

**Marine Spills – Causes, Monitoring and Morality Aspects****M. Drille\*, I. Rozenštrauha\*\*, I. Dreyer\*, A. Unbedahts\*\*, V. Priednieks\*\***\* *Riga Technical University, Azenes str., 14/24, Riga, LV-1048, E-mail: ineta@ktf.rtu.lv*\*\* *Latvian Maritime Academy, Flotes str. 5 B, Riga, LV-1016, E-mail: unbedahts@one.lv***Abstract**

The ocean water contamination is one of the basic problems to assure sustainable development and utilization of marine resources in the future. With the intensification of marine transport, which increases the risk of water pollution, monitoring of ocean water quality and spill detection are the most important questions. The requirements to the water quality dumped from the ships are systematically increased. To satisfy these requirements, elaborated control systems and wastewater treatment equipment must be installed onboard.

However, improvement of the ecological situation mainly depends on human consciousness, education level and good will, because improvement of the ecological situation depends on the decisions taken by individuals.

**KEY WORDS:** *oil spills, water pollution, ecological situation*

*How inappropriate to call this planet Earth, when clearly it is Ocean.*

*Arthur C. Clarke*

**1. Introduction**

Oil spills can have a serious economic impact on coastal activities and on those who exploit the resources of the sea. Effects of Marine Oil Spills -impact of oil on coastal activities, impact of oil on fisheries and mariculture, biological effects of oil, impact of oil on specific marine habitats,

Over 70% of our globe is covered by water. Ninety-seven percent of all water on earth is in oceans. Life on earth began in the oceans and then evolved from the ocean to the land. Today, the ocean remains a necessity to maintain life, as we know it. The oceans provide most of the oxygen we need to breath, a reservoir for soaking up almost half of the globe's gaseous carbon pollutants (more than 2 billion tons per year), and a food source that can feed the world. The Ocean is main factor in maintaining Earth climate. Throughout history, people have been living near oceans with the sense that nothing humans do could possibly affect it in any way. While humans were few in numbers, the oceans were able to withstand and absorb most of destructive activities. Now with a growing population of over 6.5 billion, we know that human actions are causing problems. The ocean is a very sensitive ecosystem and is now showing signs of imbalance from chronic overuse and abuse. We do not yet know the long and short-term consequences of our actions.

**2. Awareness and Education**

One of the main problems is ignorance about the impact humans are causing to the marine system. January 31, 2006 two ships collided in the English Channel, General Grot-Rowetski carrying 26 000 tons of phosphates and Ecce with 10 000 tons of phosphoric acid. Reading the Latvian newspaper Independent (Neatkarīgā) about this catastrophe we find [1]: "The acid will not cause pollution threat because the phosphoric acid is soluble in water ..."

This is tragically naïve conclusion: if we do not see it, it does not exist! Public attention is drawn to the accidents, which happen near the shoreline polluting beaches. The Prestige (November 13, 2002) casualty get a broad attention due to the pollution of the Spanish coastline and large scale clean up operations. However, with the 63 000 tons of oil spill it is only 35th by size. The largest was 287 000 ton spill from Atlantic Empress in 1979 off Tobago [2].

Oil spills from tankers are causing big damage to the ocean and big attention, but this is not the main source of ocean pollution with oil. Three-quarters of all marine pollution comes from land. A National Academy of Sciences study estimates that the oil running off our streets and driveways and ultimately flowing into the oceans is equal to an Exxon Valdez oil spill – 37 000 tons - every eight months [3].

In the Baltic Sea, one of the latest and biggest accidents was the shipwreck of Flawless (such a name of ship in such an accident asks for pun) off the Estonian coast with the spill of 1.5 tons of mazut January 25, 2006 [4].

Spills can be caused by:

- people making mistakes or being careless;
- equipment breaking down;
- natural disasters such as hurricanes;
- deliberate acts by terrorists, countries at war, vandals, or illegal dumpers.

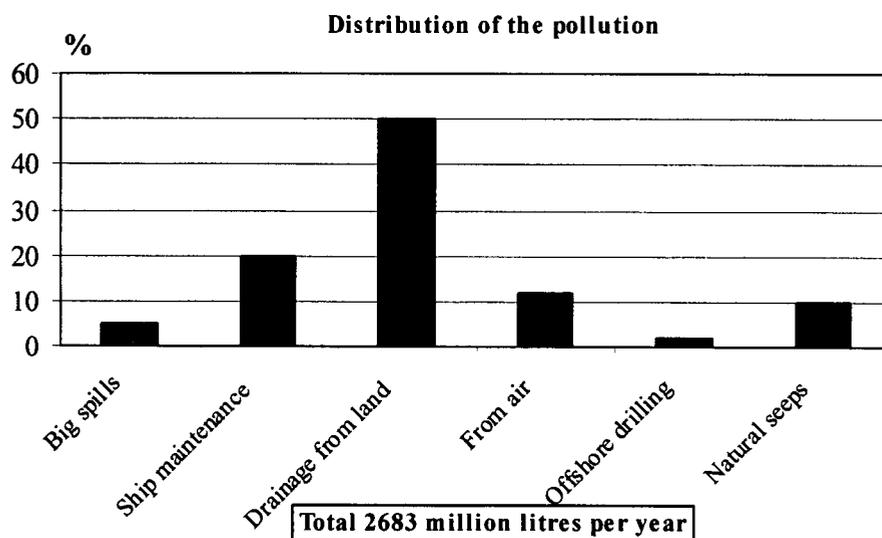


Fig. 1 Marine oil pollution sources

### 3. Marine transport ecological problems

In the beginning of history main human activities were concentrated on the land. With the development of steam and diesel engines and recognizing the vast amount of valuable resources in the seas, more and more activities are carried out off the coast, - passenger and cargo transportation (including fleet of very large tankers carrying oil and chemical substances), oil drilling, intensification of fishing far away from coastal line, etc. This intensification process sometimes-called Progress) in making more and more impact to the marine systems. The marine systems self-purifying capacity of is not boundless and in many regions has reached the limit.

Baltic Sea and Riga Gulf are in the list of most polluted waters. This is due to the high intensity of the marine transport, high level of industrialization on the land and off shore, high density of population, shallowness, and very low water exchange with bigger accumulators [5, 6]. In the Baltic Sea water fully exchanges only in 30 years. The Baltic Sea is on the start of clinical death [7] and responsibility lays on all Baltic Sea countries. Every year hundreds of millions are spent by the EU for the improvement of the situation, but in the next 10 to 20 years the improvement, comparing with the existing, is planned only as 2 to 3%.

The unification of Europe and overall globalization process has challenges and, in the same time, new possibilities. During the last decade we can indicate several positive tendencies:

- Significant decrease of toxic emission from industry
- Improvement of the monitoring and management systems,
- Oil pollution to the marine systems has decreased,
- Improvement of the waste water treating systems has decreased the pollution load of river basins and seas.

Ships are equipped with powerful engines which are causing oil leaks at the normal operational conditions, carrying out repairs, changing lubricate filters, etc. Washing waters also contain oil. Bilge water, if discharged, is serious pollutant, and only modern and big ships have oil separators on board, mandatory by latest regulations. Oil spills can happen also at the pier during the fuelling operations. Big source of pollution, as can be seen from Fig. 1, is incomplete oil combustion products discharged to the air and later accumulated by the ocean. Oil content in the bilge water varies widely depending from the type of engine, quality of operation, and technical condition. According with the International Maritime Organization data average oil content in bilge water is 20 000 ppm and tankers are producing 55 – 57 liters per day such water. Regulations demand less than 15 ppm of oil in the dumped water, but in some regions (Black Sea, Mediterranean, North Sea, Caribbean region, Antarctica, and Baltic Sea) no oil spills are allowed [7].

Oil spills are connected with two main problems, which most be solved operatively:

- detections of oil spills and
- elimination of accident's pollution.

However oil spills can happen first voluntary actions of human, second – independent from human cause, for instance accidents of transport ships or other emergency situation. These cases resulted with catastrophic pollution of hydrobiological marine environment as well as economical losses for countries, by which the accident is happen. As example are the biggest accidents: in year 1992 oil spill from Greece tanker „Aegean Sea” by Lakorunja coast was 74 000 t crude oil; in year 1989 by Alaska coast oil spill from „Exon Valdes” was 40 000 t crude oil.

The causes of ship's accidents can be either ship's construction gaps – inadequacy of constructions for cargo, the failure in ship's hull calculus during designing or others independent from ship's crew reasons: on the board of old ships sometime nonworked purification engine but oil filters are non-steadily working and change of its are inadequate expensive. Important is ship's technical standard – the amount of oil on board mismatch to the capacity of purification engines.

Still we must not forget human factor – ship's crew and its motivation as well as its working conditions. Important is health of personnel, its overload during work, tiredness, level of possession of information, ability to be competent in extreme situations as well as other factors, which influence at time of the decision choice.

The positive influence on the improving of situation make the rules for technical water delivery to the harbour for free in order to decrease of desire to dump its in the sea.

#### 4. Oil detection in the water

Ships must be equipped with control systems registering oil content in the dumped water, keeping records of the amount of dumped oil per mile and total amount of dumped water, and automatically stopping discharge, if oil content is bigger than demanded by regulations.

There are several methods for the oil content determination in water:

1. Turbidimetry, which is based on the light absorbance. Photometric cell detects variation of penetrating light intensity.
2. Luminescence. Sample is excited by UV radiation, giving different emission spectra from various species of molecules.
3. Photometry, which is based on various absorbencies of UV radiation by various species of oil components. From the sample oil products are extracted and then automatically transferred to the photo calorimetric cell.
4. Infra-red spectro-photometry is also based on light absorbance, but in the range of 3.4-3.5  $\mu\text{m}$ .
5. Laser spectroscopy is based on the reflected laser beam intensity measurements.

All instrumentation must be resistant to corrosive action, and stable in the conditions of ship's vibration and rolling. Precision of measurement must be independent from dispersed solid particles, color and salt content of water. Laser spectroscopy installation by Umwelt Pollution Messtechnik is one of best solution for continuous control of oil polluted waste waters which allows complete automation of bilge water dumping [8].

#### 5. Spill detection

However, according with the data of Latvian Environment Agency [9], 90% of oil spills in the year 2002 were done consciously and illegally. This means that wastewater control systems on-board are not effective enough, they can be shut off any time and highly polluted waters can be dumped in any place.

Beside of oil spills there is a vast problem of tank and container washing waters. Only the biggest ports are equipped with the washing installations and washing water treatment facilities. Ships are carrying many kinds of products, beginning with the meat, which leaves abundant deposits of fat on the walls of containers, and ending with toxic chemical substances. Where are going washing waters? - Mainly to offshore waters.

European Cosmic agency has developed a satellite control system possible of spill identification with the resolving power of 5 – 10 meters. Such global satellite control system is planned to introduce in the next decade [10, 11] and it will be a big asset in combating illegal spills and fight the ecological consequences of ship accidents or accidents at offshore oil drilling platforms.

#### 6. Conclusions

In order to provide for sustainable use of the natural resources of the sea both now and in the future, the purity of the world's oceans should be considered to be a very crucial issue. Therefore the monitoring of the environment is essential, especially due to the development of the shipping and the increase of the intensity of the sea routes, which result in the danger of the risk of ecological pollution. The requirements for the level of the purity of shipboard oily water have

increased; various control mechanisms are being used on the ships in order to monitor and prevent the accidents, which can result in the pollution of environment.

However, the improvement of the environmental situation should start with a change of people's attitude and improvement of environmental education, because the solution of the environmental problems depends on the decisions made by individual person, which subsequently depends on the level of awareness and attitude of each person.

The environmental education is crucially important in improving the environmental situation and reaching the strategic environmental goals.

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