

November 13, 2015

MAX1 STUDIES FINAL REPORT



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I. EXECUTIVE SUMMARY

This document constitutes the final report for the MAX1 Studies. There was a very large amount of documentation generated from this study. In this report, we attempt to consolidate all information through either inclusion in the report, or reference to its location online.

The MAX1 Studies responded to two questions:

1. How effective are shipboard Oily Water Separators (OWS)?
2. What can be done to further increase the effectiveness of shipboard oily waste management?

Historically, improvements to these systems have been hampered by a lack of open communication and technical cooperation. Therefore, this effort particularly focused on cooperative evaluation and analysis, especially through identifying and engaging stakeholders to consolidate possible divergent points of view¹.

QUESTION 1:

Our findings suggest that the answer to the first question is that state-of-the-art shipboard Oily Water Separators which are compliant with MEPC.107(49) regulations are sufficient technology for their purpose. We have also found general consensus on this statement within the maritime industry.

The majority of complaints with OWS technology involve problems generally associated with OWS designed to comply with MEPC Resolution 60(33). As ships constructed after 2005 must be fitted with units that comply with MEPC Resolution 107(49), MEPC.60(33) units are no longer manufactured.

Therefore, we conclude that improving OWS technology should not be a regulatory priority, since MEPC.60(33) units will eventually be overtaken by improved MEPC.107(49) units without any additional intervention.

With regard to making continual improvements to MEPC.107(49) equipment, we suggest that the best method to address remaining issues is not to amend regulations to make a particular technology required, but rather to incentivize manufacturers to continue to improve OWS/OCM technology. To assist manufacturers with making OWS/OCM improvements, shipowners and crews must also work to improve the customer feedback loop, which continues to show insufficient reporting of issues back to the manufacturer.

Remaining issues include the time-intensive nature of OWS cleaning/maintenance and false negatives/positives with Oil Content Meter (OCM)² equipment. Specifically, technical advances in OCM oil detection accuracy would find a ready market in the industry. False OCM alarms can become a serious operational issue, since possible false alarms make OWS systems difficult to troubleshoot, which results in ineffective crew efforts at resolving the alarm. Crews should be trained to recognize this reality and to stop using an OWS that does not respond properly, issue

¹ Notably, the study included a widespread industry [survey](#) and a single day [conference](#) with representatives from all major stakeholder groups.

² Note that current IMO regulations refer to OCM equipment as "15 ppm bilge alarms".



a service report, and request that it be resolved at the next port. The study indicates that Port State Control officials would welcome this type of report and operational feedback.

A number of reported issues with MEPC.107(49) units can also be improved through adequate crew training, and ensuring that an appropriate OWS system is selected for its intended operational environment. For a shipowner, these types of systems considerations will likely provide the greatest improvements to MEPC.107(49) OWS operations.

We emphasize that there is no indication that further regulatory efforts³ at improving OWS technology are required. In fact, any regulatory change would most likely be counterproductive, since it would be destabilizing, requiring many years for implementation and creating confusion and possibly new myths. Additionally, changing regulations would divert resources from methods that have been found to be more effective at improving shipboard oily waste management, such as those detailed below.

QUESTION 2:

With regard to the second question, we offer the following promising pathways to increase the effectiveness of shipboard oily waste management, which were reached through review of existing literature, extensive consultation with stakeholders, and technical and systems analysis:

- Increasing and improving crew **training** (in OWS operations and MARPOL regulations)
- Addressing availability and cost issues with **port reception facilities**⁴
- Moving towards **drier bilges**
- Increasing and improving crew **dialogue with shore** management (making crews feel comfortable as part of the solution)
- Exploring options for **electronic record keeping**
- Cultivating a “**culture**” of compliance/trust/communication/transparency

For the most part, these suggestions are best applied through reliable, data-driven, transparent implementation by shipowners in consultation with relevant stakeholders such as regulatory bodies, shore personnel and ships crews, within the existing regulatory structure.

The study found that some shipowners are already solving these problems effectively, reducing stress on the system for all stakeholders. Today's regulations are resulting in increasingly drier bilges⁵ and improved OWS capability, reducing discharge of oil to water by total volume. With improved compliance this trend of reduced total discharge will only accelerate.

The following report details how the above outcomes of the MAX1 Study were reached, and provides useful waste stream management information and insights. Questions and comments should be directed to info@martinottaway.com.

³ Specifically, there have been various efforts at reducing the legal discharge limit from 15 ppm to 5 ppm. The study indicates that this would be counterproductive. While state-of-the-art MEPC.107(49) OWS systems can routinely deliver 5 ppm discharges, today's OCM technology cannot effectively monitor that discharge level, resulting in false alarms, impossible troubleshooting and crew frustrations.

⁴ This may be addressed on a regulatory level by mandating inclusion of waste disposal costs in port fees.

⁵ Notice that drier bilges by themselves reduce the volume of oil discharged to sea. It is significant that the actual goal of Annex I is to minimize waste discharge to the oceans, not the rate at which waste is discharged to the oceans.



II. INTRODUCTION

MAX1 Studies was a study performed January 2015 - June 2015 on shipboard machinery space waste stream management and Oily Water Separator (OWS) technology, as regulated by amended MARPOL Annex I ("MAX1"), Chapter 3.

The study was commissioned by the [National Fish & Wildlife Foundation](#) and managed by the maritime consultancy firm [Martin & Ottaway](#). The study also had limited oversight and involvement from the United States Coast Guard.

The study primarily responded to two questions:

1. *How effective are shipboard Oily Water Separators?*
2. *What can be done to further increase the effectiveness of shipboard oily waste management?*

These questions were developed in consultation with NFWF, the USCG, and the plea agreement from which the monies for this study originated, which states:

"...for funding of the specific projects described hereinafter, related to the prevention of violations of MARPOL Annex I: I) A study of ship design aspects of waste stream management. The focus of the study shall be on machinery space derived wastes and potential methods for ship designers to improve the ability of vessels to process their wastes legally; and II) A study of the effectiveness of existing Oily Water Separator technology. The focus of the study shall be on the design and practical operational aspects of existing technologies used to process machinery space waste streams in order to evaluate their effectiveness."

The study focused on oily waste streams as defined in MARPOL Annex I⁶, inclusive of oil residues (sludge) and engine-room oily bilge water. However, it was expected that solutions developed would not only benefit machinery space waste stream management and OWS systems but all shipboard waste stream management and the larger environmental management components on board vessels.

The development and improvement of shipboard waste stream management and OWS systems is an on-going effort that continues to suggest new improvements and solution paths as further information becomes available and new regulations come into effect. Historically, development has been hampered by a lack of open communication and technical cooperation throughout the system. Therefore, this effort particularly focused on cooperative evaluation and analysis, especially through identifying and engaging international stakeholders to consolidate possible divergent points of view.

⁶ Note that we abbreviated the initiative using the number one (MAX1), rather than the corresponding roman number used in MARPOL regulations.



III. BACKGROUND

Systems to manage shipboard machinery space waste streams, rather than discharge these wastes directly overboard, were first installed on ships in the 1970's as a result of MARPOL Annex I regulations.

Managing these oily waste streams represented a fundamental change in the historically established function of a shipboard crew. Before environmental regulations, a ship's crew existed to keep a vessel moving to allow it to carry cargo/passengers in an economic and safe manner. Since the 1970's, this crew function has evolved to include environmental management and awareness of a ship's waste streams and emissions. As such, a ship's crew used to serve one master (the vessel Owner) but now serves two (the vessel Owner and the public at large).

This shift has resulted in confusion and an adversarial tug of war between ship owners and the public with ship crews left in the middle. This tug of war needs to be resolved for environmental systems to function properly aboard ships.

Environmental functions aboard ships continue to expand. Meanwhile, evidence based on a continual stream of noted violations indicates that some operators continue to have problems with machinery space waste stream management. This study focuses on identifying methods to make shipboard machinery space waste stream management more effective and reliable aboard ships. The knowledge derived from this effort is also geared towards helping with the implementation of other shipboard environmental functions.

Today's ship crews (and ship operators) are also facing a steadily increasing number of necessary regulations and procedures. This paperwork can result in resentment and loss of focus by all stakeholders. Remarkably, recent efforts have strongly indicated that there are solutions that actually reduce paperwork, workloads and operational costs. These trends need to be further analyzed and studied.

Problems with shipboard waste stream management continue to occur, and resolution of these problems will require a combination of improvements in technology, operational practices, training and human factors considerations. This study endeavored to bring together all stakeholders in order to develop best practices on all of these fronts.



IV. MARPOL OVERVIEW

MARPOL, as amended, is the main international convention addressing pollution from ships. It provides regulations aimed at preventing and controlling pollution resulting from routine ship operations and maritime accidents. Within the convention, six technical Annexes detail these regulations:

Annex	Title	Date of Entry into Force
I	Regulations for the prevention of pollution by oil	October 2, 1983
II	Regulations for the control of pollution by noxious liquid substances	April 6, 1987
III	Regulations for the prevention of pollution by harmful substances carried by sea in packaged form	July 1, 1992
IV	Regulations for the prevention of pollution by sewage from ships	September 27, 2003
V	Regulations for the prevention of pollution by garbage from ships	December 31, 1988
VI	Regulations for the prevention of air pollution from ships	May 19, 2005

This convention undergoes frequent revisions. As such, keeping up to date with the evolving and often complex new regulations can be challenging.

History of MARPOL

Widespread concern regarding maritime oil pollution began in the first half of the twentieth century. The early result was a series of local efforts by nations to control oil discharge within territorial waters.

The first significant attempt at international management of maritime oil pollution came in 1954, when the United Kingdom organized a conference on the matter. The result was the International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL), 1954. The 1954 OILPOL Convention established regulations to reduce oil pollution caused by standard tanker operations and the discharge of oily waste from machinery spaces. It entered into force on July 26, 1958.

Meanwhile, the international nature of shipping and expanding globalization of trade prompted the United Nations to adopt a convention in 1948 formally establishing the Inter-Governmental Maritime Consultative Organization (IMCO), as it was then known. The convention entered into force ten years later, in 1958 and thus, introduced the first international body devoted strictly to maritime concerns. The name of the organization was changed in 1982 to the [International Maritime Organization](#) (IMO), and today, its objectives are summarized by the slogan: "safe, secure and efficient shipping on clean oceans".

In January 1959, IMO assumed responsibility for maintaining and promoting the 1954 OILPOL Convention. Under IMO direction, the convention was amended in 1962, 1969, and 1971.

As oil trade and industry developed, parties began to recognize a need for further work in regards to oil pollution prevention at sea. This need became increasingly apparent in 1967, when the tanker *Torrey Canyon* ran aground entering the English Channel, spilling 120,000 tons of crude oil.

The *Torrey Canyon* grounding marked the biggest oil pollution incident recorded up to that time. Among other things, the incident forced the maritime industry and public to question the efficacy of standing regulations and preventative measures pertaining to oil pollution at sea. Formally, it



prompted a series of new conventions.

IMO held an emergency session of its Council to deal with immediate incident particulars but recognized the need for readdressing regulations pertaining to maritime pollution. In 1969, the IMO Assembly decided to hold an international conference in 1973 dedicated to this matter. The overarching goal would be to develop an international agreement for controlling general environmental contamination by ships.

It was during the November 1973 conference that IMO adopted the International Convention for the Prevention of Pollution from Ships (MARPOL). The 1973 Convention came as the first comprehensive anti-pollution convention. It established regulations pertaining to various sources of ship pollution under five Annex headings (Annexes I-V). Much of Annex I was rooted in the 1954 OILPOL Convention and subsequent amendments.

To enter into force, the 1973 Convention required ratification of Annexes I and II by 15 States representing no less than 50 percent of the world's shipping by gross tonnage. (Annexes III-IV were deemed optional.) This ratification process dragged, however, largely as a result of technical problems associated with Annex II.

In 1976-1977, the world saw a series of tanker accidents. These incidents prompted the IMO to hold the Conference on Tanker Safety and Pollution Prevention in February of 1978. The Conference adopted a number of regulations impacting tanker design and operation on February 17, 1978. In part, these were incorporated into the Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol).

Because the 1973 Convention had yet to enter into force, it was absorbed by the 1978 Protocol. The combination was titled the International Convention for the Prevention of Marine Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto (MARPOL 73/78).

The 1978 Protocol provided that only Annex I would be immediately enforced upon ratification of MARPOL 73/78. Annex II would be enforced three years thereafter. (As before, Annexes III-V would remain optional.) This pushed the ratification process along, and MARPOL 73/78 officially entered into force on October 2, 1983, superseding the 1954 OILPOL Convention, as amended.

Changes to MARPOL

Since its entry into force, MARPOL 73/78 has been regularly amended. Amendments may be adopted by establishing a diplomatic conference of Parties to MARPOL or more typically, after consideration by the IMO's Marine Environment Protection Committee (MEPC). The IMO Assembly established the MEPC in November 1973. The committee is one of five under IMO and is responsible for coordinating IMO efforts with regards to the prevention and control of pollution from ships.

Significant amendments to MARPOL 73/78 were incorporated into the Protocol of 1997 and adopted on September 26, 1997, at an IMO Conference established for this purpose. The 1997 Protocol added a sixth Annex to MARPOL 73/78 and entered into force on May 19, 2005. Subsequently, at its 56th session, the MEPC agreed to refer to the convention and its six Annexes as a whole using the abbreviated term "MARPOL".



Consolidated Editions of MARPOL have been published by IMO as follows:

Edition	Year of Publication
1st	1991
2nd	1997
3rd	2002
4th	2006
5th	2011



V. PROJECT EXECUTION AND DESIGN

There have been historical difficulties with studying the effectiveness of OWS and shipboard waste management. This study was designed to engage as many study mechanisms as possible, some of which have only recently become available to researchers of multi aspect problems. The below discussion is provided as guidance in designing future projects of this type. The project focused on social media transparency, while introducing anonymity where it was thought to be needed.

All data was web based and the website included a forum section, a participation sign up option and other social features.

Achieving critical communication mass in the early part of the study was found to be extremely difficult. A significant part of the study effort was absorbed by this task, requiring a high level of personal persuasion of industry stakeholders by the study team. Developing more effective methods to gain and hold people's attention on this relatively unpopular and complex subject (if they exist) would assist the cause tremendously.

The following study mechanisms were implemented and tested:

Website:

The website functioned as a central contact point for the study. Referring interested parties simply to a webpage for further information greatly increased the efficiency of the project.

Email updates:

Our primary means of disseminating interim study outcomes and opportunities for input and participation in the studies was through a mailing list subscription offered on the MAX1 website. At the conclusion of the study, 137 people had signed up for and were receiving these MAX1 updates, which were sent approximately every two weeks. A number of individuals were also added to the mailing list directly by the project managers (e.g. a contact person for a partner organization, conference participants).

In the end, the entire set of emails provided an effective project chronological report. The text of the email updates is included as Appendix A of this report.

Partnering:

Obtaining official partners helped establish the legitimacy of the project and reduced anxiety of being associated with this project. It became progressively easier to sign up partners once the first few partners in each category had been signed up and made public on the partners website page. Towards the end of the study no further effort to sign up additional partners was made, but it would have been relatively easy to add a few dozen more partners.

Google docs:

In particular for the construction of the chronology, Google docs in its spreadsheet form was extremely effective at building this document from multiple locations. The website did not



support Google docs directly and periodically the website chronology was updated by uploading the latest Google doc version of the chronology.

Basecamp

A remote project management online service called Basecamp was used for assigning tasks to interns working remotely during the school year (e.g. website maintenance) and for coordination with our contacts in North Carolina. While the service was not used heavily, it proved to be useful, with a straightforward, easy-to-learn interface.

Web forum:

The MAX1 Forum was an effort to allow online discussion of topics related to shipboard waste stream management and OWS technology. The interface for the forum was offered by our chosen website host, Weebly.

This effort did not get much traction, for reasons that are not entirely clear. Possibly, stakeholders were hesitant to speak honestly and openly in a public, online forum about such a sensitive issue, particularly one with USCG oversight. It is also possible that participants were deterred by the interface, which was not entirely clear on how to enter comments. In retrospect, discussion topics may have been more effective on a familiar interface such as LinkedIn, which also may have reached more people.

The project leaders started a number of topics, with very few responses, that are included as Appendix B. The few comments that were received were addressed at the MAX1 Conference.

Other social media:

More general subjects or promotional subjects were developed as blogs on the M&O website and were then posted on various LinkedIn interest groups. LinkedIn was a significant enabler in increasing awareness about the MAX1 study through posting of blogs as information items on LinkedIn special interest groups (such as the SNAME LinkedIn site).

The M&O blogs about the MAX1 studies can be found [here](#), and include the following topics:

	Date Published
What's So Funny About ORB's?	Aug 14, 2015
MAX1: Do People or Equipment Cause Ocean Pollution?	Aug 13, 2015
MAX1 Conference in Wilmington, NC; A First in Shipboard Waste Management	July 1, 2015
Solving the Really Difficult OWS and Police Brutality Problems	May 28, 2015
MAX1 Studies: Please Take the Survey to Build Knowledge of OWS and OCM	April 9, 2015
MAX1 Studies OWS Chronology Analysis	Mar 27, 2015
MAX1 Studies, a NFWF ship waste stream management and OWS study. Invitation for Participation	Jan 29, 2015

Survey:

The MAX1 Survey was another stakeholder involvement effort that proved to be more successful than the forum. This may be due to the anonymous nature of the responses. The survey was developed in consultation with stakeholders, and received valuable dissemination support through our partner organizations.



The survey was built with skipping logic to minimize the amount of time required to take it. Survey time ranges from 5-20 minutes depending on responses, and responses are anonymous.

The survey was circulated through various methods⁷, such as listings in other newsletters and magazine articles, specific requests to industry friends, shipowners and operators, and subsequent to the MAX1 Conference, by providing Port State Control inspectors with a flyer to hand out to crew members.

We received slightly over 500 responses at the time of this report. This is a significant response rate, especially noting that the incentive to respond was relatively low, and noting that not all mariners have ready access to internet and if they do they will not prioritize responding to a survey. It is noted that the quality of the responses was high, and showed varied and thoughtful knowledge by the survey respondents. However, the response rate means that only a tiny percentage of an estimated 1,000,000 people who interact with MARPOL Annex I have provided feedback on the subject.

The survey will remain open for an indeterminate amount of time in the future, as responses continue to slowly come in through various sources. It is noted that any random reference to the survey could result in an additional surge in responses.

We note that Appendix C is a printout of the responses to three operational OWS open-ended questions. These responses provide a powerful troubleshooting guide to OWS and bilge water management, and would be useful for training purposes.

Conference:

No study of this type should be performed without a wrap up conference. The terms of the plea agreement indicated that the conference should take place in North Carolina. Despite a tremendous effort by NFWF, the USCG and M&O and attractive financial incentives, no North Carolina corporate, government or academic support for this effort could be obtained. This total lack of success in this regard is symptomatic of the lack of interest and support by shore-based entities of IMO efforts more generally.

Regardless, Wilmington NC proved to be a very suitable and low cost conference location and only at the conference did the study team receive the feedback and discussion that had not developed using other communication techniques. On the other hand, the other communication techniques primed the conference participants and it is highly unlikely that there would have been any significant interest in the conference without the other communications mechanisms.

Library

The MAX1 Library aimed to locate and consolidate a number of different types of information, including regulations, current OWS technology, case studies, best practices, academic papers, white papers, and presentations on waste stream management and OWS systems.

⁷ It was possible to generally gauge the effectiveness of various survey request disseminations by the response rate after the request was made. In particular, it was noted that a Maritime Executive online article, a World Ocean Council email circular, and an American Club circular resulted in a rapid spike in responses.



The Library was hosted on the MAX1 website, and documentation was added throughout the course of the study. The MAX1 Library documents were eventually consolidated into the MAX1 Chronology of bilge water management efforts.

Chronology

The MAX1 Chronology proved to be both a useful exercise for our own documentation review purposes and resulted in the production of a concise document describing the history of efforts on this topic. The historical aspect of machinery space waste stream management is critical for this topic in order to provide context on decisions that have been made and to help remove dead-end and resolved issues from the discussion.

Since the chronology contains links to original documentation, it also contains a wealth of information through reference to other online resources.

We note that the chronology can be considered a live document, since it is impossible to ensure that all significant machinery space waste stream management efforts have been included, and therefore may be revised over time.



VI. PARTNER ORGANIZATIONS

In order to facilitate stakeholder engagement, we asked maritime companies and organizations through various publications to get involved in the study as Partner Organizations. Partner organizations were asked to elect a representative who would follow the study (mainly via the email updates), and contribute to efforts as they deemed appropriate.

The following companies and organizations represented our official partners, but we note that there were also a number of companies that followed and contributed to the studies without seeking partner status. In general, the project managers found that it required executive-level initiative to authorize public corporate involvement as a partner to this study. The MAX1 partners provided invaluable knowledge and perspectives throughout the study, and we are thankful for their efforts.

- American Club
- American Salvage Association
- Betancourt, van Hemmen, Greco & Kenyon, LLC
- Ership
- Hornbeck Offshore
- Kristian Gerhard Jebsen Skipsrederi
- Matson
- MF Shipping Group
- National Fish & Wildlife Foundation
- North American Marine Environment Protection Association
- SMIT
- Society of Naval Architects & Marine Engineers
- STAR Reefers
- Total Marine Solutions
- United States Environmental Protection Agency
- United States Coast Guard
- University of Michigan
- Webb Institute
- Welch & Harris
- Women's International Shipping & Trading Association
- World Ocean Council



VII. MAX1 CHRONOLOGY

The following table organizes documents and events related to shipboard MARPOL Annex I waste stream management in chronological fashion, in order to provide a comprehensive resource for historical issues on this subject. Links to original documentation are also included in this document.

Date	Title	Publisher	Description	Keywords
1954	OILPOL convention of 1954		This is the first effort at reducing operational oil pollution. It limits oil discharge over 100 ppm within 50 miles from land. It also promotes the development of shore based reception facilities.	100 ppm
1955	No Activities Recorded			
1956				
1957				
1958				
1/13/1959	First IMO assembly			IMO
1960	No Activities Recorded			
1961				
1962	OILPOL amendment of 1962		The OILPOL convention was amended to extend the limits for dumping oily wastes.	100 ppm
1963	No Activities Recorded			
1964				
1965				
1966				
1967				
1968				
1969	OILPOL amendment of 1969		The OILPOL convention was amended to introduce the "load on top" procedure.	100 ppm
1969	IMO Marine Environmental Protection Committee (MEPC) created			IMO, MEPC
1970	No Activities Recorded			
1971	OILPOL amendment of 1971		The OILPOL convention was amended to limit the size of cargo tanks in tankers built after 1972 (in an effort to limit potential spills).	100 ppm



Date	Title	Publisher	Description	Keywords
10/1/1971	Resolution A.233(VII) is adopted	IMO	100 ppm OWS that should require the minimum of attention to bring them into operation.	MARPOL, OWS, OCM
1972	No Activities Recorded			
11/1/1973	MARPOL First adopted by IMO			IMO, MEPC, MARPOL
1974	No Activities Recorded			
1975				
1976				
11/14/1977	Resolution A.393(X) is adopted	IMO	15 ppm OWS/OCM is now required for new ships.	MARPOL, OWS, OCM
2/1/1978	MARPOL Modified		MARPOL was renamed MARPOL 73/78, and contained five Annexes of which ANNEX I part 1 covers OWS.	IMO, MEPC, MARPOL
11/15/1979	Resolution A.444(XI) is adopted	IMO	Uniform requirements for OWS/OCM units installed on or before January 20, 1979 all must comply with A.393(X).	MARPOL, OWS, OCM
1980	No Activities Recorded			
1981				
1982				
10/2/1983	MARPOL Annex I comes into force		Prevention of pollution by oil & oily water.	IMO, MEPC, MARPOL
1984	No Activities Recorded			
1985				
1986	General Engineering Knowledge for Marine Engineers, Volume 8, pages 380-388	Reeds Marine Engineers Series, Jackson and Morton, 4th edition	One of the few technical textbook descriptions of OWS. Useful, but barely up to date in 1986. There is no mention of OCM.	OCM, OWS
4/6/1987	MARPOL Annex II comes into force		Control of pollution by noxious liquid substances in bulk.	IMO, MEPC, MARPOL
12/31/1988	MARPOL Annex V comes into force		Prevention of pollution by garbage from ships.	IMO, MEPC, MARPOL
1989	No Activities Recorded			
12/13/1990	MEPC/Circ.235	IMO	Guidelines for systems for handling oily wastes in machinery spaces of ships.	OWS, IMO, MEPC, MARPOL
1991	1st edition consolidated MARPOL book is published	IMO	This is the 1st consolidated edition of MARPOL regulations. The most recent edition was published in 2011.	IMO, MARPOL



Date	Title	Publisher	Description	Keywords
7/1/1992	MARPOL Annex III comes into force		Prevention of pollution by harmful substances carried by sea in packaged form.	IMO, MEPC, MARPOL
10/30/1992	MEPC.60(33) Adopted by Resolution	IMO	This is the date that the 60(33) regulations were adopted by IMO and came into force. This is the beginning of the 60(33) implementation process.	OWS, OCM, 60(33)
1993	First cruise ship OWS investigation		Led to prosecution and guilty plea in 1994. Cruise ships identified by USCG overflight.	OWS, criminal
1994	No Activities Recorded			
4/17/1995	Purification of Oily Waste Water by Ultrafiltration	Elsevier	A study of membrane and reverse osmosis waste water treatment. Includes a large list of filtration references.	RO, membrane
1996	No Activities Recorded			
1997	Annex VI is added to MARPOL		Prevention of air pollution from ships.	IMO, MEPC, MARPOL
1997	2nd edition consolidated MARPOL book is published	IMO	This is the 2nd consolidated edition of MARPOL regulations. The most recent edition was published in 2011.	IMO, MARPOL
9/25/1997	IMO Resolution MEPC.76(40) Standard Specification for Shipboard Incinerators	IMO, MEPC	Adoption of the MEPC.59(33) incinerator standard specification in Annex V of MARPOL. Regulations for incineration of sludge are part of Annex I, but Annex VI specifies regulations for operation of incinerator equipment.	Incinerators, IMO, MEPC, Annex V
1998	Assistant engineer awarded \$500,000 whistleblower award		One of the earliest whistleblower awards and one of the earliest million dollar fines.	Whistleblower
6/2/1998	Cruise ship company pays a \$9 million penalty and pleads guilty to a fleet-wide conspiracy of dumping oil into the ocean and lying to the U.S. Coast Guard to cover up the crimes		One of the earliest shipping company plea deals and fines.	Criminal, cruise
11/20/1998	Interim Guidelines for the Application of Human Element Analysing Process (HEAP) to the IMO Rule Making Process	IMO, MEPC/Circ. 346	Initiates a trial period where rule making will take into consideration the human element. Also provides a process that will allow rule making review.	Human factors
1998	Marine Auxiliary Machinery, 7th edition	Elsevier, H.D. McGeorge	This paperback edition of this licensed preparatory textbook indicates that 100 ppm OWS is the strictest standard. Bilge diagram does not show OCM. OCM operational theory is incorrect.	Training



Date	Title	Publisher	Description	Keywords
1999	General Engineering Knowledge for Marine Engineers, Volume 8, pages 380-388	Reeds Marine Engineers Series, Jackson and Morton, 4th edition	A 1986 textbook technical description of OWS was reprinted in 1999, but no longer correct.	OCM, OWS
7/1/1999	IMO Resolution MEPC.78(43) Amendments to the Annex of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973	IMO, MEPC	Lays out an updated IOPP certificate and provides amendments to Annex I of MARPOL 73/78 Regulations 13G and 26.	IOPP, MARPOL
7/21/1999	Cruise ship company pays record \$18 million criminal fine		Fined for dumping oil and hazardous chemicals, making false statements; faces 21 felony counts in 6 different U.S. courts.	Criminal
3/1/2000	Technical Report: Novel Oil/Water Separator for Treatment of Oily Bilgewater	SNAME, Marine Technology Spring 2000, Caplan et al	Description of PetroLimator bioremediation bilge water treatment process. System received IMO and USCG type approval in January 2000.	OWS, bioremediation
3/17/2000	Enhanced MARPOL Oil Pollution Prevention Holland America Line Case Study	Dixon, Doug, presented at SNAME Pacific Northwest Section Meeting	Abstract: "Presented in this paper are a review of the current oil pollution prevention regulations and status of MARPOL Annex authorization. Also discussed are the efforts of Holland America Line to comply with the oil pollution regulations and a review of their bilge waste management equipment, procedures and internal reporting in excess of the regulations."	Case study, waste stream management, MARPOL
10/5/2000	Resolution MEPC.93(45)	IMO	Amendments to the standard specification for shipboard incinerators.	Incinerators
9/1/2000	Environmental Criminal Liability in the United States, a Handbook for the Marine Industry	Chamber of Shipping of America	This is a 122-page book published by the Chamber of Shipping of America that provided detailed legal discussion of the subject. It does not appear it has been updated.	Criminal
12/31/2000	First non-passenger vessel OWS plea		The first non-passenger shipping company enters a plea agreement with the U.S. Department of Justice for OWS violations.	OWS, criminal
2001	No Activities Recorded			
2002	3rd edition consolidated MARPOL book is published	IMO	This is the 3rd consolidated edition of MARPOL regulations. The most recent edition was published in 2011.	IMO, MARPOL



Date	Title	Publisher	Description	Keywords
2002	Oil in the Sea: Inputs, Fates and Effects	U.S. National Research Council NRC	This study estimates that 98% of oil discharges are caused by MARPOL non-compliance. It estimates that ships discharged 255,700 tonnes of sludge in 1999, thereby saving these shipowners a total of \$12.8M per year.	Sludge, discharge costs
4/19/2002	Cruise ship company guilty plea requires implementation of corporation-wide Environmental Compliance Plan (ECP), 5 year probation, and pays \$18 million fine		This led to creation of Corporate and Operating Company Environmental Compliance departments, appointment of VP-level environmental executives and Environmental Officers on each cruise ship.	ECP, environmental officer
5/16/2002	Guidance on the Use of Human Element Analysing Process (HEAP) and Formal Safety Assessment (FSA) in the IMO Rule Making Process	IMO, MEPC/Circ. 391	Compares HEAP and FSA in the rules making process.	Human factors
7/31/2002	Cruise ship company signs plea agreement with the U.S. felony violation of APPS and agrees to pay a \$1 million criminal fine		Last large cruise ship company plea agreement with regard to OWS. Lower penalty because company turned itself in and cooperated with prosecutors.	OWS
12/1/2002	Deckma Hamburg OCM test liquid instructions and MSDS	Deckma	OCM's can be tested with a test liquid. This is the instruction as provided by Deckma, and provides the Material Safety Data Sheet for the test liquid.	OCM, Deckma, calibration
12/31/2002	5 shipping company OWS pleas		In 2002, 5 shipping companies enter plea agreements with the U.S. Department of Justice for OWS violations.	OWS, criminal
2003	Cost Savings Stemming from Non-Compliance with International Environmental Regulations in the Maritime Sector	Organization for Economic Co-operation and Development (OECD/OCDE), Marine Transport Committee, Philippe Christ	This lengthy paper provides significant background on environmental compliance. It opines that some shipowners make conscious economic decisions to ignore environmental regulations to save money.	Economics, Annex I, waste water management, discharge costs
4/1/2003	Carnival Corporation & plc installs white boxes on all cruise ships	Carnival Corporation & plc	White boxes are more complete overboard discharge monitoring devices for bilge water discharge. Regarded as an additional monitoring device beyond the statutory (MARPOL) OCM, this equipment was developed to help enhance the reliability of conventional overboard discharge controls and related recordkeeping.	White box



Date	Title	Publisher	Description	Keywords
7/18/2003	MEPC.107(49) Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships adopted by resolution	IMO, MEPC	This is the beginning of the 107(49) implementation process, and supersedes MEPC.60(33). It requires OWS to treat more complex bilge liquids (emulsions) and often it adds post treatment to the 60(33) type OWS, and requires a more sophisticated OCM that records alarms (storing data for 18 months).	IMO, MEPC, OWS, OCM, 107(49), emulsion
9/27/2003	MARPOL Annex IV enters into force		Prevention of pollution by sewage from ships.	IMO, MEPC, MARPOL
11/10/2003	IMO MEPC Circ.406 Guidelines for Application of MARPOL Annex I Requirements to FPSOs and FSUs	IMO, MEPC	MARPOL Annex I also applies to FPSOs (Floating Production Storage and Offloading Units) and FSUs (Floating Storage Units). This circular discusses the application of Annex I to FPSOs and FSUs.	IMO, MEPC, FPSO, FSU, Annex I, IOPP
12/31/2003	2 shipping company OWS pleas		In 2003, 2 shipping companies enter plea agreements with the U.S. Department of Justice for OWS violations.	OWS, criminal
5/1/2004	A Guide for Correct Entries in the Oil Record Book, Part I Machinery Space Operations, Edition 1, May 2004	Intertanko	This is a guide published by Intertanko to provide crews with assistance in filling out Oil Record Books. It was a valiant effort at trying to provide crews with real guidance, but in its production and attempts at standardized procedures incurred its own problems and inaccuracies. (This is a marked up copy.)	ORB, sludge production, residue production
10/15/2004	Resolution MEPC.117(52)	IMO	Amendments to the annex of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from ships, 1973. This is the full text of MARPOL Annex I on this date.	Annex I
11/2/2004	Revised Guidelines and specifications for pollution prevention equipment for machinery space bilges of ships MEPC/Circ.420	IMO	This circular provides guidance on implementation dates for MEPC.107(49).	107(49)
11/17/2004	Practical Guide in Regard to Marine Bilge Water Properties and Treatment Technologies	SNAME NY section, IMarEST, SMPE, Hal Alpert	This is a practical discussion of issues that occur during bilge oil water separation and methods to deal with them.	OWS, centrifuge, flocculation, adsorbents, emulsions
12/1/2004	Bilge Water Treatment - the need for advanced technology	The Motor Ship	This is Coffin's description of their MEPC.107(49) approach.	OWS, 107(49)



Date	Title	Publisher	Description	Keywords
12/31/2004	6 shipping company OWS pleas		In 2004, 6 shipping companies enter plea agreements with the U.S. Department of Justice for OWS violations.	OWS, criminal
2005	Factors Affecting Bilge Water Properties and Oily Water Separator Performance	Hal Alper, MYCELX	Discussion of emulsions and 107(49) emulsion treatment strategies.	107(49), emulsions
2005	Draft Environmental Compliance Plan	U.S. Department of Justice	When a shipowner entered a guilty plea with the USDOJ, a significant portion of the plea agreement would be the shipowner's implementation of an Environmental Compliance Plan with regard to MARPOL and other regulations. These plans are quite extensive and this is a draft of a typical plan in 2005. Compliance is far from a trivial task.	ECP, DOJ
2005	Human Factors in Classification and Certification	American Bureau of Shipping	A technical discussion of human factors failures aboard ships not related to OWS, but noting the following main causes: • Inadequate situation assessment and awareness • Task omissions • Risk taking / risk tolerance / risk perception often associated with fatigue.	Human factors
1/1/2005	MEPC.107(49) on new construction	IMO	On this date only 107(49) OWS equipment can be installed on newly constructed vessels. The actual implementation of 107(49) is a little more complicated than just this date.	107(49), OWS, OCM
1/1/2005	SNAME forms T&R Ad Hoc Panel 14 to study OWS issues	SNAME	SNAME budgeted \$10,000 start-up funding hoping other organizations and shipowners would join in financing a clearinghouse. No additional funding was provided. Ad Hoc 14 functioned as a pro bono project.	SNAME
2/17/2005	Cruise Ship Pollution Prevention. What Works and What Doesn't?	American Association of Port Authorities	Environmental training was most difficult part of ECP. When in doubt report. Don't shoot the messenger. Transparency. Provides incident numbers (300, with 147 equipment failures). Notes white box helps.	Passenger vessels, OWS, ECP
3/24/2005	Guidelines for the Inspection of Oily Water Monitor and Separator Systems	USCG, MOC Policy Letter No. 04-13, Rev1	This is a USCG policy letter that discusses inspection issues with 107(49) systems. It discusses OCM calibration procedures (at least once every five years at IOPP renewal).	107(49), OWS, OCM



Date	Title	Publisher	Description	Keywords
5/1/2005	Treatment of Bilge Water Using a Combination of Ultrafiltration and Reverse Osmosis	Conference on Desalination and the Environment, Santa Margherita, Italy, Tomaszewska et al	Study investigating the possibility of bilge water treatment using integrated ultrafiltration/reverse osmosis (UF/RO) systems. Involved system testing with model oily waste water and collected bilge water. Considered feed concentration, transmembrane pressure.	OWS, ultrafiltration, reverse osmosis
5/19/2005	MARPOL VI enters into force		Prevention of air pollution from ships.	IMO, MEPC, MARPOL
7/22/2005	Resolution MEPC.139(53)	IMO	Guidelines for the application of the revised MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs).	FPSO
8/31/2005	Pollution Prevention Equipment required by MARPOL 73/78 MEPC.5/Circ.9	IMO	This circular is the last MEPC.5 circular to provide an international listing of approved equipment for various MARPOL regulations before IMO moved to an electronic register of equipment in GISIS. It lists a large number of 60(33) OWS and OCM manufacturers and a smaller list of the newer 107(49) OWS and OCM manufacturers. (This version of the document has deleted the other approved MARPOL equipment such as incinerators and sewage systems.)	OWS, OCM, GISIS
9/26/2005	MSC-MEPC.4/Circ.1: Retention of original records/documents on board ships	IMO	Circular outlining the actions to be taken with regard to removal of the ORB from the vessel.	ORB
9/30/2005	Ship Source Pollution & Criminalisation of Seafarers - A Shipowner's View	Robert Ho, President Fairmont Shipping, at Maritime Cyprus	Ho discusses being part of an OWS criminal investigation and requests that industry starts a think tank on the subject.	Criminal, whistleblower
11/3/2005	USCG Notice of Proposed Rule Making for Pollution Prevention Equipment	Federal Register USCG	The USCG provides notice for the inclusion of MEPC.107(49) into the CFR. The USCG estimates that the cost to install MEPC.107(49) equipment is \$13,000 higher than for MEPC.60(33) equipment for large oceangoing vessels. There is no estimate for increases in operational costs, such as filter materials and OCM calibration.	OCM, costs, OWS 107(49)



Date	Title	Publisher	Description	Keywords
11/13/2005	Bypassing the Oily Water Separator is a Shortcut to Jail!	Part of American Club Circular No. 25/05	This poster was produced and communicated to American Club Members in 2005, and led at least one shipowner to conduct a large scale bilge management initiative within their company.	OWS, magic pipe, criminal
12/1/2005	USCG approves Alfa Laval EcoStream 107(49) OWS	Alfa Laval	This is approval of a centrifugal OWS system. These systems need a filter for emulsion separation.	OWS, centrifugal
12/31/2005	6 shipping company OWS pleas		In 2005, 6 shipping companies enter plea agreements with the U.S. Department of Justice for OWS violations.	OWS, criminal
2006	NAVSEA Warfare Center Environmental Quality Systems Brochure	U.S. Navy	The U.S. Navy also has researched OWS technology solutions. This brochure mentions the VS-50 OWS and OCM tested aboard the USS WASP LHD-1.	OWS, OCM, U.S. Navy
2006	Shipping Industry Guidance on the Use of Oily Water Separators Ensuring Compliance with MARPOL	Maritime International Secretariat	This is an extensive list of recommendations that appears to be a compendium of all recommendations that have been made to date. Full compliance would require a full time crew member. This is the First Edition. No further editions are known to have been developed.	OWS, SMS, ISM
2006	4th edition consolidated MARPOL book is published	IMO	This is the 4th consolidated edition of MARPOL regulations. The most recent edition was published in 2011.	IMO, MARPOL
2006	Pollution Prevention Equipment under MARPOL 2006 Edition	IMO	This is a small book that contains the MEPC specifications for MARPOL equipment required aboard ships in 2006. It basically republished 107(49) and 76(40) (incinerators) but also provides some background. This is the latest IMO book format MARPOL equipment publication by IMO, and as such does not cover later developments. OCM is still identified as "bilge alarm."	OWS, OCM, bilge alarm
1/17/2006	Docket USCG-2004-18939 Pollution Prevention Equipment Comment	Gulf Coast Mariners Association	The USCG issued a request for comment and this is a lengthy response by the GCMA, representing smaller oceangoing vessels such as supply vessels. Request mandated training on OWS. Consider just holding tanks on smaller vessels.	USCG, OWS, MARPOL



Date	Title	Publisher	Description	Keywords
1/20/2006	Guidance for the Enforcement of MARPOL ANNEX I During PSC Examinations	USCG, G-PCV Policy Letter 06-01	This is a USCG policy letter that provides instruction to PSC officers with regard to ORB, OWS and OCM inspections during PSC visits. It provides substantial additional references.	PSC, OWS, OCM, ORB
1/30/2006	Carnival Corporation Environmental Management Report Fiscal Year 2005	Carnival Corporation & plc	Carnival Corporation issues first annual public environmental management report, which includes data on OWS failure issues.	OWS, white boxes
2/1/2006	Initial Recommendations for Bilge Oily Water Separator System Design and Operation	Presented Feb 2006, ASNE MEETS Symposium, Hendrik van Hemmen	This paper is the result of a SNAME Ad Hoc panel effort over five years, with input provided by dozens of engineers on the subject. It includes a detailed description of the OWS system and problems and has been reprinted in slightly modified formats in various journals.	OWS, OCM
2/1/2006	A Guide for Correct Entries in the Oil Record Book, Part I Machinery Operations, Edition 1, revision February 2006	Intertanko	This was an updated revision of the May 2004 guide.	ORB, sludge production, residue production
2/13/2006	A Separate Society	Lloyd's List, Michael Pryce	Mentions "for the public systems" and environmental officers.	For the public, environmental officer
3/1/2006	Polishing up Bilge Water	Marine Log, Gennaro A. D'Alterio, Met-pro.com	An article that describes U.S. Navy problems with MEPC.60(33) type OWS and describes a U.S. Navy solution using polisher filters.	OWS, U.S. Navy
3/1/2006	GISIS Database	IMO	Port Reception Facility Database goes on line through IMO's Global Integrated Shipping Database (GISIS).	PRFD, GISIS
3/2/2006	MEPC 54/10/6 Reports of Subcommittee	IMO MEPC	This report contains a discussion of OWS issues that starts in the latter half of the report. In this report mention is made of IBTS (Integrated Bilge Treatment Systems) and provides a complex proposed diagram. This approach attempts to capture all engine room drainage to the bilges and proposes treatment methods. This is a first attempt at IBTS.	OWS, IBTS
3/24/2006	IMO Equipment Data Base in GISIS	IMO	The Global Integrated Shipping Information System (GISIS) allows users to identify IMO approved antipollution equipment.	GISIS



Date	Title	Publisher	Description	Keywords
3/24/2006	Resolution MEPC.142(54)	IMO	Amendments to the guidelines for the application of the revised MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs).	FPSO
3/30/2006	Vessel Pollution & Solutions	Richard Udell, Senior Trial Attorney U.S. DOJ, Intertanko	A PowerPoint presentation by an attorney of the U.S. Department of Justice on the cause, extent and possible solutions to MARPOL violations.	MARPOL
4/18/2006	MEPC.1/Circ.511	IMO	Revised guidelines for systems for handling oily wastes in machinery spaces of ships incorporating guidance notes for an integrated bilge water treatment system.	IBTS
5/2/2006	The USCG starts an investigation based on a report that one of their own cutter men illegally discharged oily water on March 8, 2006	USCG	This matter was publicly reported by the USCG and resulted in criminal prosecution of the violator and USCG procedural review and modification. This matter indicates that motivation for violation does not automatically rest with vessel owner economic motivations.	Criminal, USCG
5/22/2006	Checklist for Considering Human Element Issues by IMO Bodies	IMO, MSC- MEPC.7/Circ.1	A restatement of the HEAP process in a checklist form.	Human factors
6/1/2006	MER Letter to the Editor	IMarEST	In an anonymous letter to the editor an engineer questions why the crew made such a fancy magic pipe. The engineer suggests that MER provides an anonymous forum.	Magic pipe
8/10/2006	MEPC 55/INF.8 Incinerators for Disposal of Oil Residues	Denmark delegation to IMO	There have been problems with vessels incinerating more oil than the rated capacity of the incinerator. This document explains that larger incineration rates than the rated capacity are not unusual.	Incinerator, ORB
9/1/2006	Oily Waste Management Onboard of Vessels	AFCAN, Capt. Le Calvez	Summary of a lecture to European law enforcement personnel. Talks about sludge discharge ports and small sludge pumps.	PSC, sludge pump sizing, PRF
9/5/2006	Solving the Oily Water Separator Puzzle	Naval Automation Group	This case study describes issues with a light scatter OCM (false positive) and the installation of a fluorescence oil detection meter.	OCM, fluorescence
10/2/2006	An Improved IBTS Diagram	Martin & Ottaway	The proposed IBTS diagram as shown in IMO MEPC 54/10/6 had some weaknesses that are addressed in this document. Overall and in retrospect this approach may have been too complex.	IMO, MEPC, IBTS



Date	Title	Publisher	Description	Keywords
12/31/2006	6 shipping company OWS pleas		In 2006 6 shipping companies enter plea agreements with the U.S. Department of Justice for OWS violations.	OWS, criminal
2007	Marine Auxiliary Machinery, 7th edition	Elsevier, H.D. McGeorge	This 2007 printing of the 1998 paperback edition of this licensed preparatory textbook still indicates that 100 ppm OWS is the strictest standard. Bilge diagram does not show OCM. OCM operational theory is incorrect.	Training
1/1/2007	U.S. Oil Record Book (Rev. 01-07)	USCG	The United States Coast Guard releases a new version of the U.S. Flag Oil Record Book, and directs vessel owners to cease use of the older version, since the old one no longer conforms to current MARPOL requirements.	ORB
3/9/2007	BIMCO Discusses Oily Water at IMO	BIMCO bulletin #2 2007	A summary report on efforts by IMO to perform a comprehensive overhaul of MARPOL Annex I regulations by Denmark.	OWS, IMO, MARPOL
3/16/2007	Carnival Corporation Environmental Management Report Fiscal Year 2006	Carnival Corporation & plc	Carnival Corporation continues to issue annual public environmental reports with data on OWS failure issues.	OWS, white boxes, cruise
4/6/2007	MEPC 56/6/2 Phase out of existing pollution prevention equipment complying with Resolutions MEPC.60(33) and A.586(14)	IMO Submitted by the USCG	With 107(49) in place the USCG recommends phase out of 60(33) and earlier equipment. Eventually this recommendation was rejected by IMO and 60(33) equipment, when installed aboard a vessel prior to 107(49), can operate until the vessel is scrapped as long as it remains operational.	OWS, 107(49), 60(33)
4/6/2007	MEPC 56/19/2 Work Programme of the Committee and Subsidiary Bodies. Proposed amendments to the revised MARPOL Annex I (Electronic means to control oil discharge from ships)	IMO Submitted by Dominica	A proposal to use electronic reporting of OWS use.	OWS, GPS
9/1/2007	KGJS's Environmental Compliance Programme	Kristian Gerhard Jebsen Skipsrederi A/S	This is a PowerPoint presentation printout that discusses OWS operational issues and upgrades by a shipowner starting in 2004. It provides actual crew comments and many other specifics.	OWS, OCM, tank, seals
11/14/2007	Appendix V Environmental Crimes Voluntary Disclosure Policy	USCG Maritime Law Enforcement Manual	This document establishes a legal process where under certain conditions shipowners can self declare environmental violations and the USCG will not recommend criminal prosecution.	Criminal



Date	Title	Publisher	Description	Keywords
12/1/2007	Draft Cruise Ship Discharge Assessment Report	Prepared by U.S. EPA	Considers five waste streams: sewage, gray water, bilge water, solid waste, hazardous waste. Discusses nature/volume of waste stream, applicable federal regulations, shipboard attempts at env management, potential env impacts, and federal steps taken toward management.	Waste stream management, cruise ship, regulations
3/31/2008	The Coast Guard's Environmental Crimes Voluntary Disclosure Policy - What It Does and What It Doesn't Do	Benedict's Maritime Bulletin, David Dickman, et al	This legal paper discusses the USCG Voluntary Disclosure Policy, which was issued on Nov 14, 2007. It is cautious about recommending its use by shipowners.	Criminal
4/15/2008	Carnival Corporation Environmental Management Report Fiscal Year 2007	Carnival Corporation & plc	Carnival continues to make their Environmental Management review publicly available. This report records the installation of white boxes on all of Carnival's fleets. It reports 9 OWS failures resulting in an estimated discharge of oil of 1744 liters in 2007.	OWS, white boxes, cruise
4/22/2008	USCG Office of Port and Facility Activity Organization	Homeland Security & U.S. Coast Guard	A PowerPoint that describes the activities and organization of this office. This is the office that deals with U.S. port reception facilities.	PRF, GISIS
5/1/2008	Britannia: Oily Water Separator Violations	Britannia	Very comprehensive report on the state MARPOL regs enforcement.	Criminal
9/1/2008	The Need for Additional Human Factors Considerations in Ship Operations	Hendrik F. van Hemmen, SNAME 2nd International Symposium on Ship Operations, Management & Economics, in Athens, Greece	This paper discusses workload changes aboard ships, and suggests that the time for an environmental officer aboard oceangoing vessels may have arrived.	Environmental officer, human factors
10/7/2008	Ferry Oily Wastewater Treatment	Elsevier	A study of membrane filtration for wastewater treatment.	Membrane
10/10/2008	MEPC.176(58)	IMO	Modifies Annex VI incinerators, which are used under Annex I.	MARPOL
11/4/2008	MEPC.1/Circ.640	IMO	Interim guidance on the use of the oil record book concerning voluntary declaration of quantities retained on board in oily bilge water holding tanks and heating of oil residue (sludge).	ORB, evaporation
11/12/2008	2008 Revised Guidelines for Systems Handling Oily Wastes in Machinery Spaces of Ships Incorporating Guidance Notes for an Integrated Bilge Water Treatment System (IBTS) MEPC.1/Circ.642	IMO	This IMO circular addresses drainage of oil residue (sludge) service tanks, often called incinerator tanks and Integrated Bilge Treatment Systems (IBTS).	Incinerator, tank naming, IBTS



Date	Title	Publisher	Description	Keywords
11/30/2008	Report on Performance of Separators operated by a shipowner	Marinfloc	Some OWS manufacturers are deeply committed to getting OWS to work right. This may involve a lot of technical work, but it provides a large amount of generally not well distributed information. This report refers to review of close to 100 emails, three ship visits, crew interviews and chemical analysis to work through some operational issues with OWS, and makes some interesting observations about real life bilge liquid compositions.	OWS, Flocculent
12/19/2008	MSC-MEPC.4_Circ3.pdf	IMO	Blanking of bilge discharge piping in port.	OWS
12/28/2008	Cruise Ship Discharge Assessment Report (final)	U.S. Environmental Protection Agency	Refers to California's Cruise Ship Environmental Task Force Report (2003) that identified a number of potential problems associated with OWS systems. Discusses environmental impacts of oil discharges (one of the few publications to do so). Summarizes typical problems identified by vessel inspections.	OWS, OCM, environmental impact, enforcement
12/31/2008	Royal Caribbean Cruises Ltd. 2008 Stewardship Report	Royal Caribbean Cruises Ltd.	Royal Caribbean issues first annual Stewardship Report.	Cruise
2009	SNAME T&R Bulletin 6-1 Guide to Diagnosing Contaminants in Oily Bilge Water to maintain, operate and troubleshoot Bilge Water Treatment Systems	SNAME, T&R Panel EC-3	Through its Technology and Research Panel EC-3, SNAME developed a step by step guide to troubleshoot OWS/OCM problems.	OWS, OCM, troubleshooting
1/6/2009	USCG Interim Rule	USCG	On this date the USCG issued the Interim Rule for Pollution Prevention Equipment, and seeks public comment. It relates to implementation and installation of 107(49) equipment on vessels built before Jan 1, 2005.	107(49), OWS, OCM
4/1/2009	A Guide for Correct Entries in the Oil Record Book, Part I Machinery Operations, Edition 2, April 2009	Intertanko	This guide was quickly superseded by the November 2009 revision.	ORB, sludge production, residue production
5/7/2009	Carnival Corporation Environmental Management Report Fiscal Year 2008	Carnival Corporation & plc	Carnival Corporation continues to issue annual public environmental reports with data on OWS failure issues.	OWS, white boxes
5/8/2009	Discussion of USCG interim rule on Pollution Prevention Equipment	Blank Rome, Jeanne Grasso	Grasso discusses the issue of having to install MEPC.107(49) OCM's on MEPC.60(33) OWS equipment when the OCM is replaced.	60(33) 107(49) OCM



Date	Title	Publisher	Description	Keywords
7/17/2009	Amendments to regulations 1, 12, 13, 17 and 38 of MARPOL Annex I, Supplement to the IOPP Certificate and Oil Record Book Parts I and II MEPC.187(59)	IMO	This IMO circular provides tank name definitions and IOPP discussions. It also notes that sludge tanks cannot be connected to the bilge system. This caused various confusion with regard to the water drainage arrangements from sludge tanks.	Tank naming, sludge piping
7/20/2009	Guide to Good Practice for Port Reception Facilities Providers and Users. MEPC.1/Circ.671	IMO	Describes the steps that need to be taken in order to effectively dispose of waste by ships at port reception facilities.	OWS, PRF, PSC
7/22/2009	MEPC.1/Circ.677 Guide to Diagnosing Contaminants in Oily Bilge Water to maintain, operate and troubleshoot Bilge Water Treatment Systems	IMO, IMarEST	IMO apparently word-for-word took the SNAME guide to OWS trouble shooting and credited the development to IMarEST. They recommend further work and recommend the guide be disseminated to all parties at interest through member governments.	OWS, OCM, troubleshooting
7/31/2009	Amendment to the 2008 Revised Guidelines for Handling Oily Wastes in Machinery Spaces of Ships Incorporating Guidance Notes for an Integrated Bilge Water Treatment System (IBTS) MEPC.1/Circ.676	IMO	This IMO circular resolves confusion between MEPC.197(59) and MEPC.1/Circ.642.	Tank naming, incinerator
11/1/2009	A Guide for Correct Entries in the Oil Record Book, Part I Machinery Operations, Edition 2, November 2009	Intertanko	This guide provides assistance to crew members in ORB record keeping. This guide is somewhat in conflict with IMO guidelines.	ORB, sludge production, residue production
12/31/2009	Royal Caribbean Cruises Ltd. 2009 Stewardship Report	Royal Caribbean Cruises Ltd.	Royal Caribbean issues second annual Stewardship Report.	Cruise
11/8/2010	MEPC.1/Circ.736	IMO	Circular that provides guidelines for the Recording of Operations in the Oil Record Book Part I - Machinery Space Operations. These guidelines have some inconsistencies.	MARPOL, ORB
12/31/2010	Royal Caribbean Cruises Ltd. 2010 Stewardship Report	Royal Caribbean Cruises Ltd.	Royal Caribbean issues third annual Stewardship Report.	Cruise
2011	Consolidated MARPOL book is published	IMO	This is the current (as of June 2015) most up to date MARPOL book incorporating MEPC resolutions up to MEPC.208(62).	MARPOL
2011	MEPC.205(62)	IMO	Guidelines and specifications for add-on equipment for upgrading resolution MEPC.60(33)-compliant oil filtering equipment.	MARPOL



Date	Title	Publisher	Description	Keywords
2011	Report on Environmental Attitudes Survey Performed by SNAME T&R Panel EC-7	Edward Schembor (Horizon Lines SNAME T&R EC-7 Intern) et al	Results of a one-year survey on maritime environmental attitudes (including OWS systems), which ran from 2010-2011.	Survey, OWS
1/1/2011	Oil Record Book Entries: Machinery Space Operations (Part I)	UK P&I Club, number 35, revised from Bulletin 24	In November 2010 IMO issued MEPC Circ. 736, and this came into force under MEPC.187(59) on January 1, 2011. This dealt mostly with ORB entry formats and the Club provided these instructions to its members.	ORB
4/9/2011	Carnival Corporation Sustainability Summary Report Fiscal Year 2009	Carnival Corporation & plc	Carnival Corporation continues to issue annual public environmental reports with data on OWS failure issues. This is the first year where Carnival combines public environmental and sustainability reporting, and when all of Carnival's subsidiary Operating Companies issue their own GRI-based FY2009 Sustainability Reports.	OWS, white boxes, cruise
5/1/2011	Guidance for the Environmental Class Notations, Clean and Clean Design	Det Norske Veritas	DNV guidance for Clean and Clean design classification designation. The bilge water section required 5 ppm treatment.	5 ppm
8/25/2011	MEPC.1/Circ.760	IMO	Amendments to the 2008 revised guidelines for systems for handling oily wastes in machinery spaces of ships incorporating guidance notes for an integrated bilge water treatment system.	IBTS
8/25/2011	MEPC.1/Circ.736/Rev.1	IMO	Guidance for recording of operations in the Oil Record Book Part I – Machinery space operations. This was the first revision, which revoked MEPC.1/Circ.736, and was superseded less than two months later.	ORB
10/6/2011	MEPC.1/Circ.736/Rev.2	IMO	Guidance for the recording of operations in the Oil Record Book Part I - Machinery Space Operations (All Ships). This is the current version, which revokes MEPC.1/Circ.736/Rev.1	ORB
11/1/2011	Oily Bilgewater Separators	U.S. EPA	OWS technology descriptions and evaluation of OWS effectiveness based on their ability to achieve low effluent oil concentrations.	OWS, OWS effectiveness
11/3/2011	Carnival Corporation Sustainability Report Fiscal Year 2010	Carnival Corporation & plc	Carnival Corporation issues first annual public GRI-based corporate-level sustainability report with data on OWS failure issues.	Cruise



Date	Title	Publisher	Description	Keywords
12/31/2011	Royal Caribbean Cruises Ltd. 2011 Stewardship Report	Royal Caribbean Cruises Ltd.	Royal Caribbean issues fourth annual Stewardship Report.	Cruise
2012	MARPOL International Convention for the Prevention of Pollution from Ships	NAMEPA	This booklet was originally distributed to seafarers in Massachusetts and North Carolina. The booklet was produced by NAMEPA through grant money from NFWF.	MARPOL, awareness
2012	Systems Design for Meeting New and Existing International Regulations	SNAME 2012 Annual Meeting, Hendrik van Hemmen; Martin & Ottaway	This paper discusses systematic approaches to international regulation implementation and argues that only integrated approaches can result in eventual successful implementation.	SMS, QESTH
5/1/2012	Accuracy Considerations in Tank Soundings and ORB Volume Recording	Martin & Ottaway	This technical memo discusses accuracy considerations and sets a reasonable standard for ORB volume recording. Developed for a shipowner based on results of a company-wide MARPOL compliance investigation conducted by M&O.	Tank volume accuracy, ORB
5/1/2012	Bilge and Sludge Tank Naming Convention	Martin & Ottaway	This technical memo discusses the importance of bilge and waste oil tank naming convention. Developed for a shipowner based on results of a company-wide MARPOL compliance investigation conducted by M&O.	Tank naming, ORB
5/1/2012	Production Capacity of OWS Equipment	Martin & Ottaway	Technical memo developed for a shipowner based on results of a company-wide MARPOL compliance investigation conducted by M&O. This memo discusses various factors that affect actual OWS production rates as compared to their rated capacities.	OWS
5/1/2012	Incinerator Use Considerations in Specific Trade	Martin & Ottaway	This technical memo relates to fuel regeneration in the composite boiler and sludge incineration. Developed for a ship owner based on results of a company-wide MARPOL compliance investigation conducted by M&O.	Incinerator
5/1/2012	Use of Unified Format Stamps in ORB Recording	Martin & Ottaway	This technical memo suggests that ship based custom stamps may improve ORB record keeping tasks. The USCG has tacitly approved this approach. Developed for a shipowner based on results of a company-wide MARPOL compliance investigation conducted by M&O.	ORB



Date	Title	Publisher	Description	Keywords
5/1/2012	Use of Excel Spreadsheets for ORB Recording	Martin & Ottaway	This technical memo proposes future development to work towards a spreadsheet approach to ORB entries. Developed for a shipowner based on results of a company-wide MARPOL compliance investigation conducted by M&O.	Reception facilities, MARPOL
5/24/2012	MARPOL Requirements for Port Reception Facilities	IMO	Lists the requirements for port reception facilities to ensure that waste can be discharged without undue delay. Discusses long standing lack of PRFs and under reporting. Port Reception Facility Database (PRFD).	OWS, PRF, PRFD
6/1/2012	Standard Specification for Shipboard Oil Pollution Abatement System	ASTM F2283-12	This is a very extensive ASTM standard for shipboard OWS systems. It addresses many issues that are associated with the design of OWS systems such as power requirements, materials, etc. In effect, it is a very extensive checklist for those involved in the design and installation of OWS systems. This is the most recent version of this standard.	OWS
12/31/2012	Royal Caribbean Cruises Stewardship Report 2012	Royal Caribbean Cruises	Royal Caribbean issues fifth annual Stewardship Report.	Cruise
2013	General Engineering Knowledge for Marine Engineers, Volume 8, pages 389-398	Reeds Marine Engineers Series, Russell, Jackson and Morton, 5th edition	This is the 5th edition of this textbook. The section on OWS starts on page 389, and makes mention of the so called magic pipe. It also mentions an ORB, but makes no mention of 107(49) or even an OCM.	OCM, OWS, magic pipe
3/6/2013	Norwegian Cruise Line introduces Eco-Smart Cruising program	Norwegian Cruise Line	Norwegian Cruise Line's public statement of environmental approach and policy.	Cruise
4/1/2013	Opex must be considered in bilge choices	The Motorship, Wendy Larsen	Article on operational and cost issues with regard to bilge water management. Provides narrative on 10/21/2014 Cleanship presentation.	OWS, operating expenses



Date	Title	Publisher	Description	Keywords
4/9/2013	KGJS's MARPOL Annex I Compliance PowerPoint presentation	Kristian Gerhard Jebsen Skipsrederi A/S	This is an updated version of a 2007 presentation by a shipowner that discusses OWS operational issues and upgrades starting in 2004. SKS reports as follows: "As our bilge management drive evolved, we received a steady stream of proposals and suggestions from the vessels. Each proposal that was found valid was tested on one or two vessels before being rolled out on the fleet. We were very concerned about not to overdoing it, questionnaires were sent to the fleet several times asking for their opinions after installations had been in use for some time. If we should point at one thing that started the momentum, it was a poster issued by the American Club warning about criminal prosecution consequences to which we added a warning that we should make sure that bad habits from incoming engineers do not spoil our progress."	OWS 107(49), OCM, tank, seals
4/24/2013	Sustainable Ocean Summit	World Ocean Council	Reviews ways to preserve oceans and also discusses the legalities of properly disposing of oily waste. Summarizes development and evolution of PRFs.	OWS, EU legislation, PRF
5/17/2013	Resolution MEPC.240(65)	IMO	2013 amendments to the revised guidelines and specifications for oil discharge monitoring and control systems for oil tankers.	ODME
5/24/2013	Cruise Ship Industry's Environmental Record: Not Triumphant	Outside magazine, Mary Catherine O'Connor	Not atypical assessment of ship operations by a partially informed author. Contains links to listings of alleged cruise ship environmental violations. Listings are unclear as to how the violations were reported (self-reported or not).	Cruise
6/27/2013	Revised Consolidated Format for Reporting Alleged Inadequacies of Port Reception Facilities. MEPC.1/Circ.469/Rev.2	IMO	This is the latest revision of a form that allows a ship master to report inadequacies in port reception facilities. This form should be submitted to the Flag State and also the Port State if possible.	PRF, inadequacy reporting
7/1/2013	Guide to Good Practice for Port Reception Facilities Providers and Users. MEPC.1/Circ.671/Rev.1	IMO	Updates the steps that need to be taken in order to effectively dispose of waste by ships at port reception facilities by including additional MARPOL IV and V developments.	OWS, PRF, PSC



Date	Title	Publisher	Description	Keywords
7/1/2013	Standard Format for the Advanced Notification Form for Waste Delivery to Port Reception Facilities. MEPC.1/Circ.644/Rev. 1	IMO	Details the standard format for notification by the ship to a port facility for acceptance of shipboard waste. This form should be submitted 24 hours prior to arrival.	PRF, advanced notification
7/1/2013	Standard Format for the Waste Delivery Receipt Following a Ship's Use of Port Reception Facilities. MEPC.1/Circ.645/Rev.1	IMO	Details the layout of what the receipt following a ship's use of a port reception facility should look like.	PRF, waste delivery receipt
9/23/2013	Carnival Corporation Sustainability Report Fiscal Year 2011	Carnival Corporation & plc	Carnival Corporation issues second annual public GRI-based corporate-level sustainability report with data on OWS failure issues.	OWS, white boxes
12/17/2013	2013 Ocean Ranger Season Report		This is a running report that is updated annually and contains a large amount of information. It shows improvement trends and no recent OWS problems in Alaskan waters. The technical description of the OWS/bilge systems has some minor errors.	Ocean Ranger
12/18/2013	MARPOL Reception Facility Inadequacies	USCG Sector Houston-Galveston MSIB 11-13	In this bulletin the USCG draws attention to some waterfront facilities' unwillingness to accept residue and waste from vessels, which in certain circumstances can be a finable legal violation.	Reception facilities, MARPOL
12/19/2013	Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels	EPA	This study addresses discharges of oil, including oily mixtures, from ships subject to MARPOL. It also includes technology-based effluent limits and related requirements for specific discharge categories, including bilge water discharges.	VGP
12/31/2013	2013 Final Issuance of National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of Vessels Fact Sheet	EPA	Exhaustive EPA review of VGP. On Page 62 it discusses bilge water requirements and discusses the possibility for requiring 5 ppm equipment.	5ppm, VGP
1/1/2014	MARPOL International Convention for the Prevention of Pollution from Ships	NAMEPA; updated in Jan 2014	Since the original printing NAMEPA has printed and distributed this MARPOL booklet to over 200,000 seafarers, port communities, recreational boaters and students throughout North America.	MARPOL, awareness



Date	Title	Publisher	Description	Keywords
1/14/2014	Characterizing shipboard bilgewater effluent before and after treatment	Environmental Science and Pollution Research (2014) 21:5637-5652; McLaughlin et al	This study looked at the effectiveness of bilge water treatment systems. Includes land-based type approval data for 20 OWS systems and experimental data for three shipboard OWS systems. Very instructional paper with regard to actual OWS operations, although it only has a small shipboard sample. It notes that there are issues with false positives and false negatives for optical OCMs used aboard ships.	OWS, OCM
2/3/2014	Carnival Corporation Sustainability Report Fiscal Year 2012	Carnival Corporation & plc	Carnival Corporation issues third annual public GRI-based corporate-level sustainability report with data on OWS failure issues.	Cruise
4/4/2014	Resolution MEPC.244(66)	IMO	2014 standard specification for shipboard incinerators.	Incinerators
10/21/2014	Upgrading Bilge Water System on Vessels delivered 2010-2012	OSV Conference, Cleanship.se	Case study on OSV bilge water management. Customization of vessel for specific trade, while maintaining original functionality.	OWS
11/19/2014	Carnival Corporation Sustainability Report Fiscal Year 2013	Carnival Corporation & plc	Carnival Corporation issues fourth annual public GRI-based corporate-level sustainability.	Cruise
12/15/2014	Ocean Ranger Guidebook	Alaska Department of Environmental Conservation	Most recent version of the Ocean Ranger guidebook, which notes that Alaskan cruise ships generally do not use the OWS to discharge in Alaskan waters (p73). Book provides a lengthy discussion of OWS, but is not always correct or clear (strip chart on p. 77, definitions of OWS, oil filtering equipment and OCM).	Ocean ranger
1/1/2015	Oil Record Book for Dummies	John Wiley and Sons/Hornbeck Offshore by Todd Brock	Hornbeck Offshore worked with the "Instructions for Dummies" people to create a little pocket guide for ships' crews regarding ORB's. This is a very clever guide that clearly delineates what is cause for concern and what is simply shipboard life. It also explains ORB record keeping in lighter vein, which helps everybody feel a little better about the subject. The change in tone is a major innovation. Even if things are serious, it does not mean that humor in training is not allowed.	ORB, training
2/2015	OWS Tech Discussion: Pre/Post Treatment	Prepared by Martin & Ottaway for the MAX1 Studies	This informal discussion looks at the role of pre- and post-treatment for Flag State approved OWS systems.	Pre/post treatment



Date	Title	Publisher	Description	Keywords
2/2015	A Failure to Communicate Case Study	Prepared by Martin & Ottaway for the MAX1 Studies	This case study was prepared as a thought exercise, based on an experience of oil contaminated water being drawn into a boiler.	Criminal
4/2015	A discussion on data for OWS operations failures	Prepared by Martin & Ottaway for the MAX1 Studies	This informal discussion looks at the lack of data on OWS operations failures. It also asks for any data that would allow the industry to track the frequency of OWS failures more effectively.	Criminal
5/15/2015	MEPC.266(68)	IMO	This is the full MEPC.266(68) report that shows the incredible amount of regulatory activity that takes place in just one IMO MEPC meeting. Only a part of it applies to OWS and shipboard waste, but often things interconnect. Shipboard exhaust gas scrubbers generate waste water, so how should this water be treated for disposal? The Polar code also requires amendments in MARPOL Annex I. This document also includes specific Amendments to MARPOL Annex I Chapter 3 Requirements for Machinery Spaces of All Ships Part A Construction Regulation 12 – Tanks for Oil Residues (sludge) Paragraphs 1 to 4.	Sludge tanks, sludge piping
5/28/2015	How to Fix a Broken Police Department	The Atlantic, Alana Samuels	Not an OWS or marine environmental management article, but in the Martin & Ottaway blog , Rik van Hemmen makes a case that this article has parallels to the human factors aspect of ECP implementation.	ECP, human factors, transparency
6/24/2015	MAX1 Conference in Wilmington, North Carolina	Martin & Ottaway	This conference, a component of the MAX1 studies, brought together a cross section of all stakeholders for OWS and Shipboard Waste Management. It also provided major input to the MAX1 studies final report. For presentations from the conference, go to this link .	OWS, training
9/1/2015	Conclusion of MAX1 Studies	Martin & Ottaway, National Fish & Wildlife Foundation	Documentation related to the MAX1 studies, including the final report, survey results, and IMO recommendations can be found on the Martin & Ottaway website at this link .	



VIII. MAX1 SURVEY KEY FINDINGS

Note: the full list of survey questions, summary results, full raw data, skipping logic flow chart, and a number of other survey resources are available at the link on the bottom of this page.

Overall, our survey takers were relatively positive about the effectiveness of MARPOL Annex I waste stream management, but suggested many areas for improvement, especially regarding increasing and improving training, running drier bilges, and improving Port Reception Facilities⁸.

Introduction

The MAX1 Survey was a key component of the MAX1 Studies, which had the following overarching goals:

1. To establish the current state of shipboard waste stream management and OWS knowledge across a wide range of maritime occupations and roles
2. To determine perceived effectiveness of current waste stream management and OWS systems
3. To solicit opinions on increasing the effectiveness of waste stream management and OWS systems

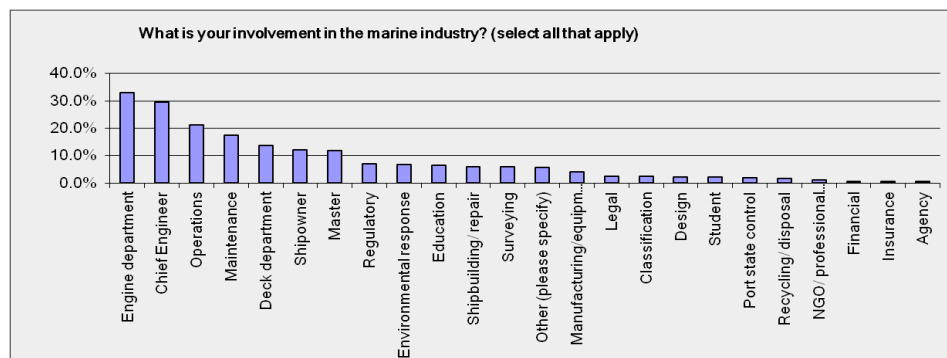
The survey was developed in consultation with MAX1 Partner Organizations⁹. It was opened on April 28, 2015, and remains open to accept responses. Responses are completely anonymous. The below analysis was conducted using the data up to June 25, 2015. At that time there was a total of 500 responses. Since that time, 14 additional responses have been received.

The survey continues to be available at the link: www.surveymonkey.com/s/max1survey

The full list of survey questions and survey results (including raw data) are available at the link: <http://www.martinottaway.com/technical-documents/MAX1-Studies/survey>

Survey taker demographics

Over 98% of the survey takers indicated that they were at least partially a member of the marine industry at some point in time, in the following reported capacities:



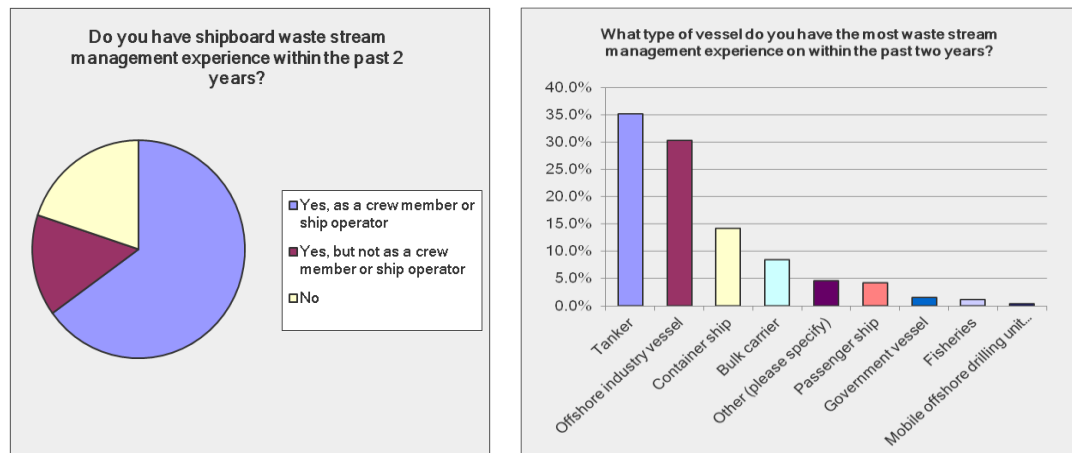
⁸ Many survey takers also suggested improving OWS technology, but the majority of specific complaints with OWS tech involved problems generally associated with OWS technology designed to comply with MEPC Resolution 60(33). As ships constructed after 2005 must be fitted with units that comply with MEPC Resolution 107(49), MEPC.60(33) units are no longer manufactured, and therefore we have not made this a main focus for improvement.

⁹ The list of MAX1 Partner Organizations can be found [here](#).



Average number of years in the industry was 20 years (median = 15 years, mode = 15 years). 42% of respondents live in North America, 34% live in Europe, 20% live in Asia, and the remaining 4% live in Africa, South America, and Australia.

A large component of our survey takers were crew members or recent crew members, and we note that certain sectors were considerably better represented than others - see below:

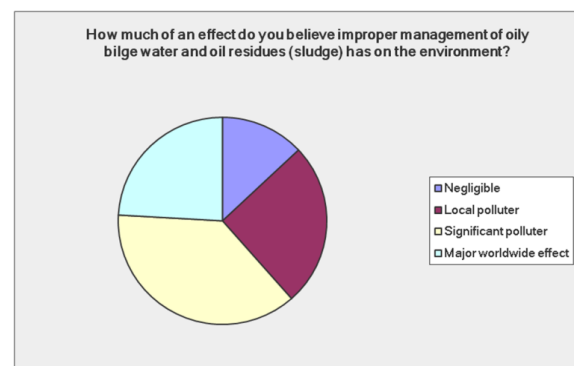


Current state of knowledge (Survey Goal #1)

Over 98% of our survey takers knew what MARPOL was, 99% of survey takers knew what bilge water was, and 96% knew where shipboard oil residues (sludge) comes from. However, since the majority of our survey takers were voluntary¹⁰, in all likelihood our survey takers are considerably better informed about these issues than the general maritime population.

There was a wide range of opinions regarding the impacts of improper management of oily bilge water and oil residues on the environment. For the significant proportion of people who thought that the effects were negligible (13%), it may provide an incentive for compliance if they are exposed to compelling evidence that the effects are not negligible.

A majority of the survey respondents were also unaware that there are any valid or legal reasons to discharge untreated oily bilge water or oil residues (sludge) overboard (65% said no valid reasons, and 60% said no legal reasons). If crews and shipowners were made aware that emergency situations could be reported without fear of legal repercussions, this could reduce possible cover-ups and mistrust between parties¹¹.



¹⁰ The non-voluntary survey takers included a number of engine room crews that were asked to complete the survey by their shipowners.

¹¹ The survey results show that lack of trust is the most common complaint for Port State Control inspections, with 46% of survey takers with waste stream management experience in the past 2 years encountering these problems.



Main outcomes

The remainder of this report is broken into the main topics covered by the survey (with respect to MARPOL Annex I wastes), as follows:

- MARPOL regulations
- Shipboard waste stream management (general)
- Oily Water Separators
- Port Reception Facilities
- Training
- Paperwork

Each section discusses current perceived effectiveness (Survey Goal #2) and potential methods for improving effectiveness informed by the survey results (Survey Goal #3).

Before discussing the survey results for the topics listed above, it is informative to look at the results of the final two questions on improving shipboard waste stream management overall first, since they provide a picture of the most important issues to the survey takers, and were, for the most part, reflective of the overall survey results.

In Question 56, survey takers were asked to rate 21 approaches for improving shipboard waste stream management in terms of effectiveness. The top ten rated^{12,13} approaches were:

1. Improve on-board training
2. Run "dry" bilges where possible and minimize OWS operations
3. Improve academy / maritime school training
4. Improve OWS technologies such that OWS operation becomes less labor intensive
5. Develop a concise and ship's crew focused guidance document describing the obligations under MARPOL on a shipboard level
6. Require shipboard testing of OWS systems before acceptance by IMO and/or USCG (in order to test real world ability to produce effluent <15 ppm)
7. Develop methodology that holds equipment suppliers more directly responsible
8. Perform human factors studies
9. Automate waste stream management records through a shipboard plan maintenance system that automatically date stamps entries
10. Automate ORB entries (with automatic date stamped entries)

Question 57 was the corresponding open-ended question on how to improve shipboard waste stream management, and the most common suggestions were, respectively: training, improving/simplifying equipment, education, increasing the number of Port Reception Facilities (PRFs), reducing ORB paperwork, lowering cost of PRFs, installing bigger storage tanks, and sending all waste ashore. Note that, at the time of survey design, we did not anticipate the extent of the PRF problem and therefore improving PRFs was not included as an option in Question 56.

¹² A rating of "counter-productive" was assigned a value of -1, "not effective" = 0, "somewhat effective" = 1, "extremely effective" = 2, "not sure" = 0, and ratings were averaged over all responses.

¹³ Recall that due to a heavy crew component, the most popular methods may be somewhat biased towards methods beneficial for crew members (e.g. methods with low shipboard time commitment).



However, the most popular methods are not necessarily the most effective methods, and technical and systems analysis is also required. For example, while method #6 was a relatively popular suggestion, in reality it would be very difficult to execute effectively, since different OWS systems are more or less effective depending on the vessel type, frequency of use, and type of bilge effluent being processed. In this report, we endeavor to provide the survey results as found, but also discuss these technical and systems considerations where appropriate.

MARPOL regulations

Perceived effectiveness:

The majority of survey takers thought that MARPOL Annex I regulations are generally effective, although apparently less effective than most other MARPOL Annexes:

- 91% thought MARPOL regulations are generally effective at preventing shipboard pollution
- 79% thought MARPOL Annex I regulations are generally effective at preventing *accidental* oil pollution
- 68% thought Annex I regulations are generally effective at preventing *intentional* oil pollution
- Only 2.1% of survey takers agreed with the statement "MARPOL Annex I is broken"

However, in the open-ended questions, a significant number of people noted MARPOL Annex I as too long and too confusing. This is also reinforced by the fact that creating a concise and ship's crew focused MARPOL guidance document was ranked as the fifth highest ranked solution in Question 56.

Increasing effectiveness:

In addition to developing a concise guidance document, the following common and/or interesting suggestions were identified in response to the open-ended question "Do you have any specific suggestions to improve MARPOL Annex I regulations?":

- Simplify/reduce confusion - "Too much reading, not decisive and clear-cut enough and doesn't get straight to the point like most IMO issued regulations and documentation"
- Shift responsibility to incentivize compliance (e.g. to Captain)
- Ensure adequate crew size through an IMO requirement
- Anonymous feedback mechanisms
- "Reset the limits for overboard discharge to 50 ppm. Most oily water separators can attain this and, more importantly, most monitors, even those using light scatter principles, can reliably indicate oil content as opposed to paint, rust, sediment within this range."
- "The huge net of Annex 1 is too constrictive, trying to cover 500m ships to 50m yachts. Surely the only, single regulation should be 'Do not intentionally dispose of or discharge hydrocarbons at sea'. How you deal with that is up to you. If you fail, you are in breach & liable to action."

We also received a large number of very general outlooks in this open-ended question related to training, port reception facilities, paperwork, shipboard waste stream management and related



topics. It is unclear whether the intent of these suggestions was for actual MARPOL regulations to be modified to make these suggestions required, or whether survey takers were suggesting improvements for increasing compliance within existing regulations¹⁴.

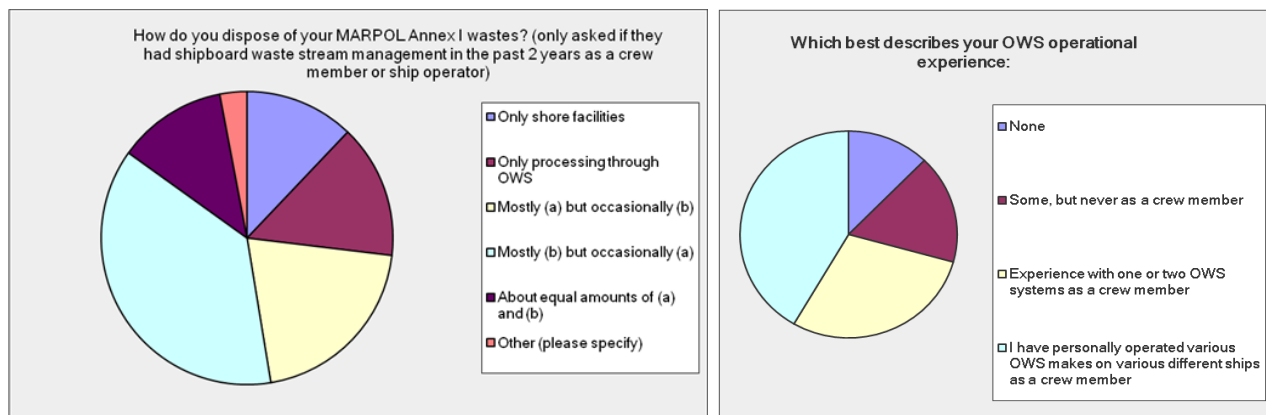
Shipboard waste stream management

Perceived effectiveness:

Perceived frequency of MARPOL Annex I violations remains high, but does appear to be going down, with the perceived percentage of ocean-going ships' crews that violate MARPOL Annex I going down from an average of 28% in 2011¹⁵, to 20% in our survey.

With regards to the source of MARPOL Annex I wastes, the most common reported problematic bilge water inflow type was leakages (45 respondents), followed by condensation (32 respondents), and then wash water / cleaning (17 respondents).

Regarding disposal of MARPOL Annex I wastes, we note that our survey takers had both significant experience with disposal of MARPOL Annex I wastes via port reception facilities (PRFs) and disposal overboard after processing MARPOL Annex I wastes through an Oily Water Separator (OWS) - see charts below. Specific perceived effectiveness of both of these methods is discussed in their respective sections of this report.



Increasing effectiveness:

Outside of improving Port Reception Facilities, Oily Water Separators, training, and paperwork requirements, which are all discussed individually below, running drier bilges was mentioned frequently in the open-ended responses, and was also the second highest rated method for improving shipboard waste stream management in Question 56.

¹⁴ These general comments may be due to the fact that this question appeared early in the survey, when survey takers were not sure whether they would have open-ended questions later in the survey to provide their opinions on related matters.

¹⁵ The 2011 data comes from a year-long survey administered by the Society of Naval Architects and Marine Engineers (SNAME) on environmental attitudes regarding the maritime industry. More information on this survey is available [here](http://www.martinottaway.com/technical-documents/MAX1-Studies).



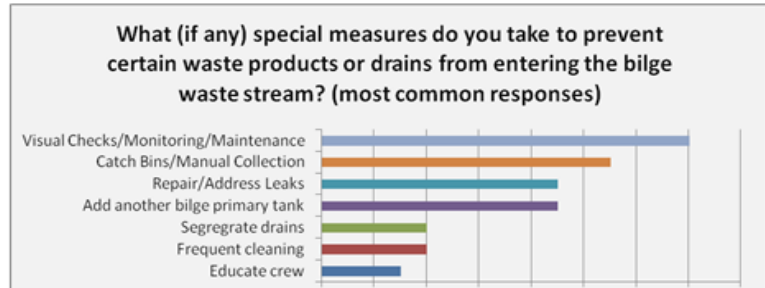
Practical methods for running drier bilges, and reducing / stopping bilge water production as much as possible at the source, are relatively self-explanatory. These approaches can be seen in the most common responses to the voluntary open-ended question asked of crew members with recent¹⁶ shipboard waste stream management experience.

Increasing holding tank capacities and giving crews the resources to conduct regular maintenance were also common suggestions in other open-ended responses.

We note that regular maintenance to minimize bilge water production requires that Owners supply their crews with adequate and good quality spares, and ensure that crews are not overburdened so that there is sufficient time to stay ahead with maintenance.

Other common and/or interesting open-ended suggestions to generally improve shipboard Annex I waste management included:

- Need to invest in a whole system approach rather than just compliance
- Creating a crew culture of compliance - "It's only as effective as the onboard leadership"
- Increase equipment capacities
- Correctly designed sludge/bilge segregation systems
- Providing adequate spare parts - "Some owners put CE's in a precarious position by not having a properly functioning OWS, not supporting with supply of necessary spare parts"
- "Most ship visits I have conducted to solve problems involve a lack of operator maintenance, inoperable equipment or the wrong type of equipment for the vessel's operating condition. One size or type of equipment does not solve waste stream problems. Evaluate vessels from a whole vessel and crew perspective to solve discharge problems."



Oily Water Separators

Perceived effectiveness:

The average perceived effectiveness of OWS's was 7.2 out of 10 (median = 8, mode = 8), and as expected, the MEPC 60(33) compliant equipment was perceived as less effective than the MEPC 107(49) equipment¹⁷.

Issues reported when operating an OWS¹⁸ included equipment breaking/malfunctioning (14 responses), dirty/muddy water affecting performance (12 responses), frequent maintenance/cleaning (9), clogging (8), staying under the 15 ppm limit (7), alarm/sensor failure

¹⁶ Within the past two years

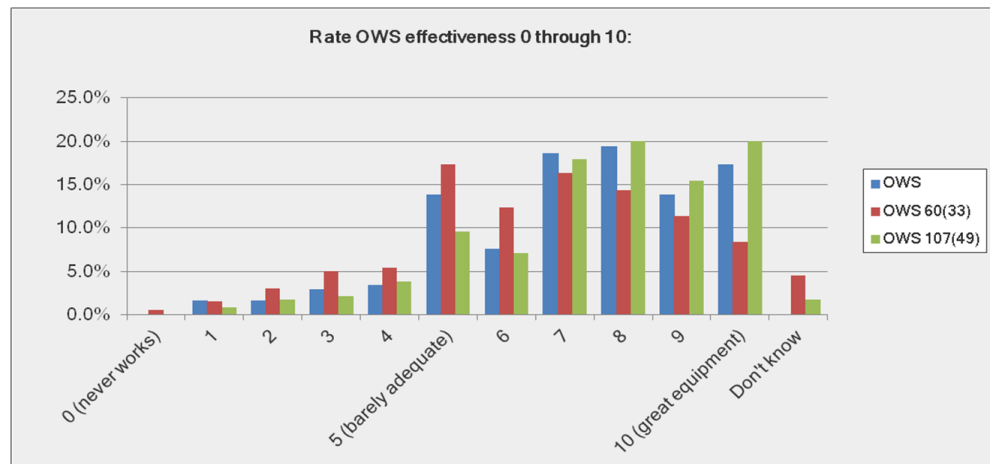
¹⁷ 60(33) Mean: 6.54, Median: 7, Mode: 5

107(49) Mean: 7.52, Median: 8, Mode: 8

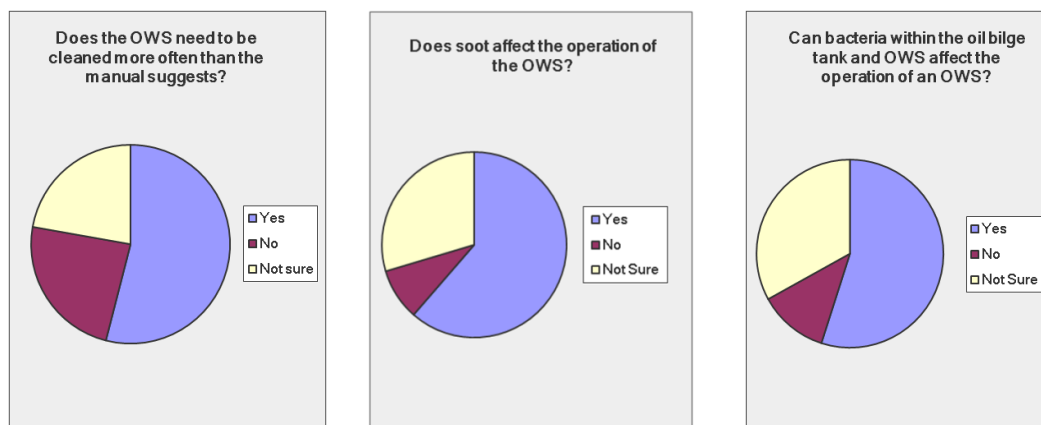
¹⁸ In response to the question "What are the common issues you experience (or have heard of) when operating an OWS?", which received 161 responses.



(7), soaps/detergents affecting operation (6), contamination (6), emulsions (5), and lack of familiarity/understanding of the system (5).



The following considerations also appear to be relevant:



However, we note that MEPC.60(33) units are no longer manufactured, as ships constructed after 2005 must be fitted with MEPC.107(49) units, and therefore we should focus on problems with 107(49) units. Common complaints about MEPC.107(49) units were:

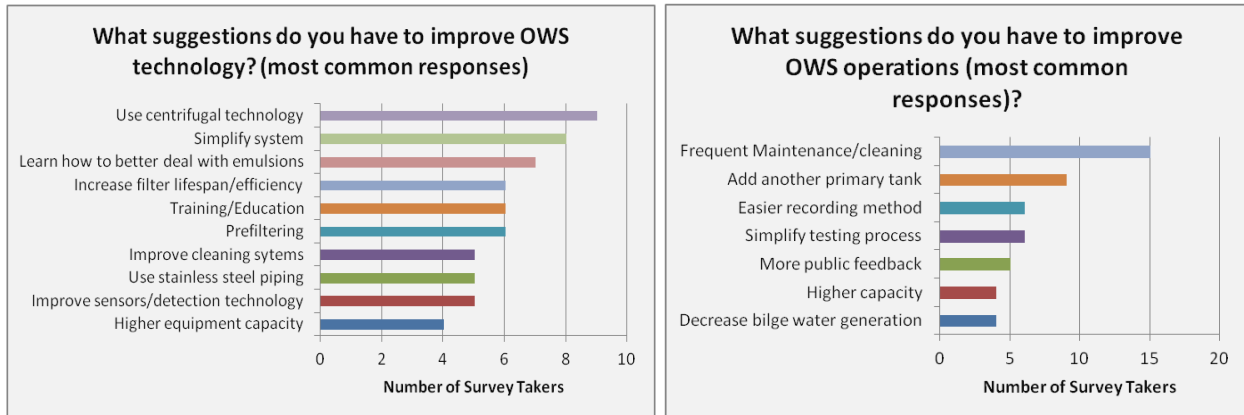
- Time-intensive maintenance/cleaning
- Faulty OCM readings, e.g. "Better 15 ppm monitor designs. Most monitors give incorrect alarms when the sample is dirty due to mud or rust from pipelines."
- Contamination of the filtering elements, e.g. "Second stage filters (like spirolators) become clogged too fast and are expensive"

The "favorite" OWS manufacturer was JOWA, followed by Alfa Laval, RWO, Marinfloc, and Coffin (respectively). The favorite OCM manufacturer was Deckma. However, due to the large number of OWS manufacturers, low frequency of individuals with exposure to many different types of OWS systems, and considering the size of our survey, our survey's rankings are unlikely to be an accurate representation of the preferred manufacturers throughout the industry.



Increasing effectiveness:

Improving OWS technology was a common suggestion throughout the survey results, and more specifically, suggestions from our survey takers included:



Based on the survey results, it appears that a large number of reported issues with MEPC.107(49) units can be improved through adequate crew training¹⁹ (see the training section of this report), and ensuring that the OWS system selected is the proper one for its intended use. For a shipowner, these types of systems considerations will likely provide the greatest improvements to OWS operations.

For the remaining issues, particularly the time-intensive nature of OWS cleaning/maintenance and OCM detection problems, we note that the best method to address issues may not be to amend regulations to make a particular technology required, but rather to incentivize manufacturers to continue to improve OWS/OCM technology²⁰.

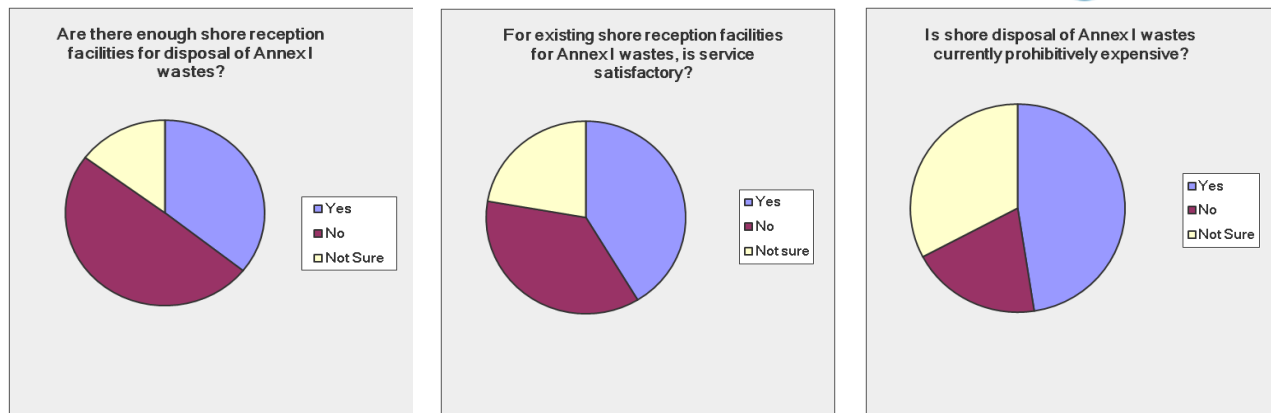
Port Reception Facilities

Perceived effectiveness:

Common issues cited for PRFs were cost, lack of facilities, improper disposal, environmental considerations and time considerations. The following charts show considerable perceived inadequacy of PRFs in terms of availability, service, and cost.

¹⁹ For example, interestingly, 23% of all survey takers with OWS operational experience said that the OWS did not need to be cleaned more frequently than the manual suggests. However, among those that only operated a 107(49) OWS and had had formal OWS training, this number went to 45%.

²⁰ For example, Rik van Hemmen proposes that the USCG name both the shipowner and the OWS/OCM manufacturers in press releases regarding OWS-related pollution prosecutions. His blog on this subject is available [here](#). Note that this is simply a proposed approach, and, for example, a public USCG or worldwide IMO list of pleas and detentions by equipment make and model would achieve the same result.



In the open-ended question asking what the biggest problem with PRFs was, the most popular response among survey takers was cost.

Increasing effectiveness:

Unfortunately, at the time of survey design, we did not anticipate the extent of the PRF problem and therefore did not build questions that mined specific suggestions for improving PRFs.

In any case, it is clear that the availability of PRFs that accept MARPOL Annex I wastes needs to be improved²¹. It is possible that this will inherently lead to improved service and reduced costs due to competition and oversight, and if not, new solutions may have to be developed to force PRFs to do so.

Common ideas mined from open-ended questions included:

- Develop relationship between shipboard personnel and shore facilities (feedback mechanisms for customer satisfaction)
- Increase speed of discharge
- Move burden of PRF disposal cost - e.g. "Every port should have mandatory reception facility which should be part of the port dues. This should cover all vessels staying or calling at anchorage"

Training

Perceived effectiveness:

Increased *and* improved training was consistently noted by survey takers as key to improving shipboard waste stream management. Training was also the most common suggestion for the open-ended question on how to improve shipboard waste stream management.

For general MARPOL Annex I waste stream management, only 5% of crew members have not received any training.

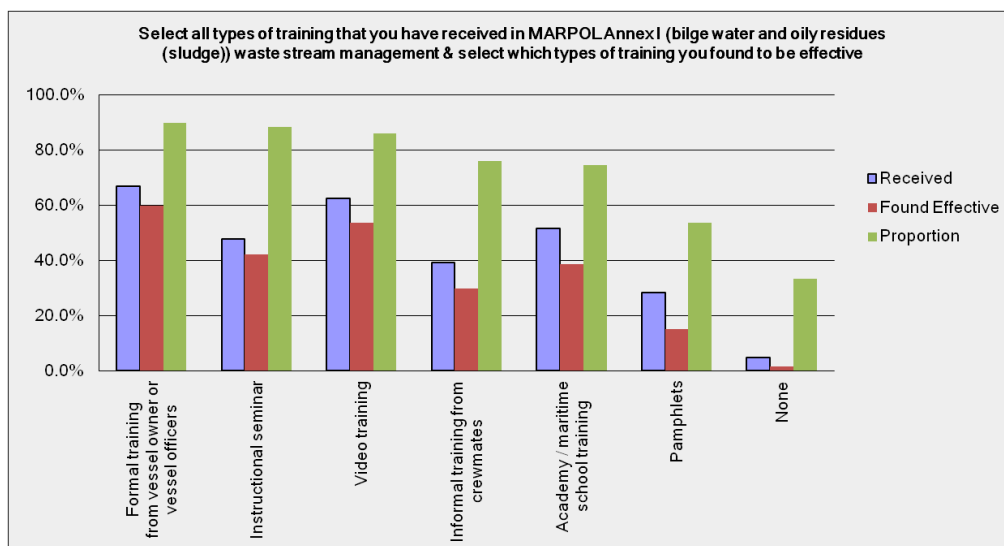
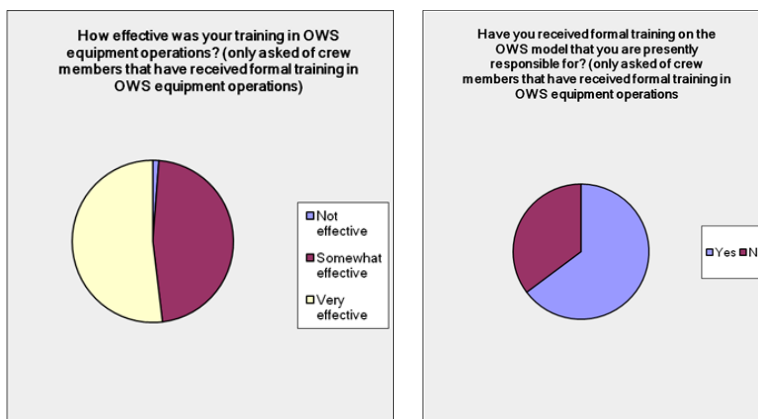
²¹ We note that, in theory, all signatory states that are party to MARPOL Annex I (see Regulation 38) are already required to provide adequate reception facilities.



Lack of OWS training was far more common, and of those crew members with OWS operational experience, only 55% have received formal training in OWS equipment operations. Of those with training, the results to the right apply.

Increasing effectiveness:

For MARPOL Annex I training, among crew members, the type of training that was perceived to be the most effective was formal training from vessel owner or vessel officers (designated person), followed by instructional seminar, and video training, respectively²².



Regarding OWS training, suggestions of *specific* OWS training (by manufacturer) and use of operational training were very common in the open-ended responses.

Paperwork

Perceived effectiveness

Paperwork reduction was a common response in a number of open-ended responses, and two solutions related to paperwork reduction were on the top ten list of suggestions to improve shipboard waste stream management (Question 56).

The majority of survey takers with waste stream management experience in the past 2 years thought that the paperwork burden on ship's crews for machinery space waste streams was manageable (58%). That said, reducing and streamlining paperwork would allow crews to

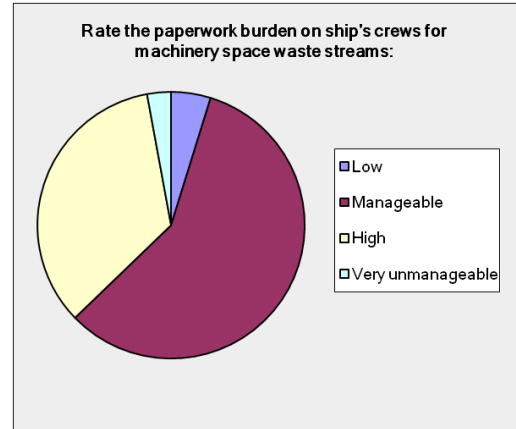
²² However, when filtering for crew members who live in Asia, the most effective self-reported methods of training were instructional seminars and video training.



spend more time maintaining drier bilges (e.g. chasing leaks, staying ahead on maintenance), as discussed in the general shipboard waste stream management section above.

Open-ended responses also included a number of complaints similar to the following examples:

- "Too much paperwork. Cannot operate effectively because we are constantly to see if we have logged the operation correctly."
- "Big problem in US that USCG has not updated ORB since 2007. This makes it difficult to fully comply with changes to MARPOL Annex I that have been adopted."

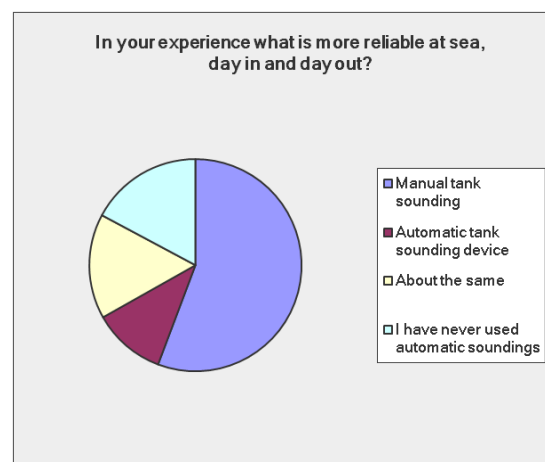
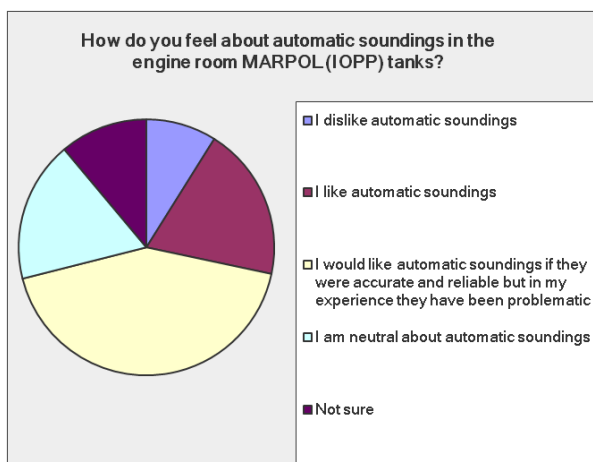


Increasing effectiveness

Reducing paperwork was a very common suggestion in the open-ended responses. More specific paperwork reduction suggestions included:

- *Approved* automated software systems (e.g. electronic ORB linked to automatic tank soundings)
- Streamline and reduce redundancy, e.g. all waste streams in a joint digital framework
- A "paperwork officer" / "clerk" crew member
- "Think you are at the middle of ocean, rolling about 15 days and manual sounding taken and try to match with Orb. This is an ex. When u want to implement a documentation think you are onboard not on a desk in office."

Automatic soundings could theoretically reduce the handwritten paperwork required for manual soundings and be automatically logged into a computer, but crew members cite accuracy concerns with current technology:



In response to the possibility of electronic Oil Record Books, 41% of people with shipboard waste stream management in the past two years indicated that they would prefer an electronic



ORB with more automation. As suspected, when this number is broken down by years in the industry, those that indicated they were in the maritime industry <10 years averaged 53%, and those >30 years averaged 37%, probably as a result of young members of the industry's higher level of familiarity with computers. Interestingly, when filtered by crew members, the percentage did not change significantly, while when filtered for those involved with regulatory maritime matters, the percentage averaged 59%.

Future opportunities

During analysis of the survey results, it quickly became apparent that the survey data collected was incredibly rich, and could be mined for far more data than that detailed above. We endeavored to make the points raised above reflective of the main issues and suggestions raised by survey takers, but certainly have not detailed all valid and interesting data.

The raw data is available in its entirety in Excel format should anyone wish to conduct their own analysis. If you choose to conduct further analysis, please feel free to submit interesting results to Martin & Ottaway via info@martinottaway.com to be used for further dissemination to the public. We compel everyone to use the data responsibly and to avoid "cherry picking" results.

We also note that the survey remains open to accept new responses, and therefore that results may change over time.

Go to www.martinottaway.com/technical-documents/MAX1-Studies/survey to find:

- The electronic version of this report
- Full list of MAX1 Survey questions
- Skipping logic flow chart for MAX1 Survey questions
- Summary results for all questions as of August 11, 2015
- Full raw data for all questions as of August 11, 2015
- Open-ended responses to OWS technology questions
- Selected filtered survey results by age, profession, continent, and vessel type

Finally, we want to thank everyone that was involved in the development and dissemination of the survey, as well as all that took the time to take it. This survey was intended to provide a method for measuring progress for an issue that has very few available metrics, and we believe the results were incredibly valuable for waste stream management improvement. In the words of one of our anonymous survey takers: "Things that are not understood are ignored".



IX. MAX1 CONFERENCE

Note: the conference agenda and biographies for speakers and panelists can be found at the link on the bottom of this page.

A conference with all interested parties was held on June 24, 2015 in Wilmington, North Carolina. The main objective of the conference was to engage stakeholders in discussions and deliberations regarding the path forward for machinery space waste stream management.

The MAX1 Conference proved to be very productive. Only the collaboration and vigorous debate by the varied participants provided a clarity that resulted in this report's recommendations. The conference showed that candid and knowledgeable discussion can resolve complex problems. Once these discussions have taken place, overall success can only be achieved by the dissemination of the answers and the faith associated with the reputation of the participants.

The background, age, point of view, and industry association of the participants was extremely varied, and included:

- Ship Owners
- Ship Operators
- Ship Masters
- Ship Engineers
- DPA's
- Equipment Manufacturers
- Consultants
- Port State Control
- Flag State
- Regulators
- Scientists
- Naval Architects
- Environmental Managers
- Maritime Educators
- Marine Engineers
- Technical Societies
- Attorneys
- Cruise Industry
- Offshore Industry
- Reefers
- Bulkers
- Container Ships
- Tankers
- Environmental Protection Agencies
- Environmental Advocacy Groups

Attendee names and organizations are included as Appendix D of this report.



X. WIKIPEDIA UPDATES

While the study information continues to be accessible through the M&O website, one of the study's objectives was to provide accurate information on the study subjects via Wikipedia, the most widely used technical reference in the world, since existing Wikipedia entries on the study subjects were incomplete and inaccurate.

The following Wikipedia pages were updated by the MAX1 Studies project team:

Page Name	Work Done	Link
IMO	Revision	https://en.wikipedia.org/wiki/International_Maritime_Organization
MARPOL 73/78	Revision	https://en.wikipedia.org/wiki/MARPOL_73/78
MARPOL Annex I	Created	https://en.wikipedia.org/wiki/Marpol_Annex_I
Oil content meter	Created	https://en.wikipedia.org/wiki/Oil_content_meter
Oily water separators	Created	https://en.wikipedia.org/wiki/Oily_Water_Separators
Oily water separator (marine)	Revision	https://en.wikipedia.org/wiki/Oily_Water_Separator_(marine)
Oil Detection Monitoring Equipment	Created	https://en.wikipedia.org/wiki/Oil_Discharge_Monitoring_Equipment
Port reception facilities	Created	https://en.wikipedia.org/wiki/Port_Reception_Facilities
Oil Record Book	Created	https://en.wikipedia.org/wiki/Oil_record_book
Magic Pipe	Revision	https://en.wikipedia.org/wiki/Magic_pipe
Bilge	Revision	https://en.wikipedia.org/wiki/Bilge

In addition, various terms were added to disambiguation pages and references were vastly increased. The overall effort very readily provides the reader with relevant and more accurate information and more quickly directs the reader to relevant Wikipedia articles when using search engines.

Wikipedia is never complete, but, at present, the structure exists that will provide a proper framework for further enhancements.



XI. IMO RECOMMENDATIONS

This document outlines recommendations made to the International Maritime Organization (IMO) in order to improve shipboard machinery space waste stream management, as regulated under the MARPOL Convention, and particularly MARPOL Annex I.

Introduction

Historically, improvements to shipboard waste stream management have been hampered by a lack of open communication and technical cooperation. Therefore, this effort particularly focused on cooperative evaluation and analysis, especially through identifying and engaging stakeholders to consolidate possible divergent points of view²³.

The study also collected and consolidated²⁴ references to over 50 years of efforts by IMO, Flag and Port State authorities, and individual maritime companies and organizations to reduce ocean pollution from machinery space waste disposal. The study found that while initially progress was slow, around the year 2000, greater awareness of the limitations of prior regulations to effectively deal with engine room waste disposal led to a great variety of efforts in increasing effectiveness.

The MAX1 Studies indicated that today's regulations are, for the most part, sufficient for their purposes. In order to further reduce MARPOL Annex I related instances of pollution, IMO should contribute towards assisting stakeholders (industry and regulators) with more effective implementation and/or application of existing regulations. Only minor specific adjustments to regulations based on stakeholder-identified remaining issues with machinery space waste stream management are necessary.

Assist stakeholders with implementation of existing regulations

The MAX1 Studies showed that there are few regulations that would benefit from changes²⁵. Instead, most of the remaining issues with machinery space waste stream management are related to inadequate **implementation** of regulations.

For example, in theory, all signatory states that are party to MARPOL Annex I are required to provide adequate port reception facilities (PRFs) (see Regulation 38). However, in practice, the MAX1 survey results and other industry feedback indicate that PRFs that accept Annex I wastes are thinly distributed, costly, and provide inadequate service in many regions of the world. This makes disposal of Annex I wastes a shipboard frustration that involves lengthy communication and operational distractions, leading to possible violations.

²³ Notably, the study included a widespread industry survey (further info [here](#)) and a single day conference (further info [here](#)) with representatives from all major stakeholder groups.

²⁴ These consolidated efforts are available as a chronological document [here](#).

²⁵ For example, there have been various efforts at reducing the legal discharge limit from 15 ppm to 5 ppm. The study indicates that this would be counterproductive and destabilizing, requiring many years for implementation and creating confusion and possibly new myths. Additionally, we note that while state-of-the-art MEPC.107(49) OWS systems can routinely deliver 5 ppm discharges, today's OCM technology cannot effectively monitor that discharge level, resulting in false alarms, impossible troubleshooting and crew frustrations.



Similarly, with regard to crew training, Section 1.1.5 (Training) of Resolution MEPC 107(49) recommends that "Ship staff training should include familiarization in the operation and maintenance of the equipment." Also, under the STCW convention, knowledge/understanding of oily water separator requirements and operation is required for the certification of watch keeping engineering officers²⁶. However, stakeholder feedback, and in particular crew feedback, shows that crews are often not trained in OWS operations, and are only rarely trained in the OWS model that they are tasked with operating.

Therefore, we recommend to IMO that, first and foremost, it undertakes to assist all stakeholders (Flag States, Port States, shipowners, ship operators, equipment manufacturers, shipbuilders, and ships crews) to fully implement and apply the regulations according to their original intent, and in particular to align with stakeholders in the following areas for improvement:

- Increasing and improving crew **training** (in OWS operations and MARPOL regulations)
- Addressing availability and cost issues with **port reception facilities**
- Moving towards **drier bilges**
- Increasing and improving crew **dialogue with shore** management (making crews feel comfortable as part of the solution)
- Exploring options for **electronic record keeping**
- Cultivating a "**culture**" of compliance/trust/communication/transparency

IMO assistance may include evaluating and supporting specific industry efforts at developing databases, training modules, and guidance documents written in plain language.

We reiterate that large-scale regulatory changes are not recommended. Since solutions vary widely for different segments of the marine industry and a uniform solution does not exist, adding regulations would be cumbersome. Instead, the existing regulatory structure should be kept in place as much as possible, so that industry can develop long-term solutions that work for each segment.

Potential IMO-led involvement

Based on the MAX1 Studies findings, there are a few areas where IMO-led involvement may result in significant improvements, particularly:

1. Inclusion of waste disposal (PRF) costs in port fees

There is currently no shore based incentive to make Annex I waste²⁷ disposal efficient. If ports carry the cost of ship waste disposal, they must individually develop cost effective solutions in order to stay competitive. This scheme prevents ports from "offering" waste disposal at astronomical rates in order to prevent ships from offloading their wastes, allows ships crews to demand that their wastes are accepted and, additionally, releases ships crews from having to investigate port disposal fee structures that differ from port to port.

²⁶ Table A-III/1 - "Specification of minimum standard of competence for officers in charge of an engineering watch in a manned engine room or designated duty engineers in a periodically unmanned engine room".

²⁷ This recommendation also applies to other wastes, such as garbage wastes regulated under Annex V.



2. Electronic record keeping

The MAX1 Studies indicate that electronic record keeping can reduce crew burden significantly in many cases. Electronic record keeping must be tamperproof, and if designed and implemented correctly, can be more tamperproof than handwritten records. The best method to ensure tamperproof electronic record keeping would be public record keeping. Many technologies are emerging, such as ABS's NS5, that would make this type of approach viable at relatively low cost.

3. Operational data exchange

At present, there is very little actual operational feedback that designers, builders, and operators can use to make rational decisions with regard to optimal equipment selection and operational designs. Some shipowners in certain trades have made significant progress with machinery space waste management, but their knowledge is generally unavailable to the industry at large. Creating or promoting methods to share this information, possibly at the IACS level, would result in much more rapid, and less costly, progress throughout the industry.

These recommendations are considered beneficial to overall system efficiencies and, if accomplished, will improve the system. The report writers are well aware of the hard and rocky road between ideal system solutions and actual regulations, but also cite IMO's impressive track record (especially when compared to land-based international regulatory efforts) to achieve worldwide consensus and realized regulations.



APPENDIX A: MAX1 Email Updates

From: Hannah van Hemmen
Sent: Thursday, February 19, 2015 12:16 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 7

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 7 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. We are currently seeking Partner Organizations for MAX1 Studies. The studies are grant funded, so no monetary support is required, but we do ask that Partners commit to circulating the MAX1 Studies Survey (due out in late March 2015) to their employees/members. If your company wishes to officially participate in the MAX1 Studies, please send us a main contact name and email address, and your company's logo so that we may include it on the website.
2. We are building a [Library](#) that aims to consolidate a number of different types of information, including but not limited to:
 - Up-to-date regulations and useful summary regulatory documents
 - Current OWS technology documents (and summary documents)
 - Waste stream management case studies and best practices
 - Academic papers, op-eds, and presentations on waste stream management and OWS systems

If you or your company wishes to contribute any documents to the Library, please email them to this email address. Note that we cannot guarantee that the documents will be featured on the website, but that they will be used to inform the MAX1 Studies, development of conference topics, and final recommendations.

3. Notice that the Library includes waste stream management case studies. If your company has existing documentation in this regard, we are happy to review and potentially feature your company's case studies. If your company does not have pre-existing case study documentation and is interested in developing a vessel or fleet-wide case study, please email us, as we may be able to provide man-hour assistance. If your company has engaged Martin & Ottaway in the past for environmental surveys, fleet-wide environmental compliance surveys, or related assignments, we may be in a position to develop a case study on your behalf (anonymously if preferred). Example case studies can be downloaded [here](#).
4. Development of the MAX1 Studies [Survey](#) is due to begin in the coming weeks. We will circulate a number of draft questions, and at that time will invite comments and suggestions for additional questions.

From: Hannah van Hemmen
Sent: Thursday, March 5, 2015 2:20 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 9

Good day,



You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 9 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. We have made progress with the MAX1 [Library](#) and continue to encourage document contributions. Industry documents (some historic and some very recent) can be found [here](#).
2. A few [MAX1 documents](#) have also been created to invite discussion on specific topics. We encourage participants to contribute by commenting via our new online MAX1 [Forum](#) section. The following topics have now been opened for discussion:
 - [OWS Tech Discussion: Pre/Post Treatment](#), which asks the question: *Are we underestimating the effectiveness of present OWS technology, or is pre and post processing equipment really required?*
 - [Case Study: A Failure to Communicate](#), which asks for *solutions for a case study where oil contaminated water was drawn into a boiler*

We will be adding additional topics in the coming months, many of them based on [industry documents](#) contributed to the MAX1 Library.

3. We continue to seek case studies and partner organizations (anonymous and non-anonymous participation is offered). We are also specifically seeking involvement from individuals with operational experience with OWS systems, so circulation of the website to shipboard engineers would be greatly appreciated.
4. We have included the last MAX1 update below for reference, but note that some of the links may no longer be active due to re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Friday, March 20, 2015 3:21 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 11

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 11 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. A number of discussion topics have been added to the online [MAX1 Forum](#) section. You may log on to the forum in order to comment using a variety of accounts such as Gmail, Yahoo, Facebook, or Twitter. Topics currently include:
 - **OWS Cleaning:** *In theory, an OWS system rarely has to be cleaned internally. In practice, how often do OWS systems require cleaning?*
 - **Crew Training:** *Is there sufficient training for shipboard crews on environmental compliance? How can it be improved?*
 - **Dry Bilges:** *How achievable are dry bilges on ships?*



- **Whistleblowers:** *Does the whistleblowing system for shipboard environmental violations work?*
 - **Electronic Oil Record Book:** *Why do Oil Record Books need to be written in paper format? What would an electronic ORB look like?*
 - **Shipboard Environmental Officers:** *Should ocean-going commercial vessels have a dedicated on-board environmental/training officer?*
 - **OWS Pre/Post Treatment:** *Are we underestimating the effectiveness of present OWS technology, or is pre and post processing equipment really required?*
 - **Case Study: A Failure to Communicate:** *asks for solutions for a case study where oil contaminated water was drawn into a boiler*
2. To assist in navigating the [MAX1 Library](#) we are building a chronological documentation history, which can be accessed [here](#). You may still contribute documents to the library by replying directly to this email.
 3. We request at this time that Partner Organizations with employees with OWS or shipboard waste stream management operational experience direct their employees toward the [Get Involved](#) section of the website to subscribe for Technical Discussion updates.
 4. We have begun development of the [MAX1 Survey](#) and will circulate the draft questions in due course.
 5. Please save the date for the [MAX1 Conference](#), to be held on June 24, 2015.

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Monday, March 30, 2015 12:04 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 13

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 13 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. A draft of the MAX1 Survey has been developed, and we invite comments and suggestions for additional questions at this time. We will be finalizing the electronic survey this week, so if you have a question you would like to include, now is the time to suggest it!

When commenting, please bear the objectives of the survey in mind, which are listed [here](#). A copy of the draft questions is attached. If you would like to submit comments, you may either print the doc and write comments on it, or edit the doc directly using the “track changes” feature of Word. Please send your comments to this email address.

The survey is applicable to a wide range of maritime participants, but is specifically geared towards crew members.

Note that the questions in blue are taken from a 2011 survey on a similar subject matter, which will allow us to track changes in the past four years. The text in green indicates skipping logic, which will allow certain questions to be skipped in the electronic survey based on the respondent’s answers to previous



questions (e.g. you would not be asked questions about the operation of an OWS system if you have indicated that you do not have OWS operational experience).

2. The following discussion topics have been added to the online [MAX1 Forum](#) section. Please feel free to comment (you may do so anonymously).
 - **OWS Requirement:** *Should a vessel be required to install an OWS if the vessel is arranged so that oily bilge water can be processed onboard (no discharge)? For example, if she is fitted with adequate tankage (3.1 & 3.3 on the IOPP), an incinerator, the oil residue tanks and the oil bilge tanks are all fitted with heating coils, and the vessel is fitted with a dedicated boil off tank for both oil residue sludge and oil bilge water (i.e. the oil residue sludge once processed is incinerated and the water content is evaporated)*
 - **Reception Facilities:** *Are reception facilities for MARPOL Annex I wastes (bilge water and oil residues (sludge)) adequate? Are reception facilities abundant enough, and do reception facilities ever refuse to take your Annex I wastes? Are the costs to use these facilities prohibitive? Should all ports be required to take these wastes as part of their port fees? What problems, if any, have you encountered with shore disposal of your MARPOL Annex I wastes? Do you report these problems, and if so, to whom?*
 - **ECA Sludge Incineration:** *Is it acceptable to incinerate sludge within designated Emission Control Areas (ECAs)?*
 - **Oil Record Book Code C.11.4:** *The heading of Code C.11.4 for Oil Record Book use states "The quantity should be recorded weekly: (this means that the quantity must be recorded once a week even if the voyage lasts more than one week)" Since Code C does not denote an inventory entry, is there a better location for this Code? Should a new code letter be created for inventory entries? Also feel free to comment on any views, difficulties and/or confusion regarding these entries.*

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Thursday, April 9, 2015 9:50 AM
To: Hannah van Hemmen
Subject: FW: MAX1 Studies update, Week 14

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 14 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. The [MAX1 Survey](#) is complete. Thank you to everyone who contributed suggestions. At this time, please take the survey, and circulate the survey to your colleagues and others you think may have valuable input on machinery space derived waste streams and OWS systems. Input from crew members will be very valuable.

The survey link is: www.surveymonkey.com/s/max1survey

Survey time ranges from 5-20 minutes depending on your responses, and responses are anonymous.

Please also circulate the survey throughout the maritime industry on social media!



We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Thursday, April 30, 2015 3:18 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 17

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 17 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. The [MAX1 Survey](#) has been running for several weeks. We have collected a large number of high quality responses and are excited to receive more of them. We will circulate some interesting interim results in the next update. Please circulate the survey to others and post the link (www.surveymonkey.com/s/max1survey) on social media so that we can increase the robustness of the results!

If your company is a ship owner or operator and has not yet forwarded the link to crew members, we encourage you to do so. The input we have received from crew members has been very valuable. Contributing a few minutes of crew time now will assist with developing solutions which can have large impacts on reducing crew burden in the future, but if your crews' concerns are not included in the data, we cannot address them! Remember that the survey is anonymous, and outside of vessel type and general location (continent), we are not collecting data which can link back to any specific company.

2. If you would like to discuss a topic from the survey in more depth, you may reply directly to this email with your thoughts. We may then open the discussion to the general public in the [MAX1 Forum](#), anonymously if preferred.
3. Our historical chronology of machinery space waste stream management has grown considerably, with links to industry documents. If your company would like your waste stream management efforts (and/or associated documents) to be recognized in the MAX1 [Chronology](#) and [Library](#), reply directly to this email.
4. The [MAX1 Conference](#) will be held on June 24, 2015 in Wilmington, North Carolina. Registration for the conference will open next month.

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Friday, May 22, 2015 2:44 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 20

Good day,



You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 20 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. The [MAX1 Survey](#) has been running for six weeks. We have attached a few interesting interim results for your review. Please continue to circulate the survey to others and post the link (www.surveymonkey.com/s/max1survey) on social media so that we can increase the robustness of the results.
2. Registration for the MAX1 Conference, to be held on June 24, 2015 in Wilmington, North Carolina, is now open. The agenda is attached. Speakers and panelists will be announced shortly. For more information and to register for this event, click [here](#). The group rate for the hotel is only being held until May 30, 2015, so book as soon as possible.

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Wednesday, June 3, 2015 4:30 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 22

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 22 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. Speakers have been announced for the MAX1 Conference, to be held on June 24, 2015 in Wilmington, North Carolina. The agenda (revised version attached), logistical details, and registration are available at this [link](#). Please note that the agenda is subject to change and may be slightly revised in the coming weeks.
2. The [MAX1 Survey](#) has been running for two months, and has gathered an additional 100 responses or so since our last update. The survey continues to be open to new responses. At the MAX1 Conference, we will present the survey findings as of June 2015, and will also have the capability to answer survey data questions as they arise during the conference, using analysis software to isolate subsets of the survey respondents (by age, profession, etc.) if requested. Therefore, please continue to circulate the link (www.surveymonkey.com/s/max1survey) within your organization and via social media to increase the robustness of the results. Remember that the responses are entirely anonymous!
3. Note that the group rate for the Best Western Wilmington hotel has been extended to the end of this week. Details available [here](#).

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.



From: Hannah van Hemmen
Sent: Thursday, June 11, 2015 3:43 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 23

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 23 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. We are excited for the [MAX1 Conference](#)! We are really going to get into the nitty-gritty and share best practices. If you don't want your company to find itself with an OWS-related prosecution, you should come. If you don't want us to give stupid regulatory recommendations to IMO, you should come. The conference will be very discussion-heavy with representatives from many different areas of the maritime industry. Register [here](#).
2. The [MAX1 Survey](#) continues to gather responses. In particular, we have seen a dramatic increase in the number of tanker crew members, so thank you to whoever is responsible for that! All ship types and maritime professions are welcome, but in particular we are looking for crew members from passenger ships and bulkers at this point. Please continue to circulate the link (www.surveymonkey.com/s/max1survey) within your organization and via social media to increase the robustness of the results.

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Friday, June 19, 2015 9:20 AM
To: Hannah van Hemmen
Subject: LAST CHANCE TO SIGN UP FOR MAX1 CONFERENCE! MAX1 Studies update, Week 24

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 24 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. **This is your last chance to sign up for the [MAX1 Conference](#)!** We are really going to get into the nitty-gritty and share best practices. If you don't want your company to find itself with an OWS-related prosecution, you should come. If you don't want us to give stupid regulatory recommendations to IMO, you should come. The conference will be very discussion-heavy with representatives from a variety of different areas of the maritime industry. **Register [here](#).**
2. We have started uploading PowerPoint presentations for the MAX1 Conference to the [MAX1 Library](#) and [MAX1 Forum](#). Questions to the speakers can be submitted via the online forum (anonymously if preferred) and will be answered during the conference.



3. Results of the [MAX1 Survey](#) will be presented at the MAX1 Conference next week. Please continue to circulate the link (www.surveymonkey.com/s/max1survey) within your organization and via social media to increase the robustness of the results.

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Thursday, July 2, 2015 3:11 PM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 26

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 26 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. Thank you to everyone who came out to the [MAX1 Conference!](#) See Rik's blog post about the conference on the M&O website [here](#). We were very happy with the progress made and valuable information shared. In particular, we found the following issues to be key for making future progress in bilge water management:
 - *Addressing availability and cost issues with **port reception facilities***
 - *Increasing and improving crew **training** (in OWS operations and MARPOL regulations)*
 - *Increasing and improving crew **dialogue with shore** management*
 - *Moving towards **drier bilges***
 - *Exploring options for **electronic record keeping***
 - *Cultivating a "**culture**" of compliance/trust/communication/transparency*

If you think we missed something important, you can respond directly to this email address. You can also start a discussion at any time in the [MAX1 Forum](#).

2. Due to a number of requests, the [MAX1 Survey](#) remains open indefinitely to accept responses. Therefore, please feel free to continue to circulate the link (www.surveymonkey.com/s/max1survey) within your organization and via social media to increase the robustness of the results. We are simultaneously conducting further analysis on the survey results as of June 23, 2015 and will circulate survey findings in the next few weeks.
3. PowerPoint presentations from a number of the MAX1 Conference speakers have been uploaded to the [MAX1 Library](#) and [MAX1 Forum](#). Feel free to provide questions and comments in the forum (anonymously if preferred).

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Thursday, July 16, 2015 10:23 AM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 28



Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 28 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. In this update, we attach a copy of the [MAX1 Chronology](#) which was provided to all conference attendees. The chronology is the culmination of MAX1's efforts to consolidate bilge water management improvement efforts throughout history and we think you will find it to be very interesting. If your company/organization has relevant efforts, please pass along documentation and we will be happy to include it. It will give your company good press, and it will help reduce duplication of efforts in the future! The MAX1 Chronology will be finalized soon, so please provide documentation for inclusion in the chrono **by Wednesday, July 22**.
2. In response to the summary of outcomes from the [MAX1 Conference](#) included in the Week 26 update, many people have inquired about the lack of recommendations regarding OWS technology improvements. This was actually a central topic of discussion during the conference, and therefore we apologize that we didn't address that in the update! While OWS technology effectiveness was discussed at length during the conference, consensus was pretty overwhelming among the participants that MEPC 107(49) compliant, state-of-the-art OWS equipment is actually pretty good technology, and that focusing on issues like crew training and better bilge waste stream management would have a much higher payoff for improving OWS operations. Please find some thoughts about this subject in the [MAX1 Forum](#) in the "MAX1 Studies Outcomes & Areas of Interest" discussion, and provide your own comments as well.

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.

From: Hannah van Hemmen
Sent: Friday, August 21, 2015 10:44 AM
To: Hannah van Hemmen
Subject: MAX1 Studies update, Week 33

Good day,

You are receiving this email because you have expressed interest in the MAX1 Studies project commissioned by the National Fish & Wildlife Foundation on shipboard machinery space waste streams and Oily Water Separator (OWS) technology, by subscribing to email updates on the MAX1 Studies [website](#).

This is the Week 33 email update. We provide the following ongoing updates, and encourage you to reply to this email address with any contributions you or your organization would like to offer:

1. We have finalized the MAX1 Chronology and the MAX1 Survey Key Findings documents, which we attach for your information. We hope you find them informative, and thank everyone that contributed to both of these aspects of the study.
2. In addition to the MAX1 Survey Key Findings document, we provide a number of resources related to the survey, including the full list of questions, survey skipping logic, and full raw anonymous survey results, [here](#). You will notice that we have begun the process of moving resources from the MAX1 website to their permanent home on the Martin & Ottaway website.



3. We are drafting the final report for the MAX1 Studies, including IMO recommendations. The attached documents will inform the IMO recommendations, so if you think there is something that is not addressed in the attachments and should be in the IMO recommendations, please feel free to reach out by replying directly to this email.

We have included previous MAX1 updates below for reference, but note that some of the links may no longer be active due to continuing re-organization of the MAX1 website.



APPENDIX B: MAX1 Forum discussion topics

- **OWS Cleaning:** *In theory, an OWS system rarely has to be cleaned internally. In practice, how often do OWS systems require cleaning?*
- **Crew Training:** *Is there sufficient training for shipboard crews on environmental compliance? How can it be improved?*
- **Dry Bilges:** *How achievable are dry bilges on ships?*
- **Whistleblowers:** *Does the whistleblowing system for shipboard environmental violations work?*
- **Electronic Oil Record Book:** *Why do Oil Record Books need to be written in paper format? What would an electronic ORB look like?*
- **Shipboard Environmental Officers:** *Should ocean-going commercial vessels have a dedicated on-board environmental/training officer?*
- **OWS Pre/Post Treatment:** *Are we underestimating the effectiveness of present OWS technology, or is pre and post processing equipment really required?*
- **Case Study: A Failure to Communicate:** *asks for solutions for a case study where oil contaminated water was drawn into a boiler*
- **OWS Requirement:** *Should a vessel be required to install an OWS if the vessel is arranged so that oily bilge water can be processed onboard (no discharge)? For example, if she is fitted with adequate tankage (3.1 & 3.3 on the IOPP), an incinerator, the oil residue tanks and the oil bilge tanks are all fitted with heating coils, and the vessel is fitted with a dedicated boil off tank for both oil residue sludge and oil bilge water (i.e. the oil residue sludge once processed is incinerated and the water content is evaporated)*
- **Reception Facilities:** *Are reception facilities for MARPOL Annex I wastes (bilge water and oil residues (sludge)) adequate? Are reception facilities abundant enough, and do reception facilities ever refuse to take your Annex I wastes? Are the costs to use these facilities prohibitive? Should all ports be required to take these wastes as part of their port fees? What problems, if any, have you encountered with shore disposal of your MARPOL Annex I wastes? Do you report these problems, and if so, to whom?*
- **ECA Sludge Incineration:** *Is it acceptable to incinerate sludge within designated Emission Control Areas (ECAs)?*
- **Oil Record Book Code C.11.4:** *The heading of Code C.11.4 for Oil Record Book use states "The quantity should be recorded weekly: (this means that the quantity must be recorded once a week even if the voyage lasts more than one week)" Since Code C does not denote an inventory entry, is there a better location for this Code? Should a new code letter be created for inventory entries? Also feel free to comment on any views, difficulties and/or confusion regarding these entries.*



APPENDIX C: Responses to MAX1 Survey OWS operational open-ended questions

	What are the common issues you experience (or have heard of) when operating an OWS?
1	System reliability, not allowed to use OWS in many areas, maintenance is difficult and dirty to carry out
2	need make proper preparation for using ows. very good when bilge tank can be heated
3	if the bilge collecting tank for overboard is contaminated in any way, then you cannot process the water overboard
4	Nil
5	when the holding tank is to half tank of level
6	Sensor failures
7	suction system and cleaning of bilge tank
8	Status of filters and cost to change frequently, general maintenance
9	LOT OF PROBLEMS
10	LOW CAPACITY
11	Protect to environment
12	engine room detergents not allowing clean phase separation.
13	IF THE WATER IS DISCOLORED DUE TO RUSTING OF THE HEATING COILS & THE INTERIOR OF THE TANK ITSELF.
14	unsuitable pre treatment
15	very dirty bilge water
16	quick accumulation of oil in coalescer filter, hence ineffective separation
17	Contamination of the filtering elements
18	We are enforced to operate on 5ppm, which is ridiculous! It's difficult to have the OWS running below 15ppm without having the bilge water to settle in tanks before passing the OWS
19	Cell cleaning
20	15 ppm
21	15 ppm alarm, bilge holding tank general cleanliness issues, Magic pipe issues etc
22	measuring cell unit sensing problem due to dirt or rust
23	slow
24	High PPM value issues
25	Don't work great and need significant maintenance
26	UTC time not match to ows
27	mud water
28	Filter element should be good condition
29	air leakage problems
30	No
31	None
32	as a ship operator
33	dirty of filter equipment
34	lack of knowledge
35	N/A
36	oil emission in water
37	na
38	Maintenance
39	liquid soap water sometimes mixed with bilge water. This is a problem for 15 ppm equipment
40	common issue prevention sea pollution



41	15ppm equipment defects
42	Currently there's no clear, practical and efficient method of determining whether regulations have been violated or not. At the most basic level, it is noted that the absolute absence of any type of standardization of OWS systems makes the initial investigation confusing, dirty, time consuming and sometimes plain incorrect.
43	do not know
44	USE OF CHEMICALS IN BILGES
45	No issue
46	Cannot handle emulsions. too small a capacity, operational not simple
47	Flow Rate Issues
48	Not effective in removing mud / dust / rust
49	On yachts the system is cramped into a corner. Too much oil in the bilge water tank, plugs the system or coalesce filter.
50	I operated Motor yachts less than 50m so lack of use.
51	Trying to separate sludge from water vice oil from water
52	faulty 3 way valve
53	sensor failure, filter issues
54	does not process grey water
55	Solenoid change-over valves & 15ppm probes being dirty
56	In cold climate or rough weather, bilge holding tank gets completely mixed up effecting OWS operation.
57	False alarms
58	dark & muddy water not able to pumped out which water not contain any oil
59	1. Pertaining to 4250 TEUs, the effectiveness is negligible. 2. It cannot filter fine mud and oil.
60	clogging of 1 st stage filters
61	faulty alarma
62	No issues as long as the equipment is operational
63	sooty or dirty water does not process effectively; bilge water can also be contaminated by other things -- dirt, solvents, etc.
64	emulsions and solids create problems
65	No common issues.
66	discharge valve closing even with clean water, regular cleaning of fitters
67	Emulsified bilge water due to misuse/lack of knowledge on what chemicals can / should be used onboard
68	SENSOR FAILURE
69	turbidity, wrong temperature, high maintenance, ageing of floc chemicals
70	start up adjustment of equipment
71	Slow and time consuming.
72	In adequate heating and no presettlement facilities
73	Equipment doesn't know what is coffee or oily water.
74	Problematic OCM or lost OCM data.
75	INEFFECTIVE FILTER CANDLES
76	alarm failure
77	Never enough capacity
78	Bilge Holding tank to be in good order (not contained oil and dirt)
79	Less than clear water does not necessarily contain oil.
80	Dirty bilge



81	Poor detection of oil
82	hard to get it overboard due to excessive backflushing
83	Lack of understanding
84	Inability to deal with contaminants, detergents, etc.
85	failure of operating valves
86	emulsions, turbidity of effluent
87	Poor training and equipment that is not adequate for the waste stream generated
88	A general understanding of bilge water management, rather than simple operation
89	Coalescing filter chokes up due to fine chippings or sand...
90	sensor issues
91	Treated bilge water that standing long time in Treated Bilge Holding Tank
92	when filter beds (coaliscer) becomes dirty and the soots getting trouble to 15ppm OCM.
93	Filter cleaning is unpractical, and is never done properly.
94	Takes a fair amount of maintenance and cleaning.
95	Many alarms, easy to be dirty,
96	necessity of frequent cleaning and replacing filter elements
97	Lack of crew familiarization with equipment
98	clogged filters
99	Unit clogging
100	probe sensitivity to degreaser
101	remarks from the engineer
102	Plastic parts breaking.
103	Emulsions & dirty water
104	Going into bypass
105	clogging of the intake
106	Flush operation not conducted after use
107	constantly clogging filters
108	does not work
109	don't know
110	people are scared of them due to a lack of fully understanding how they actually work and experience.
111	The equipment is sometimes inadequate.
112	can't handle soaps. more system issues than good output. low output seems too common in several systems. they are not overly user friendly. many are intimidated by them
113	N/A
114	Older equipment mis-used or behind in maintenance.
115	Inoperable from lack of use
116	Contamination with material not meant for the OWS
117	Dirty strainer.
118	its temperamental
119	Cost of chemicals/filters.
120	Human error is prevalent
121	process filter clogging up, due to debris left inside oily bilge water tank.
122	Ocm issues caused by something other than oil, i.e. Bacteria, air
123	some models use more moving parts and require more hands on time than others. multiple process filter changes during a run or constant flushing.



124	the filter screen clogs up a lot sometimes and having to change the filter often between operations.
125	Clogged strainers, low product flow output.
126	regulatory
127	doesn't separate water from oil
128	OCM not operating properly
129	N/A
130	sediment
131	trash in unit makes OWS ineffective
132	Smart cell issues
133	When testing there is no way to dump residue into oily water tank
134	Losing suction. Introducing too much oil resulting in shutdown and cleaning.
135	Testing of the system while in port
136	certain soaps & detergents affecting the operation
137	Improper maintenance of the system.
138	2000 or 1000 series are always trouble shoot 50 percent of the time
139	It breaks
140	They rarely work. Emulsifications aren't separated and it only leads to nonstop cleaning and 0% production from this plant. I believe they are a waste of time, money and space. Vessels should be required to retain waste onboard and pump it to a shoreside facility. Simply having a non-working OWS aboard is a reason many people that have been busted pumping overboard with magic pipes have stated as their reason. Take the OWS off the boat, change the regulations, and you may eliminate peoples urges to pump it overboard.
141	liquid mud
142	Muddy water / Rust in pipelines
143	contamination of oily water with chemicals, soot etc
144	Filters get dirty very often. OCM get frequently broken or out of calibration.
145	At times malfunctioning of the PPM meter
146	Filters, Oil Content Meter.
147	Lack of training
148	Component failure.
149	Filter and capacity
150	They require constant baby sitting
151	They only work until they get dirty
152	Oil destroying the impellers and relay valves
153	excessive ppm faulty alarm
154	Any contamination in tanks will foul OWS / corrosion in piping will trigger alarm
155	emulsified oil, dirt and debris, soaps
156	Equipment failure (PC card, control unit, display, sensor)
157	Dirt causing improper operation
158	There are not reliable equipments
159	N/A.
160	Bacteria within the bilge tank and the clearness of water. If the color of the water is black OCM has problems even if there is no oil in the water.
161	False positive of OCM forces crew to perform maintenance on OWS and does not result in proper operation
162	Difficult to troubleshoot problems with OWS equip



163	Particulate matter causing false readings (soot), bacterial growth in tanks/lines, crew understanding of basic operation
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What suggestions do you have to improve OWS operations?	
1	A system that can be used in port, confined & restricted waters.
2	Need to have better method/procedure - and, perhaps, hardware - to test OWS or run it within vessel (without discharging anything overboard or potential thereof).
3	proper segregation and preparation of BW
4	Create more weir piping systems, tall thin tanks for emulsions to settle and be drained off
5	Adjusting more filters
6	NIL
7	IMPROVED OWS UNITS MAY EFFECT POSITIVELY OWS OPERATIONS
8	clean bilge wells, reduce leaks
9	Ease of operation with foolproof devices to prevent dilution
10	INCREASE SPARE PARTS, FILTERS
11	ENGINEER TO BE TRAINED PROPERLY AND PROPER SPARE SHOULD BE KEPT ONBOARD AND EVEN FOLLOWED BY MAKER
12	More training by factory techs who know what they are talking about.
13	CREATE ANOTHER TANK FOR SETTLING/HEATING/EVAPORATION OF BILGE WATER PRIOR DELIVERY TO BHT.
14	pre treatment
15	Clean Bilge tank for condensations
16	Installation of bilge primary separation tank,
17	No point to buy an expensive OWS if you incorporate it into a shitty system without good abilities to settle the bilge water
18	Self cleaning of OCM and section of OWS
19	Keeping clean the Bilge tank
20	Better informed
21	same above
22	no
23	Filter changing interval must be increased
24	additional primary tank between BHT and OWS will be useful
25	Make IMO setup mandatory, IBTS
26	no
27	Before discharging oil must be heated
28	training
29	HIGH CAPACITY
30	Same above
31	auto start
32	no
33	inside cleaning operations and human interface must be simple and minimum part should contain
34	I haven't
35	quality of equipment
36	keep bilge clean
37	it might be effective as chemical prepreparation before OWS



38	bilge primary tank is very useful for keep clean bilge holding tank
39	Standardized and agreed procedures in regulation and violation determination.
40	Make the OWS equipment more user friendly. There should be no need to thoroughly read the Operating Manual just to be able to operate the system.
41	do not know
42	PRIMARY TANKS
43	Not to wait till the tank is about to full.
44	IBTS SYSTEM IS GOOD
45	bring a mixture of technology together.
46	Better opertaion with emulsified water
47	Better Training
48	The equipment should be easy to operate by vrew members
49	The oily bilge water tank should have a variable pick up pipe, that can be used to skim the oil off the top of the tank. Which can then be manually poured into the waste sludge oil tank.
50	Decant the tanks, manage the bilge
51	Bilge water tank constraction to be improved to make a water cleaner
52	training
53	user instructions in pictures and corresponding numbers on the equipment
54	better shore side facilites to reduce onboard treatment
55	Good maintenance, proper housekeeping
56	NO SUGGESTION
57	Should not complicate with fixing numerous pipes & valves
58	The OWS separators are barely able to run with even constant manning.
59	all crew should familiar
60	a printer to be insatalled along with ppm indicator in situ.
61	None
62	None
63	compulsory operational cerificate
64	Enhanced crew training
65	TRAINING AND AWARENESS
66	More training
67	The capacity
68	Stop the paperwork and rely on the discharge monitor
69	Better separation of oil from water
70	Betterhating input of incoming water
71	All discharging water treated such as BW Treatment & Sewage Treatment should be together. Standard Qualification for Water which can be discharge should be designated.
72	MAINTENANCE FREE UNTIL EACH IOPP RENEWAL SURVEY



73	To improve (make it simple) recording abilities (date, time, range of p.p.m.)
74	Use a centrifuge to separate oil from water as a pre-treatment.
75	Training and better technology.
76	less automation
77	None at this time.
78	fitting loggers which monitors operation of OWS
79	required technical training from each manufacturer to be on board each vessel and updated every 5 years
80	All operators to be training on good bilge water practices rather than just equipment operation.
81	Read the manual. Many don't
82	it should be simple and easy to operate
83	Good housekeeping and highly proper maintenance on the system.
84	Housekeeping of the system and doing a proper maintenance at all times.
85	less maintenance and cleaning jobs
86	IBTS system implemented on each single vessel
87	More fool proof systems. Less attempting ways to trick if needed.
88	Provide more hands-on training.
89	Bigger settling bilge holding tanks
90	secure technologies already implemented;
91	remember that it is not magic and can not process severely contaminated water.
92	Training
93	Same
94	more simple use and calibrations
95	N/A
96	Require a weir tank or other separator
97	Na
98	decant and boil off as much as possible
99	clean and maintain it properly
100	System developed to process oily bilge water to hold on board a vessel.
101	Get more involved training
102	careful segregation of bilge water.
103	Better piping arrangement
104	Make machines easier to operate and maintain.
105	more training
106	None
107	No, works good for me.
108	reduce if possible the oily water generation in the first place
109	Make on/off functional.
110	hot water cleaning cycles. Better ocm's



111	a better filtration system that would cut down on the continuous changing out of the filter.
112	keep the operation as simple and hands off for the operator as possible
113	More pre-filters for the oily water inlet side of the system to catch more debris.
114	less government intrusion, we care about the environment too, but we also care about the well being of our shipmates
115	get rid of them and use a filter system instead
116	Clean and properly train personnel on how to use the ows
117	N/A
118	have appropriate settling tanks
119	more formal training
120	none
121	Allow for a less than 15ppm holding tank for while a ship is in port for an extended period of time.
122	none at this time
123	More certified education regarding the units.
124	keep up with newer system updated
125	N/A
126	Get them off of the boats!
127	none
128	Flow rate thru the 15 ppm should be fixed flow
129	Simple testing so that crew members test often
130	Use a priming tank before bilge tank. Improve filtering efficiency.
131	Assume it is slower than the manual says
132	sustainable means to evaporate bilge water to be incorporated
133	continuous training
134	Simple and reliable.
135	large capacity
136	Make management liable for failures
137	All separators work better when clean and properly maintained.
138	SIMPLIFICATION OF TESTING AND DISCHARGE SYSTEMS. MORE FOOL PROOF. BETTER HMI.
139	multiple collecting tanks need to be tall and skinny / multiple weir stages
140	Improve crew training, i.e. onboard instruction, all aspects including data retrieval
141	N/A.
142	Lots and lots of public feedback in a central location to the shipping community
143	Make less labor intensive (especially re: paperwork, seals, etc.)
144	Better training in the operation and maintenance of the equipment; in the regulatory requirements associated with the recording of the operations



	What suggestions do you have to improve OWS technology?
1	Fully automated computerized system, with internal recording of bilge & waste water volumes (including black & gray water), daily reporting of same on board and to shore management. These reports also include an alarm log for the entire system, shore side technical assistance via internet, actually shows a payback in savings by minimizing shore side disposal.
2	ows should clean BW with desire effect from rust and mud
3	log current positions and start / stop times
4	All time with JOWA manufacture
5	no to much complicate to operate
6	Quality of sensors must be improve
7	NIL
8	Better oil detection methodology
9	EACH PASSAGE OF FILTERED WATER MAY BE CONTROLLED BY INDIVIDUAL OIL SENSOR
10	More interaction between factory techs and the real world operators.
11	ALWAYS HAVE 2 OCM IN PARALLEL.
12	equipping the vessel with higher capacity.
13	higher capacity.
14	Pre-filter (prior entering OWS)
15	Better informed
16	bilge holding tk must be separated from every other solid or liquid wastes
17	filtering equipments should have long lasting.
18	jowa
19	Made material with 316L not sus304
20	not my level
21	Change the test procedures
22	no
23	Not sure
24	it can easily deal with emulsions
25	searching
26	OIL CONTENT METER SENSING
27	If you are manage bilge effectively onboard these equipments are enough
28	easy maintenance and print out with ships positions, knots e.g
29	no
30	I haven't
31	quality of equipment
32	no any idea
33	sufficient technology
34	N/A
35	More robust and versatile OCMs
36	do not know
37	CYCLON TYPE
38	Second independent 15 ppm equipment would be very useful not to be obliged to a detector that has potential to fail due to sensitive equipment. A selector switch or similar function could send the data recorder and during the port start controls we would have second optional equipment to show. The system includes one pump only, a second pump could be very useful.



39	Bilge eveaporators are good
40	FAR better test specification that are real to the condition sin bilges.
41	Nil
42	Additional Centrifigual Purifier
43	Use centrifuge technology
44	More sight gases, with LED lights behind. Touch screen controls, which animate the flow of water around the system.
45	Automatic sludge/rag layer removal from the OWHT along with particle removal prior to entry into the OWS. Incorporate VFD's with OWS controlled by first stage output.
46	The filters to be improved and life to be longer
47	easy design and operation
48	send it all ashore
49	Should be able to handle suspended fine particles (mud, soot)
50	Make it more efficient
51	NO SUGGESTION
52	Filtering materials not to be an expensive which should available freely. Volume to be increased to reduce operating time. back flushing procedureds to be improved with applying / increasing amount of fresh water.
53	Fine filtrations to be made more effective
54	can improve pre treatment process
55	Postion of ship should be talleyed automatically
56	None
57	better solids and emultion handling
58	None
59	compulsory centrifugal OWS, better and compulsory arrangement for boil off water,
60	BETTER FILTRATION TECHNOLOGY AND TAMPERPROOF DESIGN (SEALED UNIT IN ENCLOSURE)
61	Integrated discharge technology solutions including oil, grey, black, ballast
62	Insist on bilge holding tanks before the OWS. Stop making the units as small as possible and provide 'volume' for operations
63	No one should be able to trick the equipment
64	pumping methods
65	BETTER MAINTENANCE INTERVALS/COSTS
66	Design of filters to be improved to facilitate maintenance
67	Better settling tanks for seperation. Many vesels have only a double bottom bilge tank in which bilge water is agitated by vessel movement.
68	more effective on bilge treatment
69	Make them fail proof
70	mandfatory 5 ppm



71	None at this time.
72	inclusion of primary and secondary bilge water tanks
73	rated capacity must be greater by 50% than vessels projected waste stream
74	Have them focus on the core of the issues, rather than just filtering
75	Use a sentrafuge
76	prefilter emulsions with centrifuge
77	improve sensor reading data
78	Pipeworks and related system should be in Stainless Steel materials.
79	Pipeworks are stainless steel pipe.
80	Improve the Filter extraction for cleaning process. Especially for big size OWS.
81	to be simple to clean
82	Shall be user friendly
83	To be better at separating out the oil, and better OCM to differentiate dirty water (contamination of less than 15pmm) from oily water.
84	Improve filter cleaning systems
85	centrifugal techniques
86	Training training
87	Less required maintenance and crew intervention
88	less sensitive probes so people will operate them instead of bypassing them
89	N/A
90	Distinguish dirt from oil
91	Na
92	run on regular asis
93	See through fittings incorporated on the unit to see flow of oily water
94	None
95	None
96	2-stage processing.
97	simplify system.
98	More complex does not make it better. Possibly a 2 step process where the primary unit akes suction on the oily water tank and discharges to a holding tank. Secondary processer takes suction on that tank and processes it overboard.
99	Split filter system required for all vessels
100	less maintenance and a more simple layout
101	None
102	No, works good for me.
103	I think some type of clarifier would be more effective
104	Mandate membrane filtration as a component of an OWS process
105	Reduce cost of chemicals/filters.



106	An ocm that can differentiate between oil, air, soot, and bacteria
107	make the ows a little more user friendly
108	the coalescer method followed by clay/sand seems to be as effective as the spirolator method, but far simpler and less costly.
109	More pre-filters for the oily water inlet side of the system to catch more debris.
110	more study and technology
111	get rid of them and use a filter system instead
112	Heating the oily water before discharge. Using ones and the use of skimmer on primary tank this will lessen maintenance on ows and prolonged spare parts
113	Clean and properly train personnel on how to use the ows
114	N/A
115	Perform more studies that show effectiveness, require phosphorescence OCM
116	online training
117	None
118	None.
119	none at this time
120	None
121	more formal training.
122	N/A
123	They need to process emulsifications
124	none
125	Should be able to deal with muddy / discoloured water
126	simplify technology
127	Use centrifugal separators.
128	Increased prefiltration and sloshing reduction
129	make centrifugal OWS or some other latest technology mandatory
130	unsure
131	Simple and reliable.
132	less moving part/robust filtration system
133	Use actual bilge water in design and testing, not just pour some oil into some water
134	Continue developing centrifugal technology and work on it becoming affordable to more operators
135	BETTER FILTERATION / SEPERATION PROCESS.
136	Alfa Laval type purifiers should be used
137	Keep equipment & components robust & reliable
138	Other types of equip (centrifuge)
139	to separate water from sludge and oil from bilge water I reccomend Faro Maritime Technic's SDS Light and as bilge PreConditioner I reccomend CJC Blue Baleen 0A38/50
140	N/A.
141	Lots and lots of public feedback to manufacturers
142	Provide equipment manufacturers with the real time and real life environmental situation factors and range of conditions likely to be encountered



APPENDIX D: MAX1 Conference Attendees

Name	Company
Brian Ackerman	US Merchant Marine Academy
Rob Atkinson	US flag 3AE/2AE
Joseph Breglia	Consultant, ex Horizon Lines
Kierstan Carlson	Blank Rome LLP
John Conklin	Martin & Ottaway
Commander John Dittmar	USCG
James Dunbar	USCG
Debra Falatko	Eastern Research Group
Jason Fernandes	Fernandes Maritime Consultants
Yasmin Fortuny	Scanship Americas
David Hiller	Marpol Training Institute
Tom Horan	Rowan Companies
Adriano Luati	Scanship Americas
Nick Makar	ABS
Sean March	USCG
Caroline Medich	Total Marine Solutions
Lieutenant Michelle Schopp	USCG
Pierce Power	Martin & Ottaway
Steve Pruetz	Alfa Laval
Brandon Rice	USCG
Ole Schroder	Scorpio Group
Erik Seither	SNAME
Alexandra Sible	ABS
Doug Spooner	Star Reefers
Tim Sullivan	Hornbeck Offshore
Patricia Susaeta	Ership
Hannah van Hemmen	Martin & Ottaway
Hendrik van Hemmen	Martin & Ottaway
James van Langen	Consultant
Jay Wright	National Fish and Wildlife Foundation