demonstrated that approximately 95% of the total mass of copper biocides emitted into the marine environment over a four week period originated from the passive leaching, while only 5% originated from in-water hull cleaning (Schiff et al. 2004). However, in-water cleaning of antifouling coatings is known to significantly increase the release rate of toxic biocides beyond their normal leaching rates (e.g. Valkirs et al. 2003; Warnken et al. 2004). Conversely, the HST is unlikely to exacerbate the immediate release of biocides upon treatment because it does not clean, but sterilizes the hull surface. Furthermore, it is unlikely the biocides are able to be released from the treated surface until the dead algae is removed when the vessel is underway.

Overall, I sincerely believe the HST is a much needed environmentally-friendly solution for reducing the hydrodynamic drag on vessel hulls and greenhouse gas emissions, thus supporting Australia's commitments to the Kyoto Protocol.

Regards

Ashley Coutts - Senior Research Scientist - Marine Pests

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Effect of HST Treatment on surrounding harbour water

Brett Thompson
Ecowise NSW Laboratory Supervisor

Abstract

Ecowise Port Kembla supplied a sampling and analytical service to Commercial Diving Services (CDS) as an independent laboratory in relation to HST hull treatment procedures. The Port Kembla laboratory analysed samples taken by CDS and an Ecowise sampler in order to compare baseline concentrations of several stress indicators in Sydney Harbour with the concentrations found in water post HST treatment. It was found that the analysis was comparable and application of the HST treatment procedure did not have any observable affects on surrounding harbour water.

Introduction

A sampling and analysis scheme was undertaken to identify any changes to the surrounding harbour water as a direct result of HST treatment. The main environmental concerns identified by CDS and Ecowise were thermal shock; an increase in total suspended solids (TSS); eutrophication (excess nutrients e.g. nitrogen and phosphorus); and the leaching of biocides from the exterior antifouling paint of the hull.

The active biocide ingredients contained in the antifouling paint of the ship involved in the sampling scheme were cuprous oxide and zinc pyrithione. Copper (Cu) and zinc (Zn) were analysed in pre treatment and during treatment samples as representatives of the presence of the active ingredients. A significant increase in either metal would indicate leaching of the respective biocides.

Sampling location

Sampling location was kept consistent by sampling pre HST treatment harbour water and all HST treatments during sampling on the hull directly beneath lifeboat number 5 on the starboard deck of the “Pacific Dawn” at Darling Harbour in the Port of Sydney.

An Ecowise sampler accompanied the CDS team onto the harbour to collect independent samples. Samples were taken before HST treatment in order to establish a set of analysis representative of the surrounding harbour water. Duplicate samples were taken at the hull of the ship and approximately 30 meters perpendicular from the treatment site towards the middle of Darling Harbour.

Using an YSI multi-probe, temperature and pH were also recorded for the two sites, as well as at distances of approximately 20 meters, 15 meters, 10 meters and 5 meters from the hull.

Water directly influenced by the HST treatment was sampled by collecting duplicate samples of water directly above the device during operation. Although the path of the water would be influenced by harbour currents and harbour traffic, it was assumed that taking samples as close as possible to the device would give a worst case scenario for the affect of the treatment on surrounding harbour water.

Results and Discussion

Sample site	Cu (mg/L)	Zn (mg/L)	TSS (mg/L)	TN (mg/L)	TP (mg/L)
Blank @ Hull 1	<0.01	<0.01	8	0.4	0.05
Blank @ Hull 2	<0.01	0.01	16	0.3	0.06
Blank @ 30m 1	<0.01	<0.01	31	0.2	0.05
Blank @ 30m 2	<0.01	<0.01	15	0.3	0.07
Process Water 1	<0.01	0.01	13	0.3	0.06
Process Water 2	<0.01	<0.01	15	0.3	0.07

Table 1 Analysis of Cu, Zn, TSS, TN and TP in harbour water before and during HST treatment.

The results in table 1 show that concentrations of Cu, Zn, TSS, TN and TP were comparable for both the surrounding harbour water and the water sampled during HST treatment.

Sample site	Temperature (°C)	pH
Baseline @ 0.5m	23.4	7.7
Baseline @ 5m	23.1	7.9
Baseline @ 10m	23.1	7.9
Baseline @ 15m	23.2	7.9
Baseline @ 20m	23.1	7.9
Baseline @ 30m	23.2	7.9
Process water 1	23.5	7.9
Process water 2	23.4	7.9

Table 2 Analysis of Temperature and pH in harbour water before and during HST treatment.

The results in table 2 show that temperatures and pH values were comparable between the surrounding harbour water and the water sampled during HST treatment.

Conclusion

This study was conducted by Ecowise to independently investigate the affects of HST treatment on chemical and physical properties of harbour water. Environmental issues such as thermal shock; an increase in total suspended solids (TSS); eutrophication; and the leaching of herbicides from the exterior paint of the hull were of main concern.

The results of field and laboratory analysis showed that concentrations and levels of the tested parameters in harbour water directly adjacent to HST treatment were not outside concentrations and levels of parameters expected in Darling Harbour water, within the Port of Sydney. Therefore no adverse effects of HST were identified by this study.

Brett Thompson
Chemistry Team Leader