MARINE SPILLS: PROBLEMS AND SOLUTIONS

Modris Drille, Ineta Rozenštrauha, Ilo Dreyer
Riga Technical University

How inappropriate to call this planet Earth, when clearly it is Ocean.
Arthur C. Clarke

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

Introduction

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.

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 acidents 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].

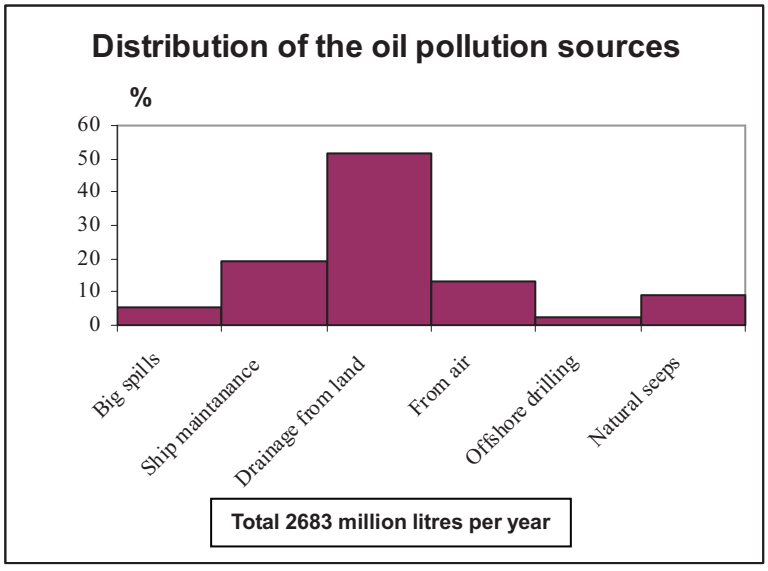

Fig. 1. Marine oil pollution sources

Marin 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 densityu of population, shalowness, and very low water exchange with biger accumulators [5, 6]. In the Baltic Sea water fully exchanges only in 30 years. The Baltic Sea is on the bringe of klinical death [7] and responsibility lays on all Baltic Sea countries. Every year hundreds of miljons are spent by the EU for the improvement of the situation, but in the next 10 to 20 years the inprovement, comparing with the existing, is planned only as 2 to 3%.

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

- Significant decrease of toxic emision from industry,
- Improvement of the monitoring and management systems,
- Oil polution 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 equipeed 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 spils can happen also at the pier during the fuelling operations.

Big source of polution, as can be seen from Fig. 1, is incomplete oil combustion products discharged to the air and later accumulated by the ocen.

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 tan 15 ppm of oil in the dumped water, but in some regions (Black Sea, Mediterranean, North Sea, Caribean region, Antarctics, and Baltic Sea) no oil spils are allowed [7].

Oil detection in the water

Ships must be equiped 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 automaticaly 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 exited 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 spectrophotometry is also based on light absorbance, but in the range of 3.4-3.5 μm.
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 continious control of oil polluted waste waters which allows complete automation of bilge water dumping [8].

Spill detection

However, according with the data of Latvian Environment Agency [9], 90% of oil spills in the year 2002 where 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.

Sources

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Dr. chem. Modris Drille
Riga Technical University, Faculty of Materials Science and Applied Chemistry, Āzenes iela 14/24, Rīga, LV-1048, E-mail: modris@ktf.rtu.lv

Dr. ing. Ineta Rozenštrauha
Riga Technical University, Faculty of Materials Science and Applied Chemistry, Āzenes iela 14/24, Rīga, LV-1048, E-mail: ineta@ktf.rtu.lv

Dr. ing. Ilo Dreyer
Riga Technical University, Faculty of Materials Science and Applied Chemistry, Āzenes iela 14/24, Rīga, LV-1048, E-mail: ilo@ktf.rtu.lv