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INTEGRATED BILGE WATER TREATMENT SYSTEM

Key words

Ship, machinery space, bilge water, sludge, waste oil, handling system, treatment.

Summary

Oily bilge water is generated due to the leakage of water and oil from equipment and piping or maintenance works resulting from routine operation in the machinery space of ships. Such oil and water leakage is usually a mixture of both and is collected in the bilge well or on the tank top as oily water.

Oily bilge water must be treated in accordance with the requirements of Annex 1 of the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships) [1]. To promote the prevention of oil pollution from machinery spaces of ships, it is very important to minimise the amount of oily bilge water generated in machinery spaces.

MEPC (Marine Environment Protection Committee) on session 54 recognised the concept of an Integrated Bilge Water Treatment System (IBTS). The paper presents some remarks and proposals to improve the rules that are sometimes inconsistent.

1. The concept of an Integrated Bilge Water Treatment System (IBTS)

The IBTS is a system to minimise the amount of oily bilge water generated in machinery spaces of ships by separately treating the leaked water and oil. It also provides an integrated means to process the oily water and residue (sludge).

A typical flow diagram of IBTS is shown in Fig. 1 [2]. To understand the flow diagram the following definitions are needed:

- 1) "Clean drains" means drains resulting from the leakage from equipment used for seawater, freshwater, steam, etc., which are not normally contaminated by oil.
- 2) "Oily drains" means drains resulting from the leakage from equipment used for oil (fuel oil, lubricating oil) and drains from equipment which under normal circumstances may contain oil.
- 3) "Oily bilge water" means water collected in the bilge wells or the tank top resulting from unexpected leakage from piping or maintenance work in machinery spaces, which may be contaminated by oil.
- 4) "Bilge water holding tank(s)". (A bilge water holding tank is arranged to receive the bilge water before this water is discharged ashore or discharged through the 15 ppm equipment overboard). A definition of bilge water holding tank(s) does not exist in the revised MARPOL Annex I. The definition is contained in MEPC.1/Circ. 511[3]. (6.2. A bilge water holding tank is arranged to receive the daily generation of bilge water before this water is discharged ashore or discharged through the 15 ppm equipment overboard. A bilge water holding tank is not mandatory, but will enable ships to operate safely during port visits, during operation in special areas and coastal waters and during periods of maintenance of the 15 ppm equipment. 6.3. A bilge water holding tank will also provide additional safeguards in the purification of oily bilge water should quick-separating detergents be used for cleaning purposes before this water is discharged ashore or discharged through the 15 ppm equipment overboard).
- 5) "Oil residue (sludge)" means sludge from the fuel or lubricating oil separators, waste lubricating oil from main and auxiliary machinery, or waste oil from bilge water separators, oil filtering equipment or drip trays – (Annex VI, Regulation 2(7) – MARPOL Consolidated Edition 2006) [1]. Other definition see [3]. (5.2 "Oil residue (sludge)" means 1 "separated sludge," which means sludge resulting from the purification of fuel and lubricating oil; 2 "drain and leakage oil," which means oil resulting from drainages and leakages in machinery spaces; and 3 "exhausted oils," which means exhausted lubricating oil, hydraulic oil or other hydrocarbon based liquids which are not suitable for use in machinery due to deterioration and contamination).

- 6) "Sludge tank" means a tank or tanks of adequate capacity, having regard to the type of machinery and length of voyage, to receive the oil residues (sludge) which cannot be dealt with otherwise in accordance with the requirements of Annex I, such as those resulting from the purification of fuel and lubricating oils and oil leakages in the machinery spaces – (Annex I, Regulation 12, MARPOL: Consolidated Edition 2006)[1]. (Regulation 12 – Tanks for oil residues (sludge): 1. Every ship of 400 gross tonnage and above shall be provided with a tank or tanks of adequate capacity, having regard to the type of machinery and length of voyage, to receive the oil residues (sludge) which cannot be dealt with otherwise in accordance with the requirements of Annex I, such as those resulting from the purification of fuel and lubricating oils and oil leakages in the machinery spaces). Other definition see (MEPC.1/Circ.511) [3].
- 7) "Bilge primary tank" means a pre-treatment unit for the separation of oily bilge water. There is no definition for "bilge primary tank" in the revised MARPOL Annex I. Some information can be found in MEPC.1/Circ.511. Appendix: Guidance notes for an Integrated Bilge Water Treatment System (IBTS) [2]
- 8) "Oil sludge incineration systems" are systems providing the incineration of oil sludge generated on board seagoing ships. The definition of such a system is contained in MEPC.1/Circ.511[3], point 5.6. (Oil sludge incinerators are systems providing incineration of oil sludge generated on board seagoing ships. Sludge incinerators could be main and auxiliary steam boilers with appropriate oil sludge processing systems or heaters of thermal fluid systems with appropriate oil sludge processing systems or incinerators with appropriate oil sludge processing systems designed for sludge incineration or inert gas systems with appropriate oil sludge processing systems). Additional information is contained in Appendix II to Annex I – Form A and B, Supplement to the IOPP Certificate, point 3; (3. Means for retention and disposal of oil residues (sludge) (regulation 12) and bilge water holding tank(s): 3.2 Means for the disposal of residues in addition to the provisions of sludge tanks; 3.2.1 Incinerator for oil residues; 3.2.2 Auxiliary boiler suitable for burning oil residues; 3.2.3 Tank for mixing oil residues with fuel oil; 3.2.4 Other acceptable means) and in Annex VI [1].
- 9) "Oil sludge processing systems" are systems servicing the sludge incinerating system. The oil sludge processing system consists of a tank for mixing oil residues with fuel oil, an oil sludge preheating system, a filter and a homogenisation system. The definition is contained in MEPC.1/Circ.511, point 11.3 [3].

2. Size of oily waste tank(s)

Tanks for the collection of oily waste from various functions in the engine-room should have adequate capacity, having regard to the intended type of service of the ship, but all other aspects applicable to the specific vessel trading pattern and time in port should also be taken into account.

The recommended capacity for oil residue (sludge) tank is specified in the chapter – Unified Interpretations of Annex I [1]. In interpretation to regulation 12 are contained some formulas, for example:

1. For ships that do not carry ballast water in fuel oil tanks, the minimum sludge tank capacity (V_1) should be calculated by the following formula:

$$V_1 = K_1 \cdot C \cdot D \quad [m^3] \quad (1)$$

where:

K_1 – 0.015 for ships where heavy fuel oil is purified for main engine, or 0.005 for ships using diesel oil or heavy fuel oil which does not require purification before use,

C – daily fuel oil consumption [m^3]; and

D – maximum period of voyage between port where sludge can be discharged ashore (days). In the absence of precise data, a figure of 30 days should be used.

2. For ships which carry ballast water in fuel oil tanks, the minimum sludge tank capacity (V_2) should be calculated by the following formula:

$$V_2 = V_1 + K_2 \cdot B \quad [m^3] \quad (2)$$

where:

V_1 – sludge tank capacity specified in .1

K_2 – 0.01 for heavy fuel oil bunker tank or 0.005 for diesel oil tanks, and

B – capacity of water ballast tanks which can also be used to carry oil fuel (tones).

The capacity of sludge tanks may, however, be calculated upon any other reasonable assumptions.

The calculated capacity is a minimum sludge tank capacity. On real ships, the capacity of sludge tank(s) is about 3–4 times larger. For example, for a container ship built in 2001 (Main Engine Sulzer 7RTA84C – 28 435 kW), the oily waste tanks are shown in Table 1.

Table 1. Sludge tank(s) and bilge water holding tank on a container ship

Tank	Content	Capacity (m ³)	Inlet from	Emptying
HFO purifiers sludge tank	Sludge	54.8	Discharge HFO purifiers. Drain HFO service tank.	Sludge pump
Lub. oil purifier sludge tank	Sludge	4.4	Discharge lubricating oil purifiers	Sludge pump
Residue tank	Residue from ME under – piston space	25.0	Under piston space drain main engine	Sludge pump
HFO / lub. oil leak tank	Leak oil	7.4	All fuel and lub. oil scuppers and drip trays	HFO transfer pump
Fuel oil overflow tank	HFO	45.9	HFO overflow pipe, overflow HFO settling and service tanks, fuel drain HFO settling and service tank	HFO transfer pump
Bilge holding tank	Bilge water	62.9	All ER scupper except fuel and lub. oil drip trays, water drain HFO settling tanks, water drain sludge tanks	Bilge water separator

3. Bilge water holding tank(s)

If fitted, bilge water holding tanks should have a capacity that provides the ship flexibility of operation in ports, coastal waters and special areas, without the need to discharge de-oiled water overboard. The capacity of bilge water holding tanks should be as shown in Table 2.

Table 2. Capacity of bilge water holding tank

	Recommended capacity (m ³) [1]	Container Ship
Main engine rating (kW)	–	28 435
up to 1,000	1.5	–
Above 1,000 to 20,000	$1.5 + (P-1,000)/1,500$	–
Above 20,000	$14.2 + 0.2(P-20,000)/1,500$	Calc.15.3 / Real 62.9

Where: P – main engine rating in kW

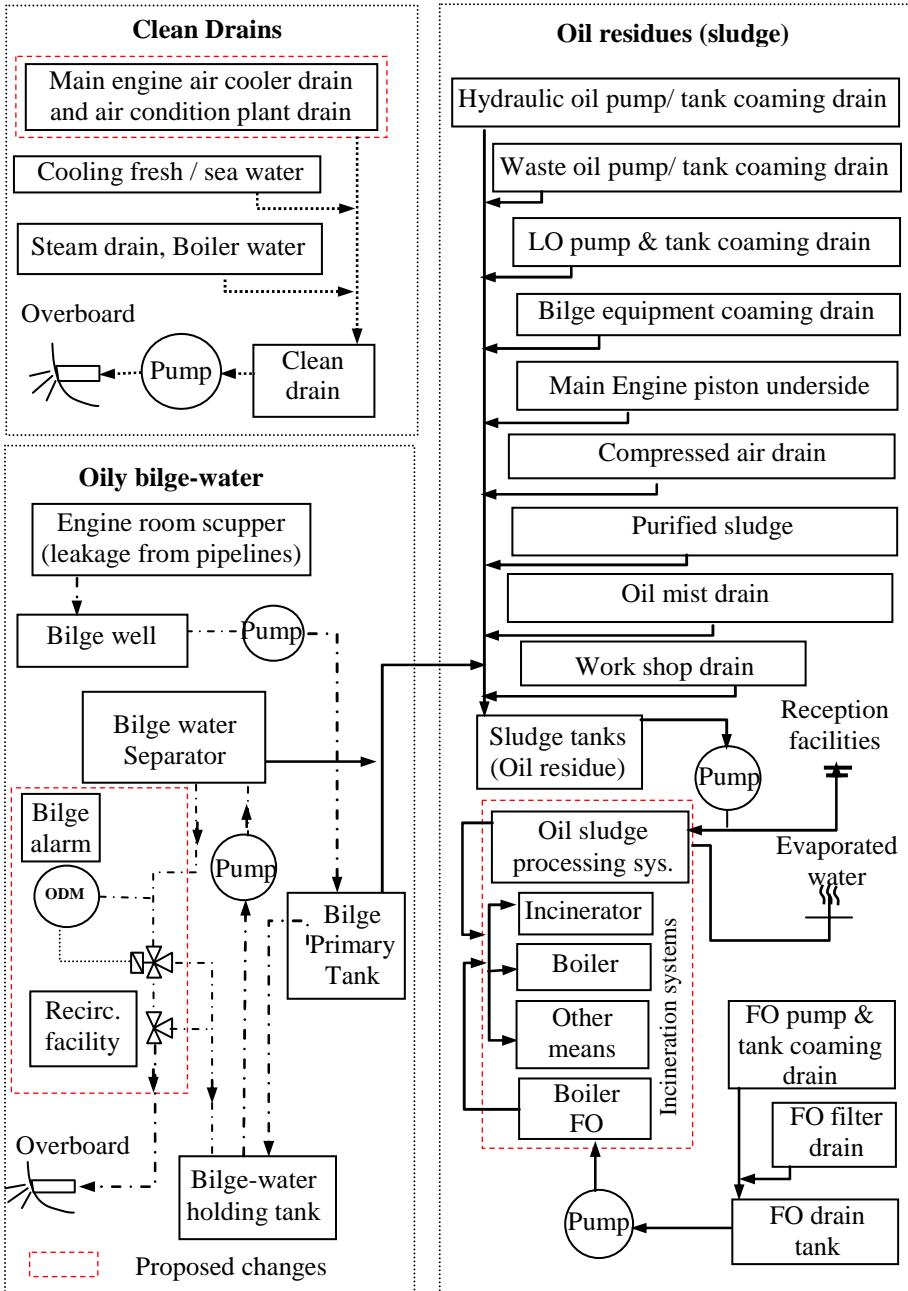


Fig. 1. Proposed flow diagram of an Integrated Bilge Water Treatment System (IBTS)

Conclusions

1. The wording of the MARPOL 73/78 Convention is customarily considered by ship operators (ship owners, shore staff) as being very obscure and troublesome. As a consequence of this, it leads to numerous misunderstandings and often is the cause of the frequent fining of the crewmembers by the surveyors of Port State Control (PSC) or maritime administration. The majority of the penalties are not actually a result of real marine environment pollution or the neglecting of regulations, but it is a result of imprecise wording in the Convention, which can be interpreted in many ways. It happens that, in various harbours of the same country, the surveyors are interpreting the same wording of the Convention in different ways.
2. This presented paper is the first try of expressing the authors' views, who are not only academic lectures but also sea going chief engineers for many years having to deal with the above discussed problems.
3. In Fig.1, the general conception of solving the problem of oily waters in a ship's propulsion plant is illustrated. It is a modified outline placed in the document [3]. Points in which changes were introduced to the outline have been marked by rectangles drawn with a dotted line.
4. The main goal of the introduced changes is to diminish the pollution by oil of the marine environment due to the normal operation of a ship through the following:
 - a) Reductions of the amount of oily water by the separation of the clean leakage (seawater, freshwater, water from boilers and distillates from air condition and air coolers). These leakages are collected in the clean water tank and dumped directly overboard.
 - b) The introduction of an incineration system, which would prepare leakage polluted by oil for combustion in the incinerator, boiler or other equipment of a similar function. The main purpose of this system is the limitation of the necessity of adding oil to the non-processed oily leakage in order to rise their heat value.
 - c) The introduction of a recirculation facility, which is a device enabling the performance of an oil separator test before the outlet discharge is directed overboard into the sea. The test would rely on the pumping of water through the bilge separator from the bilge water holding tank until the moment when the required oil concentration is reached in the cleaned water.
5. If the proposed changes will be positively accepted by the Classification Societies, than they shall be submitted for discussion at the meeting of the MEPC (Marine Environment Protection Committee) in order to be introduced into relevant regulations of the Convention.

The problem presented in this paper is an example of the authors' contribution into the improvement of IMO convention regulations.

References

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Zintegrowany system obróbki wód zęzowych

Słowa kluczowe

Statek, przedział siłowni, wody zęzowe, szlam, odpady olejowe, instalacja zęzowa, oczyszczanie.

Streszczenie

Wody zęzowe są wynikiem przecieków wody i oleju z urządzeń i rurociągów znajdujących się w siłowni okrętowej podczas ich eksploatacji oraz prac remontowych. Przecieki te, gromadząc się w studzienkach zęzowych mieszają się tworząc mieszaniny oleiste. Mieszaniny takie muszą być obrabiane zgodnie z Aneks I Konwencji MARPOL. W referacie przedstawiono uwagi autorów dotyczące nieco innego sposobu obróbki tych mieszanin. Przede wszystkim chodzi o rozdzielenie przecieków w taki sposób, aby ograniczyć ilość mieszaniny. Dążąc do wyjaśnienia bardzo zawiłych uregulowań Konwencji MARPOL, podano szereg definicji i objaśnień oraz zaproponowano zmiany w zintegrowanym systemie obróbki wód zęzowych (IBTS).