Analysis of oil pollution at sea by means of sea craft in Spain.

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1. Introduction

This is the final report submitted by the Nautical Engineering and Science department of the Technical University of Catalonia, within the Leonardo de Vinci type A project called: *Public, seamen and ship owners to be aware of effective struggle and increasing their sensitivity concerning prevention of polluting the sea by means of sea craft.*

Around 1,500 to 1,800 millions of crude oil tonnes are transported across the sea every year on board tanker ships. This quantity supposes the 35% of the world sea transport; additionally we should sum around 400 to 500 millions of refined oils tonnes as gasoline's, fuel oil, etc.

Europe is a great consumer of those commodities, receiving up to 500 millions of crude oil tonnes and around 250 to 300 million of refined products tonne, per year. This means that EU needs about 6,000 freights per year in order to cover the crude oil demand, carried out by between 1,500 to 2,000 tanker ships.

Figure 1: Main hydrocarbons transport ways in the world. Source: Oceana Non Governmental Assoc. 2004. Spain

Altogether European waters are in the middle of a lot of other tanker paths, carrying oil to other destinations, so we can confirm that the overall volume of crude oil crossing every year EU waters can exceed the 1,000 million of tonnes.

The Gibraltar strait is one of the most congested traffic points, being crossed by 18,000 ships carrying dangerous cargoes.

Around 81% of the tankers sailing in the world belonged by private companies not directly connected to oil companies nor states.

Regarding the hydrocarbons spills, annually are registered 300 accidents among oil tankers supposing the spill between 240,000 to 960,000 tonnes. The illegal and operational spills can account between 666,000 to 2.5 millions of tonnes every year, where up to 280,000 tonnes come from non tankers fuel and lube oils.

The Mediterranean Sea is the most polluted because these last kind of spills, being up to 490,000 tonnes per year. There are detected up to 3,000 hydrocarbon illegal spills in the European seas, but governments are convinced that they are only a small piece of the total volume. The Mediterranean Sea can receive around the 40% to 60% of them.
Despite this only a few numbers of ships are detained because this reason, being the approximate rate the 1% f the whole.

Dealing with the residues, generation and treatment, some sources believe that the overall quantity of oily residues generated in Europe can sum up to 20 million of tonnes per year.

Some very large crude tankers can generate up to 800 tonnes of crude residues per freight transported. Even it is estimated that tankers sailing in European waters carrying out the tank cleaning procedures, could generate annually some 12 million of oily water cubic metres.

Oily residues coming from the use of bunkers on board tanker ships calling at European ports, could reach up to 160,000 tonnes. In Rotterdam, the first port in Europe, only the 7% of ships calling there dispose their residues in the reception facilities.
In the Mediterranean ports there are 50 residues reception facilities, only 15 of them exceeds the minimum requirements.

In the Persian Gulf there it is loaded the 50% of crude oil carried by sea in the world, but there are no facilities for the residues treatment and only Oman has signed the MARPOL convention. Among the OPEP members, only Ecuador has provided the IMO information on its residues reception facilities.

In Spain the situation is not so different.
Spanish ports are receiving annually more than 100 million of hydrocarbon tonnes, where 70% of them are heavy oils as crude, fuel or asphalts. Its traffic can generate more than 3.5 million of tonnes of residues; being only sludge and oil transport residues, could exceed 250,000 tonnes.

The port of Bay of Algeciras, the biggest one in terms of volume in Spain and the fourteenth in Europe, only receives in the best case the 25% of total oily residues that would be estimated related to the traffic volumes.

2. Contacting with the main department of controlling and following sea pollution in Spain

2.1. Introduction

Spain is a maritime country that has around 8,000 Km of coast line in the western Mediterranean and NE Atlantic seas.

The government of the country is based on a democratic kingdom basis, where the king acts as the state head and the prime minister is elected every four years.

Below the state level there is the regional or autonomic government level, id est the state is divided in 17 regional or autonomic communities that are responsible for certain services as health, education or recycling of residues and wastes and other local affaires. Whilst the state rules on services as the foreign affaires, the defence or the transportation services among others.

1.2. Which department follows sea pollution

The Ministry of civil works and transportation (*Ministerio de fomento*) has three General Sub secretaries one of which is responsible of transports. This sub secretary rules and all modes of transport through the three different general directorates:

- D.G. of road transport
- D.G. of merchant marine (DGMM) (The maritime administration)
- D.G. of civil aviation

Figure 2: Schema of general directorates. Source Ministerio de fomento 2006. Spain

The DGMM is divided in four different sub directorates as follows:

- S.G. of maritime safety and pollution
- S.G. of quality and equipment and ships standardisation
- S.G. of Maritime regulations and international cooperation
- S.G. of coordination and administrative management

The competent national authority on pollution matters is identified as:

Directorate general of merchant marine (DGMM)
Sub directorate General of traffic and maritime pollution
C/Ruíz de Alarcón, 1 – 8ª
28071 – MADRID
Tel: +34 91 597 9269
Email: mnogueira@mfom.es

The civil maritime authority DGMM has responsibility for oil spill response within Spain's territorial waters and EEZ (200') and for implementation of the National Plan for Salvage and Pollution Control.

The spill notification point is the SASEMAR public society whose coordinates follows below:

National coordination centre for maritime salvage
State society for salvage and maritime safety SASEMAR
C/Fruela, 3 – 1ª
28011 – MADRID
Tel: +34 91 755 9132
Email: cncs@sasemar.es

SASEMAR was created in 1992 under the overall coordination of the DGMM to provide amongst other things, at sea pollution response. The society has a headquarter in the above address and 10 *Maritime Regional Coordination Centres* (MRCC) around the coast together with additional local centres at important ports. On site coordination and response of maritime operations is provided by the MRCC's under the coordination of the Sub Director General for Maritime Safety and Pollution Control (Mr. Manuel Nogueira).

There are some other entities of our interest depending of this ministry, as the port authorities society (*Ente Público de Puertos del Estado: EPPE*) and the Search and Rescue agency (*Sociedad Estatal de Salvamento Marítimo: SASEMAR*).
EPPE manages up to 27 general interest port authorities around the Spanish coasts, being each port authority working on a landlord schema. They have a quiet important independency but in the end must follow the lines established by EPPE.

1.3. Equipment and manning of the dedicated establishment

SASEMAR is a public society responsible for rescue, search, medical assistances, towing, publish the notices to mariners, pollution fighting, safety of maritime traffic and immediate answer to emergency calls. There is the only one establishment dedicated to the sea pollution contention. However we must remark that every port authority has its own resources to fight against inner port small spills as some cleaning small boats, barriers and technical staff.

The resources belonging to the society are mainly:

- 1000 professionals as the human force,
- the shore infrastructure as the Control centre towers in the main port authorities,
- 6 helicopters Bell/Agusta AB-139
- 4 fixed wing aircrafts Beech craft Baron B-55 property of SENASA Company (id est rented) up to the construction of the new EADS CASA 235 and owned ones.
- 14 deep ocean tugs
- 1 recovery ship of 3000 m^3 of capacity (rented), reaching the 7,300 m^3 of capacity.
- 55 fast rescue boats together with 10 bigger ones under construction.
- 6 salvage and pollution fighting bases in Madrid, Corunna, Santander, Las Palmas de Gran Canaria and Algeciras, ready for use fighting pollution material as contention barriers, devices to recover oil from, floating tanks to store it and 5 local ones.
- 6 submarine action bases under construction in Las Palmas, Corunna, Alicante, Algeciras, Tarragona and Ibiza with equipment for divers.

1.4. What methods are used to control and follow pollution?

There is a continue coverage from satellite that is provided by mainly the ENVISAT satellite belonging to the European Space Agency. Once an oil spill has been detected an airplane is sent to the scenario in order to check it and provide more precise information as confirmation of nature, colour and position of the spill. After that the pollution fighting ships coordinated by SASEMAR would reach the scenario and will use the means best consider to control the pollution.

1.4.1. Synthetic Aperture Radar (SAR)

The sensors mainly used to detect differences on sea roughness and wind profiles fitted in such satellites are mainly the SAR (Synthetic Aperture Radar) apart from the scaterometters and other sensors equipped on them.

Radar stands for radio detection and range, and its working basis is through radial frequencies return that will give information on distance, direction and strength of the reflected signal.

When the satellite systems are based on he visible light, they catch the sun light reflected on the earth but this is susceptible to be affected by the light and weather conditions, and this means 20% of time lost because visibility obstructions.

Figure 3: Picture of Envisat satellite before be launched. Source ESA 2002

The main applications are: Floating ice control, flooding chartings, tree coverage charting, oil spilling, search for oil or mineral sources and urban planning. Even the use of the C band affords to penetrate in s short depth the sea or earth surface.

Different satellites were developed as Landsat, SPOT or Radarsat, from the European Space Agency (ESA) the ERS-1 and ERS-2 and lastly the ENVISAT, have been the European chance for this purposes.

1.4.2. Coastal spills

If a spill occurs in near shore waters or impacts the shoreline, overall coordination is provided by the Civil Governor of the province affected who convenes a technical coordination committee.

Shoreline clean-up is provided by municipal councils and coordinated by the Civil Protection Board. If more than one province is affected, the Ministry of the Interior and local government representative assume responsibility. Of course coordination and response is provided by the

MRCC's under the coordination of the Sub Director General for Maritime Safety and Pollution Control.[1] In port and terminal areas, the Port Captain would act as the on-scene commander.

It is seen that the responsibility or decision power is not dependent on one person or board but by several depending on their competences.

In order to coordinate the different actors during the year 2004, the Spanish government enforced its marine pollution prevention and control capability by means of the creation of a centre that would coordinate the response to any incident at both national and regional level. The centre (*Centro para la Prevención y Lucha contra la Contaminación Marítima y el Litoral*), was established through the royal decree 2182/2004 of 12 November,[2] has directorate status and bring together senior representatives from all related directorates and agencies with a stake in maritime emergency response.

The directorate is placed in La Corunna (NW of Spain)and is dependent from the Presidential Ministry, and their main functions are:

- Analyse the on going protocols and contingency plans
- Make an inventory assessment of human and physical resources are adequate to combat marine pollution.
- Elaborate a list of ships carrying usually dangerous or pollutant substances.
- Collaborate with SASEMAR to strengthen their interventions.
- Elaborate an integral (and specific) plan for training on pollution prevention and combat.
- Furnish a data base on maritime accidents
- Promote and lead new studies on systems to combat the pollution
- Celebrate periodic meetings with the environment representatives.
- Promote collaboration agreements signing with entities related to pollution combat.

1.5. The available budget for the pollution fighting agency

The Spanish Search and Rescue agency had an overall budget of around 70 MEuros per year, but during this year this was increased the 66% up to 115,8 MEuros being only the current expenses increased up to 50%.

[1] Spain country profile. ITOPF 2005.
[2] Spanish official gazette 276 of 16th November 2004.

This exceptional growth is due to the approval of the availability of the National Maritime Salvage Plan 2006-2009 last 5th of May, that is going to provide 1,022.84 MEuros during those years. Half of the quantity is going to be used as investment in new resources.
The new plan will seek for efficient legal instruments in order to coordinate the central (maritime) administration and local coastal communities

2. Penalties and fines and their effect on the affected companies

In a first step every pollutant incident or accident should be covered in its direct costs. It means that if no bad intention is demonstrated, the guilty must pay for the recovery and repairing direct costs to the Port authority (if in inner port waters) or to SASEMAR if it occurs outside the port. We can name them as restitution costs.

2.1. Main legislation bodies

The following states the international conventions and regional agreements signed by Spain up to this year.

International conventions
Prevention and safety: MAROL 73/78 and annexes III, IV, V and VI.
Spill response: OPRC'90 and OPRC – HNS
Compensation: CLC'92, Fund'92, Supp. Fund and Bunker.

Regional and bilateral agreements
Barcelona convention with states bordering Mediterranean
Member of the EC Task Force
Observer of the Bonn agreement.

In the national side the main regulating body in national legislation is the Law 27/1992 on Ports and Merchant Marine (LPMM) with further amendments. This law frames at that time the civil structure of the maritime administration.

2.1. Sanctions

The chapter 3 of the LPMM establishes the kind and nature of infractions regarding the marine pollution. There are three main levels of infractions:

- Low infractions up to 60,101.21 €

- Heavy infractions, up to 601,012.10 €
- Very heavy up to 3.005,060.5 €

The quantities are the conversion to euros from the old rounded figures in pesetas.

Low infractions on pollution are considered the:

- No observation of the port police rules related to the water cleanness,
- The repairing operations of the hull causing pollution or the
- No accomplishment of the cargo or ship residues deposition in approved installations.

Hard infractions on pollution from ships or platforms in Spanish waters, are considered:

- The voluntary dirty water release, when it is forbidden or is made against an specific law or rule,
- The no observance of the safe navigation, loading and manoeuvring rules by tankers,
- The no use of MARPOL reception facilities nor appropriate documents by ships or platforms,
- The no communication of any accidental spill caused and the
- Negligent introduction of noxious or toxic substances in the water.

Very hard infractions on pollution from ships or platforms in Spanish waters, are considered:

- The voluntary slops, residues or materials on board release, when it is forbidden or is made against an specific rule,
- The sinking of ships or platforms containing pollutant substances,
- The deliberate no use of MARPOL reception facilities nor appropriate documents by ships or platforms,
- Deliberate introduction of noxious or toxic substances in the water.

3. Statistics archives about sea pollution and its results

The accident statistics in regarding the marine transport have been analysed from two main sources, as the Spanish government mainly from the civil works and transportation ministry and the environment ministry; together with the International Tanker Owners Pollution Federation, Ltd.

3.1. National data

From the year 1991 to 2004 in Spain there have occurred up to 123 tanker accidents of more than 7 Tm, with different environmental consequences were there were involved some kind of hydrocarbon as oil, asphalt, fuel-oil, gas oil, gasoline, naphtha or liquefied gases.

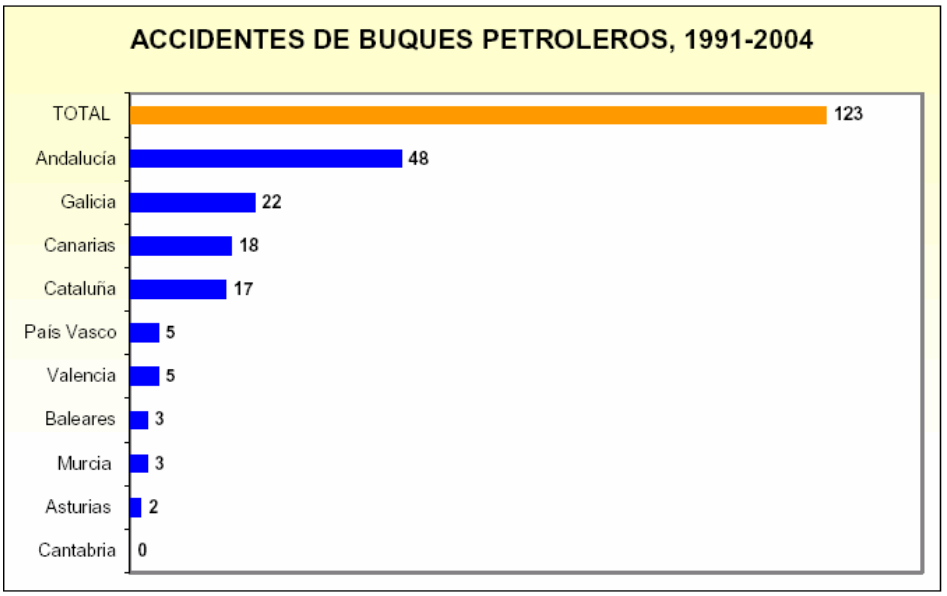


Figure 4: Tanker accidents with spills > 7 Tm by region, 1991-2004. Source Spanish Ministry of transports 2005.

During the year 2004 there were only 7 accidents and in 2003 only 5 spills.

From this figures and going to the sources we can say that the marine accidents when occur have big environmental consequences because the big traded volumes and the high dispersant capacity of the water.

For example in a global point of view from 1990 to 1999, the only 1% of accidents were responsible for the 75% of oil spilled volumes (Source ITOPF).

The main concentration of accidents are placed in the Andalusia region (Strait of Gibraltar) and Galicia (Costa da Morte-Finisterre) together with Canary island and Catalonia.

LONGITUD DE COSTA ESPAÑOLA			
CCAA	Km	CCAA	Km
País Vasco	246	C. Valenciana	518
Cantabria	284	Cataluña	699
Asturias	401	Baleares	1.428
Galicia	1.498	Canarias	1.583
Andalucía	1.890	Ceuta	20
Murcia	274	Melilla	20
TOTAL ESPAÑA:			**7.914**

Figure 5: Total coast line longitude split by region in Spain Source Spanish Ministry of transports 2006.

Among the main accident causes cited by the Ministry of transport, it is possible to point the substandard condition of vessels, their age and then the less safety measures available, together to different external causes as can be the bad weather conditions and the traffic crowding that can exist in certain zones as in the Mediterranean.

It is true that the number of accidents is not proportional to their gravity, and even their effect on the marine environment is bigger than for road or rail transports.
Spain is placed also on a passing zone in between two seas and the consequence is an intense traffic with a high risk of accidents.
Following is showed the biggest accidents in the coast of Spain:

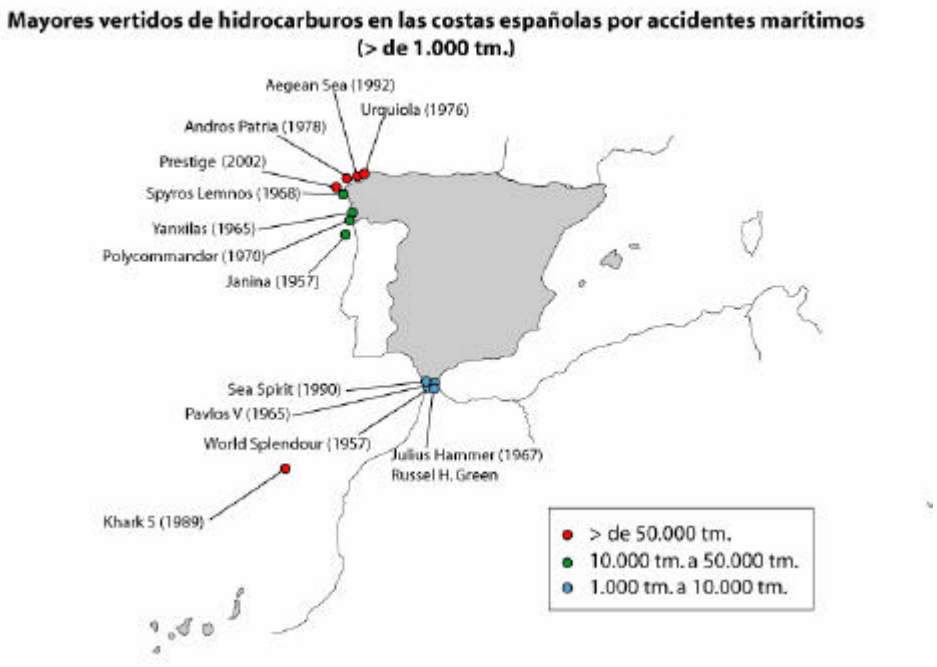


Figure 6: Main tanker accidents in the Spanish coast with spill >1000 Tm. Source Spanish Ministry of transports.

- 1970, Cíes islands (Galicia): *Polycommander*, tanker that spilled 50.000 Tm of crude oil.
- 1976, La Corunna entrance *Urquiola* tanker that spilled 100.000 Tm of crude oil.
- 1986, Porto of la Luz in Las Palmas de Gran Canaria (Canary islands): *Ángela Pando* tanker, spilled 50 50.000 Tm of fuel and oil.
- 1989, Tarragona beaches (Catalonia): *Chevron* tanker 20 Tm spilled.
- 1992, La Corunna (Galicia): *Aegean Sea* OBO ship, almost 80.000 Tm of crude oil.
- The last one on November 2002, *Prestige* tanker links 133' off Fisterra cape (Galicia), spilling more than 70.000 Tm of fuel-oil spilled to the sea. Affecting not only Spain but France coasts.

7 13/11/2002 **LAT:** 42.53 N **LONG:** 09.53 W OFF GALICIA SPAIN

VESSELS INVOLVED	VESSEL TYPE	FLAG	DWT	GT	YEAR BUILT	CARGO
PRESTIGE	TTA (MT)	BHS	81564	42820	1976	HEAVY FUEL OIL

SOURCE OF REPORT: FOCAL POINT / SPAIN **ACCIDENT TYPE:** FOUNDERING / WEATHER
SPILLED: CARGO / HEAVY FUEL OIL **QUANTITY:** 63000

RESPONSE: RESCUE OF THE CREW, SALVAGE, TOWING OF THE TANKER FROM THE SHORE, AERIAL SURVEILLANCE, CONTAINMENT, RECOVERY OF OIL AT SEA, EXTENSIVE SHORELINE CLEAN-UP OPERATIONS (IN SPAIN AND FRANCE). 13600 T OF OIL REMOVED FROM THE WRECK IN 2004.

REMARKS: THE TANKER SUSTAINED STRUCTURAL DAMAGE DURING A HEAVY STORM AND INITIALLY LOST AN UNSPECIFIED QUANTITY OF HER CARGO. AFTER BEING TOWED AWAY FROM THE SHORE THE VESSEL BROKE IN TWO AND SANK, RELEASING A SUBSTANTIAL QUANTITY OF OIL. OIL CONTINUED LEAKING FROM THE WRECK FOR SEVERAL WEEKS. REMPEC OFFERED ASSISTANCE TO THE SPANISH AUTHORITIES AND MAU WAS PUT ON STAND-BY. SEVERAL MEDITERRANEAN COASTAL STATES OFFERED THEIR ASSISTANCE THROUGH THE CENTRE.

Figure 7: Prestige tanker accident in the List of alerts and accidents in the Mediterranean. Source REMPEC, 2006.

Apart from this there are also other sources of pollution not related with the ship's accidents as for example shore industries, ship's bilge or tank cleaning procedures, etc. For example in the year 2000 there was observed an asphalt spill of 40 km long between Malaga and Cadiz, being affected up to 25 beaches and was not possible to determine its origin.

On July 2001, 700 litres of bunker lost from the Liberian flag ship *Tromso Trust*, affected the Tarragona beaches of Salou, Cambrils and Vila-seca. In this case the oil mole is placed outside the Tarragona port and is open to weather effects.

The first case responsible was not discovered but the second one was obliged only to pay the restitution costs.

3.1.1. The last spills in Spanish coasts

"Spabunker IV", Bunker lighter of 1,300 DWT built in 1991 and flagged in Spain, the vessel suddenly capsized and sunk in the middle of the Bay of Algeciras with good weather conditions the **21st of January 2003 at 15:30 hours**. The Master reported that the stern was flooded and

the ship lost the stability, two tugs went to help him but the vessel disappeared in a few minutes. The spill was assessed in **1,029 Tm of fuel, 179 of marine diesel oil and 169 of gas oil** that the wind pushed to the outer zone of the bay.

"Rolon Sur", Passenger ferry ship of 1,764 GRT built in 1978 and flagged in Spain, the vessel run aground off the entrance of Ibiza port in bad weather conditions the **20th of March 2004**. The salvage and pollution fighting brigades were mobilised and in 48 hours, all the oily substances on board were removed from their tanks. The spill was avoided thanks to the damaged zone was only in the fore part of the ship where no fuel tanks were fitted. After the accident the ship was sold to be scrapped.

"Ocean Globe", Bulk carrier of 25,498 GRT built in 1995 and flagged in Bahamas, the vessel run aground off the Bay of Cadiz the **22nd of January 2007** at 23:15 hours in an area called "Bajo del diamante" probably due to bad weather when sailing from Houston with a cargo of 38,000 Tm of coal. When the high water afford the ship to be released from the previous situation it was late as around **600 Tm of fuel** coming from the damaged double bottom tanks, were spilled. The ship was released with the aid of 4 tugs that escorted it up to the port of Cadiz to carry out the repairing.

"Sierra Nava", Refrigerated cargo ship of 4,660 GRT built in 1991 and flagged in Panama (Spanish owned), the vessel run aground off the Bay of Algeciras the **28th of January 2007** at 12:05 hours in an area called "Playa del Chirranal" when anchored due to bad weather. The anchor began to drag and in 10 minutes the ship reached the beach of Chinarral when the ship was in ballast. The spill is calculated in around **170 Tm** of fuel oil, and has affected one kilometre of the mentioned beach. The owner has signed an agreement with the company SvitxerWijsmuller with a specially provided truck with 15 technicians to recover the fuel contained in the tanks. At the same time a Workshop ship is coming from Cartagena with welding and pumping equipment, to help in the operations.

Figure 8: The reefer ship "Sierra Nava" stranded off Algeciras bay. Source Spanish Ministry of transports.

Figure 9: The reefer ship "Sierra Nava" stranded off Algeciras bay. Source Spanish Ministry of transports.

Figure 10: The reefer ship "Sierra Nava" stranded off Algeciras bay. Source Spanish Ministry of transports.

3.2. International data

Data coming from international resources are mainly provided by the International tanker Owners Pollution Federation. Most incidents are the result of a combination of actions and circumstances, contributing all of them to the final outcome. We think that the highlighted causes in the world data can be extrapolated to the Spanish case. However for a more in deep analysis a new project should be developed.

Next graphics show the primary event or operation in progress at the time of the spill, grouping in the "other/unknown" topic, spills for which information was not available.

It is apparent from the data that most of spills from tankers result from routine operations such as loading, discharging and bunkering which normally occurs in ports or at oil terminals.
Also the majority of the operational spills are small with some 91% involving quantities of less than 7 tonnes.

For the accidental causes such as collisions and groundings, generally give rise to much larger spills with at least 84% of incidents involving quantities in excess of 700 tonnes due to such factors.

	<7 Tonnes	7-700 Tonnes	>700 Tonnes	Total
OPERATIONS				
Loading / Discharging	2820	328	30	3178
Bunkering	548	26	0	574
Other operations	1178	56	1	1235
ACCIDENTS				
Collisions	171	294	97	562
Groundings	233	219	118	570
Hull Failures	576	89	43	708
Fire & Explosions	88	14	30	132
Other/unknown	2180	146	24	2350
TOTAL	7794	1172	343	9309

Table 1: Tanker accidents classed by quantity of spills and cause from 1974 to 2005. Source ITOPF 2006.

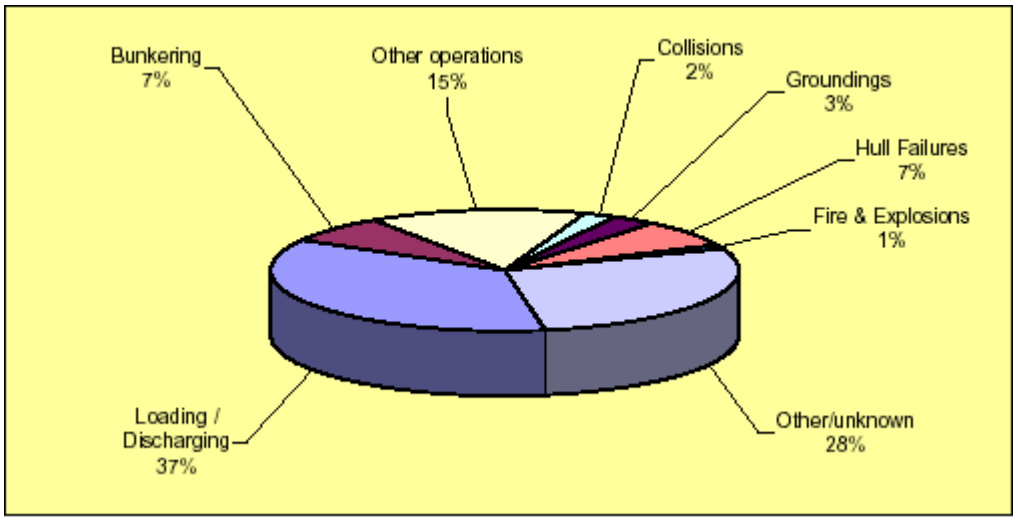


Figure 11: Incidence of spills < 7 Tm by cause, 1974-2005. Source Oil tanker spill statistics 2005. ITOPF

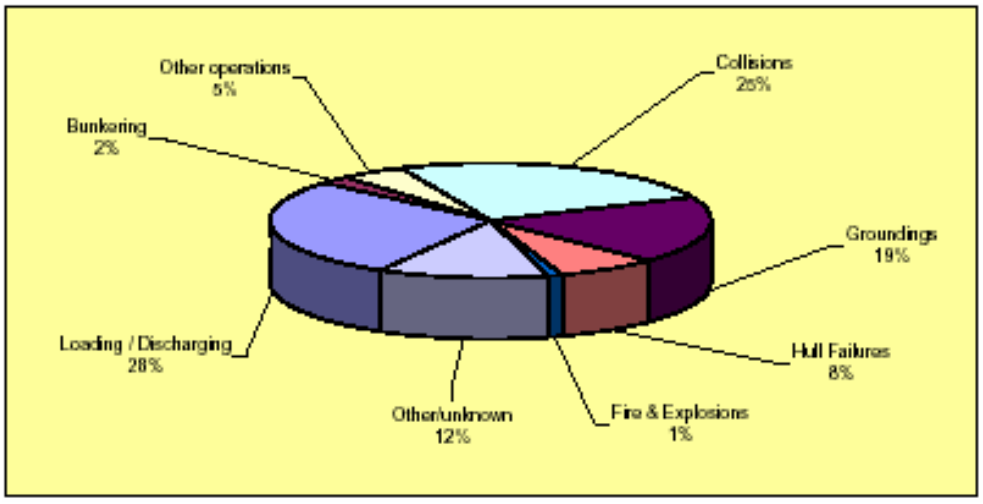


Figure 12: Incidence of spills 7 to 700 Tm by cause, 1974-2005. Source Oil tanker spill statistics 2005. ITOPF

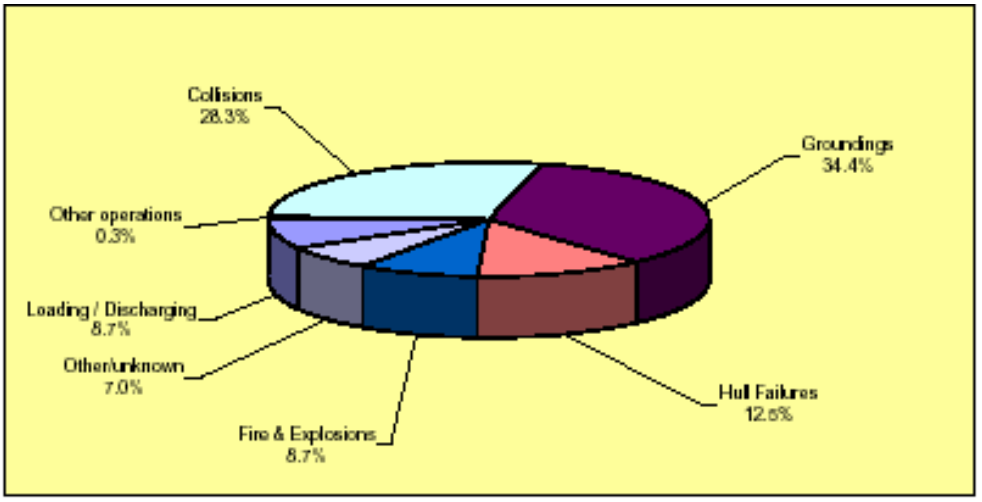


Figure 13: Incidence of spills > 700 Tm by cause, 1974-2005. Source Oil tanker spill statistics 2005. ITOPF

From a historical point of view, must be said that a single accident can distort in depth the figures from one year to another as we can see in the next graphics.

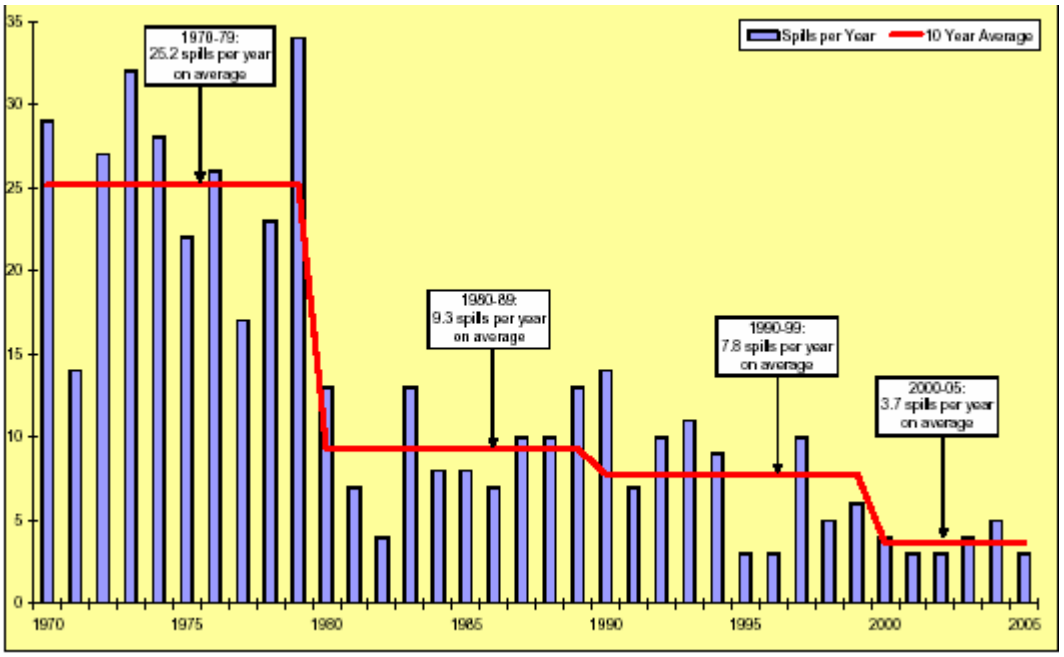


Figure 14: Number of spills bigger than 700 Tm from the year 1970. Source Oil tanker spill statistics 2005. ITOPF

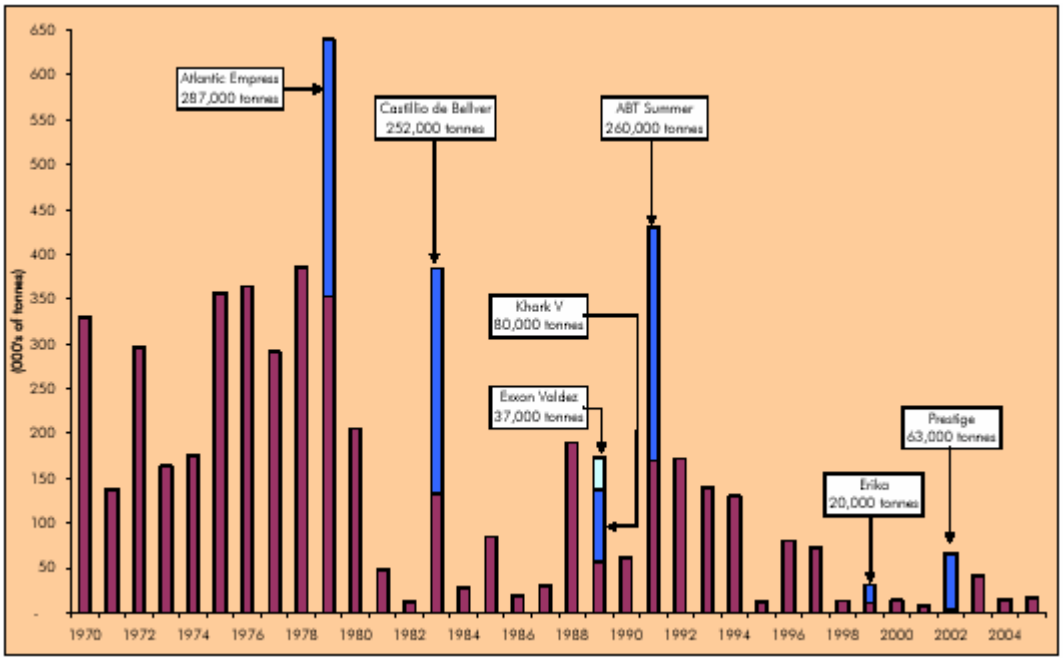


Figure 15: Quantity of oil spilt bigger than 700 Tm from the year 1970. Source Oil tanker spill statistics 2005. ITOPF

3.3 Quantities of oil spilled and number of accidents in the Mediterranean sea

The report and figures contained in this part is coming mainly from the REMPEC web site. All the data on quantities of spilled products, in general, should be regarded as approximate.

Between 1 August 1977 and 31 December 2003, approximately **304,700 tonnes** of oil (304 689 t) entered into the Mediterranean Sea as a result of accidents.

The total quantity quoted above includes 12,200 tonnes of heavy fuel oil and slops spilled from M O/B/O "SEA SPIRIT" as a result of her collision with M LPG "HESPERUS", west of Gibraltar. This quantity was added to the total amount of oil spilled into the Mediterranean Sea due to the fact that although the accident occurred outside the boundaries of the Mediterranean, as defined in the Barcelona Convention, the spilled oil entered the Mediterranean carried by winds and currents and posed a serious threat to the waters and coasts of Morocco, Spain and Algeria.

The explosion and fire on board MT "HAVEN" off Genoa in April 1991 resulted in the loss of her entire cargo of 144 000 tonnes of crude oil. Some of this oil burnt and it was not possible to establish the quantity of oil which actually entered the sea. Therefore, the figures presented, take into consideration the amount of 144,000 tonnes spilled, as the quantity of oil released to the environment. On the other hand, those figures do not include oil spilled in 49 accidents for

which the quantity of released oil remains "UNKNOWN". However, it is not likely that these quantities were significant and that the overall picture would be much changed if they were added to the above-mentioned figures.

Following graphics show **quantities of oil spilled** during each year between 1977 and 2003, **including** and highlighting the **major accidents** for this period and the **number of accidents** for each year, distinguishing between those which resulted in an actual spill and those which did not lead to a proven release of oil. It appears that the overall trend is an increase of accidents since 1977.

However, the number of accidents resulting in an oil spill dropped from 41% of the total number of accidents for the period 1977 – 1995 to 33% for the period 1996 – 2003. This is most probably due to the tendency to report more casualties even if there is no spillage as a consequence. In addition, over the past ten years, the quantities of oil spilled each year remain relatively low, with no major accident occurring in the Mediterranean since 1991.

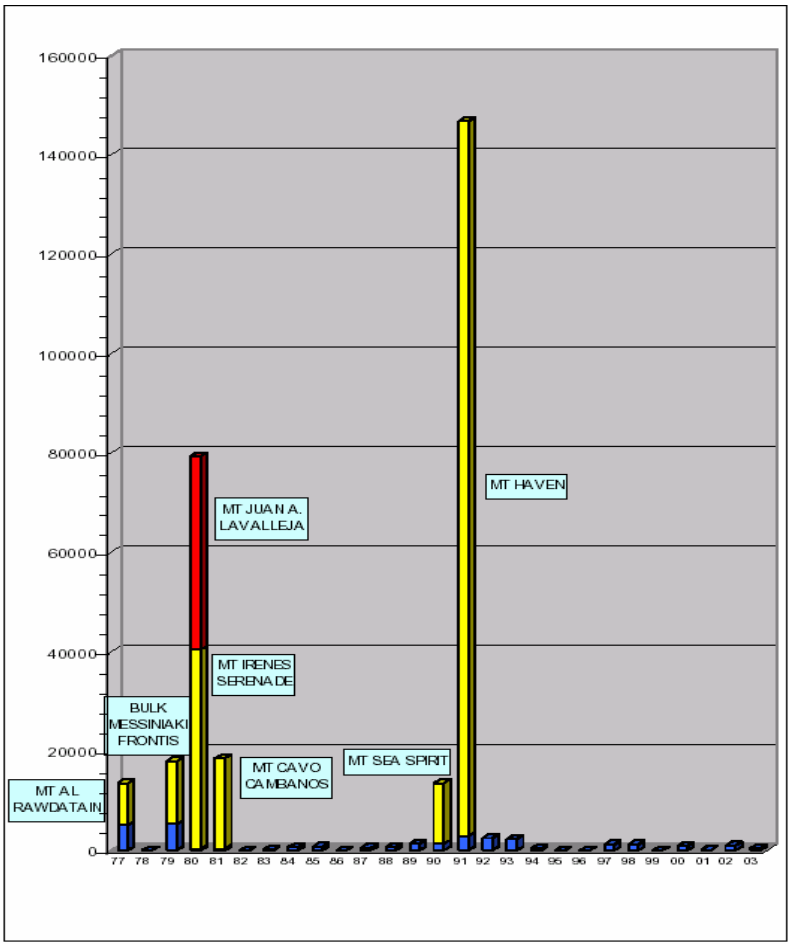


Figure 16: Quantities of oil spilled during each year between 1977 and 2003. Source REMPEC 2006.

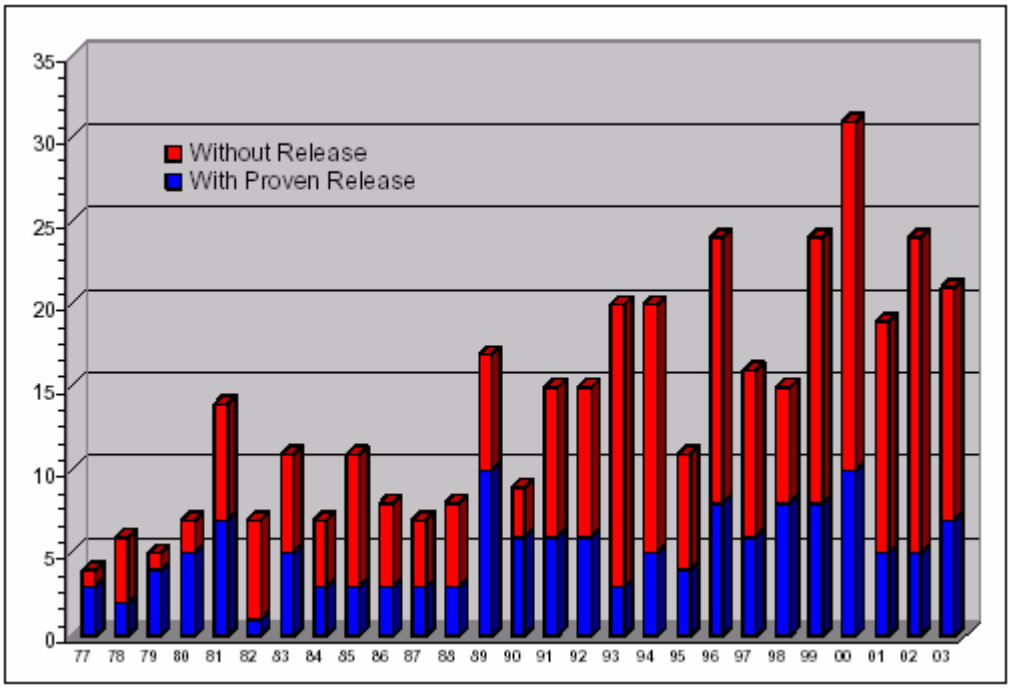


Figure 17: Number of accidents reported between 1977 and 2003. Source REMPEC 2006.

The average number of ships involved in accidents and average quantity of oil spilled for each month of the year over the 1977 – 2003 period is shown. Although these figures would need to be confirmed by meteorological data, they seem to demonstrate that the occurrence of accidents is quite strongly influenced by weather conditions. It appears that the months between October and March, which are known to be among the most unfavourable to navigation in terms of sea conditions, are the months of the year with the highest number of accidents.

The largest quantities of oil spilled were recorded for the months of December, February and March, which also corresponds to the months with usually the worst weather in the Mediterranean. However the reason why the quantity of oil spilled during January was persistently low, despite a large number of accidents, remains unclear.

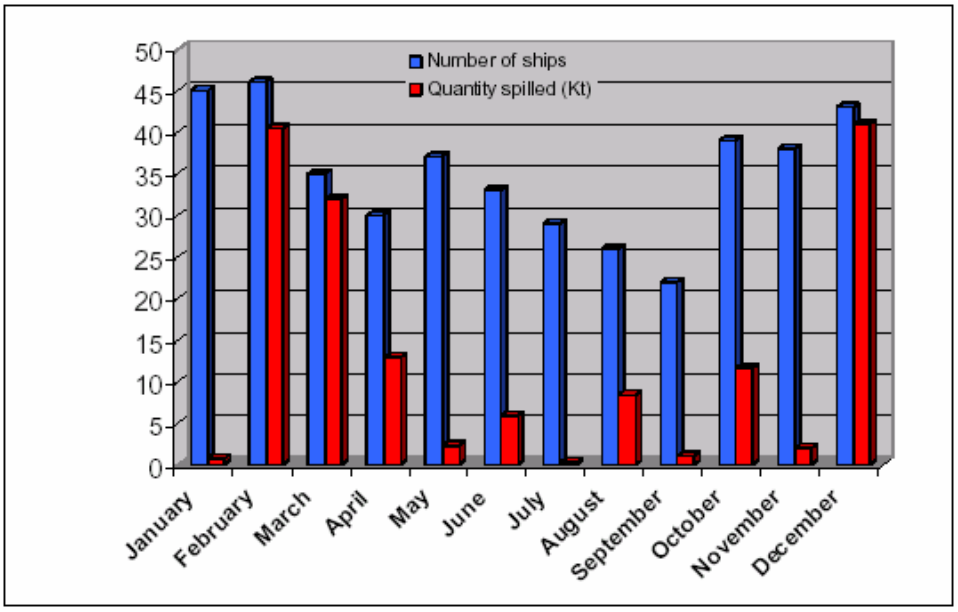


Figure 18: Number of ships involved in accidents and quantities spilled between 1977 and 2003 for each month of the year Source REMPEC 2006.

3.3.1. Types of accidents

According to the type, all accidents reported to REMPEC have been divided into the following 6 categories:

- Grounding
- Collision / Contact
- Fire and explosion
- Sinking (not caused by any of the above reasons)
- Cargo transfer failure
- Other accidents

Most of the sinking reported to REMPEC were caused by either water ingress or vessels capsizing in heavy seas.

Accidents listed in the last category comprise accidents that resulted or were likely to result in spillages, which were caused by war operations, ruptured pipes on land, various mechanical or structural failures on board ships, etc.

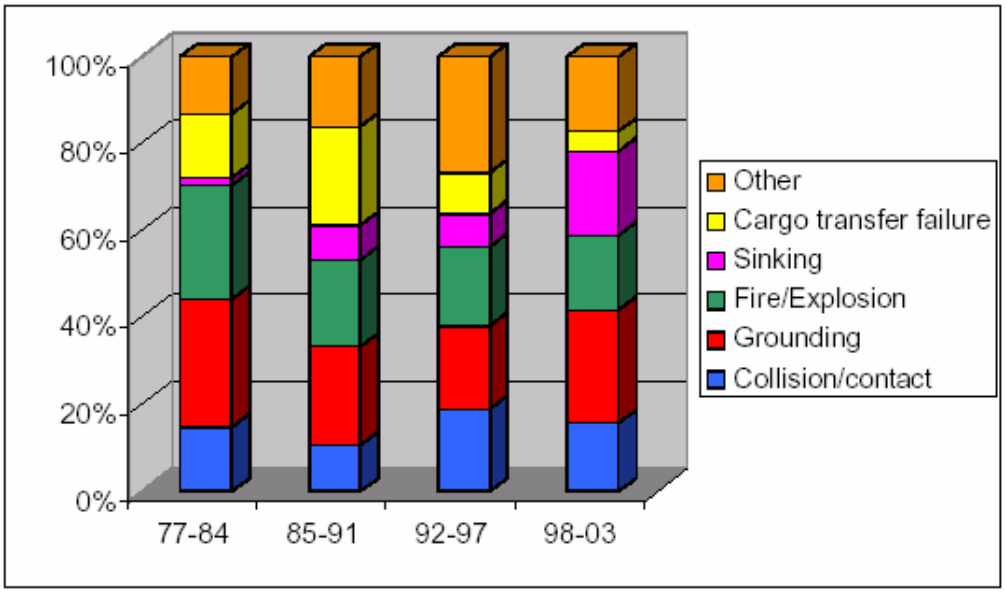


Figure 19: Number of accidents by type in percentage. Source REMPEC 2006.

Previous graphic shows the comparison in percentage of accidents in each category for the 77-84, the 85-91, the 92-97 and the 98-03 periods. Despite an increase in the relative number of sinking since 1998, and apart from a significant decrease in the percentage of cargo transfer failures over the years, the diagram does not show major evolutions, with none of the categories having preponderance over the other ones in terms of number of accidents.

Graphic 14 illustrates the quantity (in percentage) of oil spilled by type of accident for the same four above-mentioned periods. It is understood that since major incidents contribute significantly to the overall amount of oil accidentally released by ships in the Mediterranean, it is difficult to identify a general trend relating the quantities spilled and the type of accident.

However, between 1992 and 2003, period during which no spillage over 2000 tonnes occurred, the quantities of oil spilled as a result of collisions dropped drastically, and to a smaller extent so did the quantities attributable to groundings, whilst the amount of oil spilled due to fires and explosions was on the increase, as well as the amount related to accidents falling under the category “Other”, the latter accounting for almost 50% of the total quantity accidentally spilled over the 1998-2003 period.

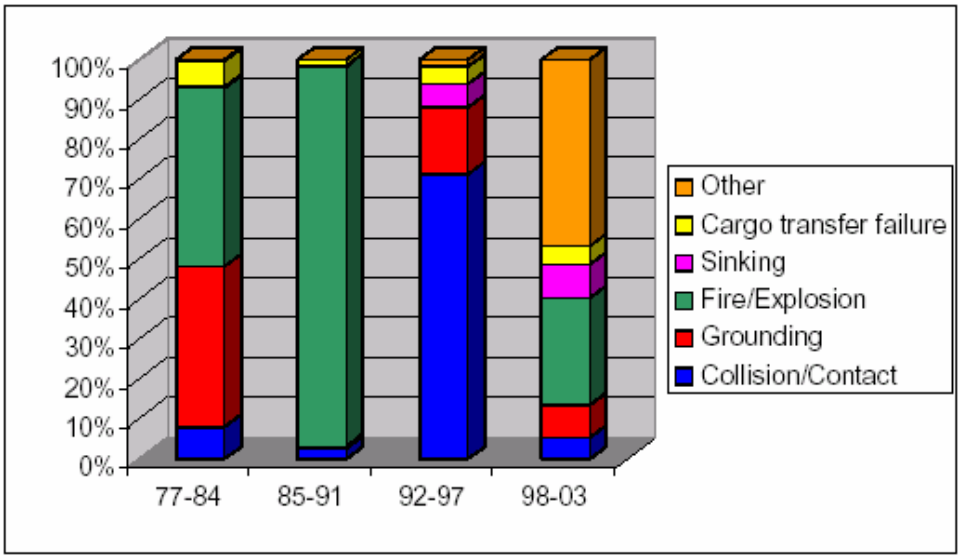


Figure 20: Number of accidents and quantities spilt in percentage. Source REMPEC 2006.

Lower quantities of oil spilled since 1998 as a result of collisions and groundings, might be attributed to the improvements in terms of ship design that occurred over the last decade and which in turn reduced the risk of a spillage when such accidents happen.

The next graphic indicates, for the period 1977 – 2003, the percentages of incidents leading or not leading to a proven oil spill for each type of accident. It is to be noted that as far as sinking are concerned, even when there is no evidence of a spill immediately after such incident, the fuel and lubricating oils, and sometimes also cargo, regularly sink along with the ship, thus eventually introducing the pollutant into marine environment, unless the oil that sinks with the ship is salvaged after the sinking.

The diagram shows that in approximately 50% of the known cases of collision, sinking and other types of accidents, some oil is spilled at sea. Fires, explosions and groundings are less frequently responsible for an oil release, whereas logically cargo transfer failures almost always generate one.

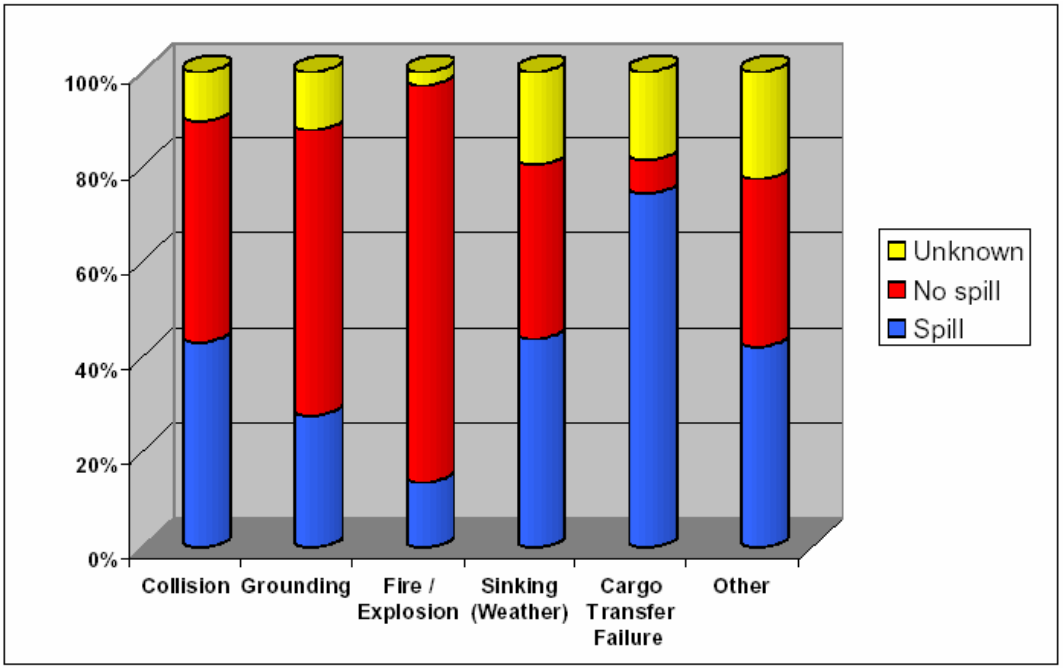


Figure 21: Proportion of accidents leading to an oil spill by type of accidents. Source REMPEC 2006.

Following we show the types of vessels (actually the number of ships in percentage for each type) involved in accidents which caused or might have caused oil pollution of the Mediterranean Sea for the same four periods considered before. The diagram clearly shows that the proportion of accidents involving oil tankers has been decreasing continuously from 74% of the total number of accidents in 77-84 to 40% for the period 98-03. On the contrary, the proportion of general cargo ships has increased and represents 31% of the accidents between 1998 and 2003, while the contribution of the other categories of ships remains roughly constant over the past 25 years.

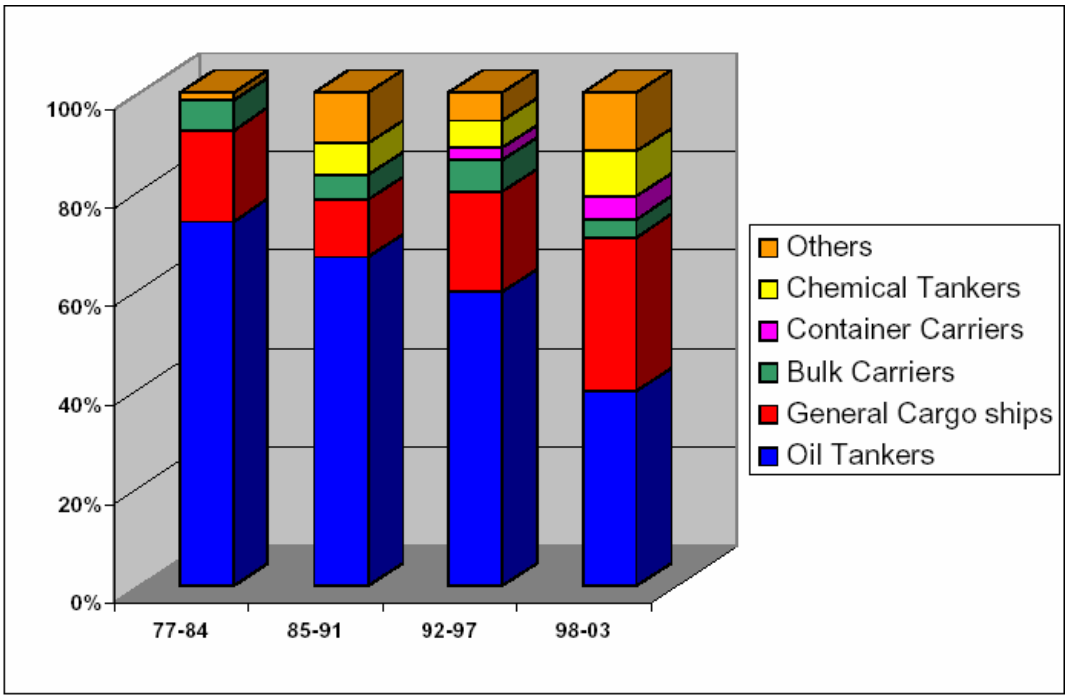
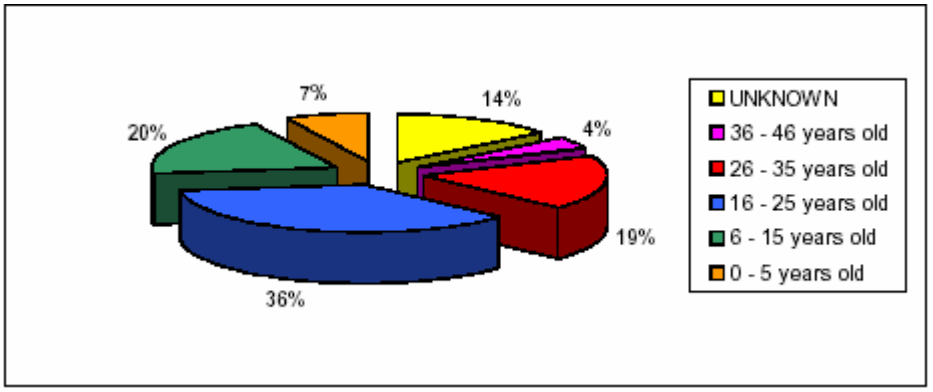


Figure 22: Types of vessels involved in accidents. Source REMPEC 2006.

The last one, represents the distribution of the ships involved in accidents between 1977 and 2003 according to their age at the time of the casualty. The majority of ships (36%) were between 16 and 25 years old, followed by the age brackets 6-15 and 26-35, accounting for roughly 20% each.



4. Hydrocarbon spills at sea, coming from ships

There is the idea is to get data on oily residues generation from the world's fleet, taking the data from the recovery facilities (i.e. in Europe) and comparing it with the registered traffic in their ports. From this comparison it is possible to deduct what is the treated residues rate and how much is left.

However it is no easy to get correct estimations from oil spills from ships. We are going to see the hydrocarbons spilt, mainly because there are a lot of differences on traffic figures, on quantities of residues recovered on ports, the type of goods carried and even the high number of intermediaries, every one giving their own figures as administrations, non governmental associations, companies and users.

The result is a mixing of criteria that makes no possible to decide what is the more proper or approximate to the reality. Due to this chaotic in determination, we are going to show all the known calculation or estimation methods, that keep similar approximation in their final results.

4.1. Quantification of hydrocarbon spills at sea, coming from ships

Within the oily residues spilt at sea, we can differentiate between solid and liquid, ones and even from their source as for example coming from shore or coming from the sea sources as ships. Of course that this project intends to give an answer from the oily spills made from the sea, but there are different types.

4.1.1. Types of spills

We can distinguish among the spills due to the fact that the oil is transported and in the other hand we can differ the ones due to the own merchant fleet activity.

These last ones can be due to accidental reasons or intentional because economic or unduly reasons.

- Own merchant fleet activity spills.
- Oil transport activity spills.

} - **Accidental.**
- **Operational**

4.1.2. Accidental spills.

During the last thirty years there have been annually around 50 tanker accidents with spills superior to 7 tonnes of crude oil and around 250 minor accidents, have occurred. This means[3], around one accident per month. Of course not all of these accidents have been reported by press or mass media. As only the ones with biggest ones are known by the society because they have left environmental consequences as in the case of Europe names as: *Urquiola, Torrey Canyon, Amoco Cádiz, Sea Express, Betelgeuse, Braer, Haven, Aegean Sea, Erika o Prestige* inter alia. But they are responsible only for an increase of 12% of the whole volume of hydrocarbons contained in the sea.

Result: Entire world's fleet

Between 240.000 – 960.000 Tm /year of hydrocarbons spilt at sea

4.1.3. Operational spills.

Operational spills due to routine actions reaches around 666,000 to 2.640,000 tonnes (too large interval) per year. This means 2.75 times the spills due to tanker accidents or also between 8 to 33 times[4] the spill coming from the *Prestige.*

The concepts considered within this operational side are the ones from illegal tank cleaning at open seas some of them can reach the 800 tonnes of residual crude oil per voyage.
In the other hand there are different quantities coming from what ever kind of ships as cargo ships, fishing boats, pleasure yachts or of course navy ships; adding all of them thousands of residues tonnes like used lube oils, oily waters, *bunkering* or other kina of products containing hydrocarbons.
Some sources estimate them in **280,000 tonnes per year**.[5] This means more than 2 millions of oil barrels (1 barrel = 137 kg) or around the daily production of the third OPEP provider that is Venezuela.

Result: Entire world's fleet

Between 666.000 – 2.640.000 Tm /year of hydrocarbons spilt at sea

[3] ITOPF (2003) Oil Tanker SIPI Statistic. The International Tanker Owners Pollution Federation.
[4] Again this is a too ample interval, but there is no more information found
[5] NAS (2002). Oil in the Sea III. National Academy of Sciences, National Academy Press, Washington, DC.

4.2. Residues coming from the tankers transit around the world

4.2.1. The traffic of tankers with hydrocarbons

Nowadays the 35% of world's transport by sea is of crude oil and only the 10% corresponds to refined products.[6] This crude oil means annually around 1,600 to 1,800 millions of tonnes, being more than 50%[7] going to the United States and the European Union. This quantity must be added to the 400 or 500 millions of refined products tonnes.

European port waters are not only receiving the ships calling there but also are crossed by ships carrying cargoes. The Mediterranean Sea is crossed every year by thousands of takers carrying crude oil from the Persian Gulf towards North America after passing through the Suez Canal. The Gibraltar strait registers around 18,000 ships carrying dangerous cargoes what means an increase of hydrocarbons volumes passing through the European waters to 1,000 millions.

The size of the ships carrying most of these quantities ranges from around 5000 GRT, mainly for the transit between ports, up to large tankers of 120,000 GRT or ultra large tankers of 300,000 GRT for intercontinental navigation. Then the average tonnage is about 40 – 45,000 GRT[8] in crude freights of about 80,000 tonnes. With these figures it is evaluated around 1,500 and 2,000 ships among oil tankers, gas carriers and chemical tankers; carrying these products to Europe, calling at European ports and discharging an average of 10,000 to 25,000 tonnes of crude oil in the refineries.

4.2.2. The traffic in Europe

Europe is the first receiver of hydrocarbons with approximately 500 millions of tonnes per year of crude oil and about 250 to 300 millions of tonnes of refined products. This is approximately a quarter of the oil world production. The distribution of theses exchanges in European waters is showed in the next figures.[9]

[6] Oceana. INTERTANKO (1998). Tankers, an interactive people business. The Intertanko Newsletter. Issue Nº1. Autumn 1998.
[7] Oceana. EC (2000) Communication from the Commission to the European Parliament and the Council on the Safety of Seaborne Oil Trade. European Commission. Brussels, 21st March 2000.
[8] BMT (2000). Study on the economic, legal, environmental and practical implications of a European Union System to reduce ship emissions of SO2 and Nox. BMT Murray Fenton Edon Liddiard Vince Limited No. 3623. Final Report for European Commission Contract B4-3040/98/000839/MAR/B1. August 2000.
[9] EC (2003). Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on enhancing maritime transport security. Proposal for a Regulation of the European Parliament and of the Council on enhancing ship and port facility security. Brussels, 2nd May 2003.

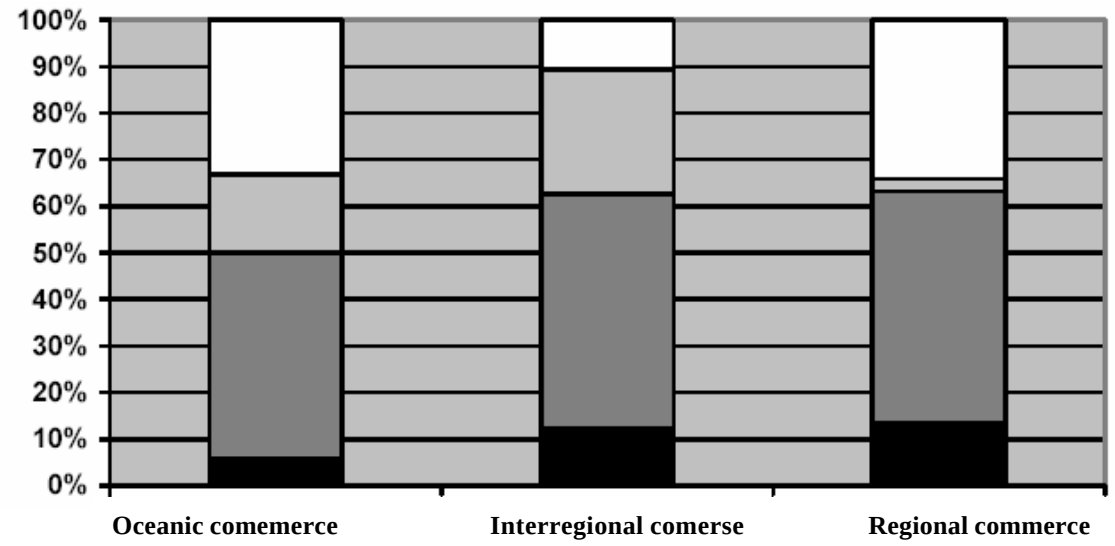


Figure 23: Maritime exchanges in European waters from down to up, Baltic, North Sea, Atlantic and Mediterranean seas. Source EC Communication, 2003.

Ranking	Port	Country	Millions of tonnes
1	Rotterdam	Holland	320
2	Antwerp	Belgium	130,5
3	Marseilles	France	94,1
4	Hamburg	Germany	85,9
5	Le Havre	France	67,5
6	Amsterdam	Holland	64,1
7	Tessport & Hartlepool	United Kingdom	51,5
8	Genoa	Italy	50,8
9	Hull & Immingham	United Kingdom	50
10	London	United Kingdom	47,9
11	Trieste	Italy	47,6
12	Dunkirk	France	45,3
13	Bremen	Germany	44,8
14	Algeciras	Spain	44
15	Wilhelm shaven	Germany	43,4
16	Forth Ports	United Kingdom	41,1
17	Saint Nazaire	France	36,6
18	Zeebrugge	Belgium	35,5
19	Gothenburg	Sweden	33,1

20	Felixstowe	United Kingdom	31,6
21	Liverpool	United Kingdom	30,6
22	Barcelona	Spain	29,8
23	Venice	Italy	28,2
24	Bilbao	Spain	27,5
25	Tarragona	Spain	27,3
	TOTAL		**1508,7**

Figure 24: Main European ports in traffic volume of hydrocarbons. Source ISEL Statistics, 2001.[10]*:*

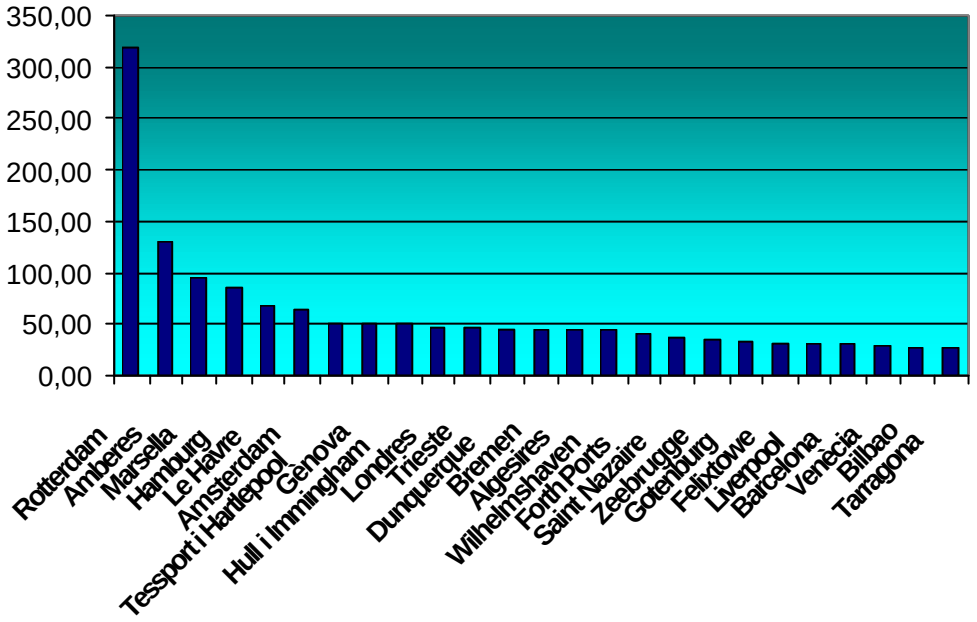


Figure 25: Main European ports in traffic volumes. Source ISEL Statistics, 2001

From 25 ports, the first 6 ports move up to the 50% of tonnes and Rotterdam totalises the volume of the last teen ports in the list.

4.2.3. The traffic in Spain

The Iberian Peninsula is placed in the middle of the two main hydrocarbon enter ways in Europe, as in one side there is the Atlantic and Cantabric area, where there are a lot of ships passing from / to America, Africa, Asia and Oceania; serving the transit between ports in the

[10] ISEL (2001). Shipping Statistics Yearbook 2001. Institute of Shipping Economics and Logistics. Bremen, Germany.

North and South of Europe. In the other hand Mediterranean waters are compulsory pass for ships from / to Suez Canal and within the ports in the South Europe and the rest of the world. Spanish ports accounts for the 12% of the freight moved by sea in Europe with around 354 millions of tonnes per year. Hydrocarbons figures are close to 120 millions of tonnes per year, where less than 50% is crude oil and the rest is distributed among Fuel oil, gasoline's, gas oil and others[11], We can say that 70% share are heavy oils formed by crude, fuel and asphalt.

Ports	Crude	Fuel	Gasoil	Gasoline	Asphalts	Others	Gases	Methane	Total
A Coruña	4.870.500	987.000	551.200	356.500	-	525.200	172.200	-	7.462.600
Algesires	11.187.000	3.968.900	1.487.700	1.158.500	-	560.800	662.000	30	19.024.930
Alacant	-	5	-	10	2.700	3.800	3.600	160	10.275
Almeria	-	-	720.000	194.300	76.400	65	-	-	990.765
Avilès	-	2.450	-	-	-	-	-	-	2.450
Balears	-	310.900	599.200	615.100	100	97.200	26.500	-	1.649.000
Barcelona	550	260.500	2.217.100	1.319.500	80	103.000	92.200	4.704.600	8.697.530
Bilbao	7.379.900	1.825.700	2.264.000	604.000	30	518.300	187.600	-	12.779.530
Cadis	20	8.400	2.800	20.400	56.700	10.600	10	15	98.945
Cartagena	10.974.800	408.400	1.050.000	245.400	3.700	531.200	637.900	2.971.400	16.822.800
Castelló	4.515.200	168.900	1.381.400	1.138.100	-	-	70.400	-	7.274.000
Ceuta	-	554.200	229.800	20.000	400	2.300	3.000	30	809.730
Ferrol	350	737.000	208.000	-	-	81.500	-	-	1.026.850
Gijón	100	138.600	709.400	161.500	95.400	-	355.300	-	1.460.300
Huelva	4.595.500	617.500	527.800	388.300	131.700	327.600	157.800	2.475.700	9.221.900
Las Palmas	2.390	1.991.200	1.550.900	718.500	2.500	38.800	40.400	400	4.345.090
Màlaga	-	-	-	-	650	1.000	-	-	1.650
Marín	-	-	-	-	-	-	5	-	5
Melilla	-	21.000	38.100	20.600	250	1.100	2.200	-	83.250
Pasajes	-	-	176.800	85.100	-	-	-	-	261.900
Santander	-	-	72.000	20.500	-	82.200	14.800	65	189.565
Sevilla	-	-	-	-	300	12.000	96.400	-	108.740
Tarragona	8.277.000	1.798.200	848.000	357.400	-	3.260.000	1.328.500	-	15.869.100
Tenerife	4.001.200	1.714.600	1.285.000	1.217.400	132.500	47.500	61.800	-	8.460.000
Valencia	910	98.500	666.400	245.000	45.800	29.600	10.000	-	1.096.210
Vigo	-	-	-	-	-	25.900	-	50	25.950
Vilagarcia	-	133.000	51.500	8.600	-	71.100	-	-	264.200
Totals	**55.805.420**	**15.744.955**	**16.637.100**	**8.894.710**	**549.210**	**6.330.765**	**3.922.615**	**10.152.450**	**118.037.265**

Figure 26: Traffic of hydrocarbon products in tonnes in the main Spanish ports. Source Ministry of Transport, 2003.

[11] MFOM (2003). Annual statistics 2002. Chapter 3. Port traffic 2002. Ministry of Transport, Madrid, Spain.

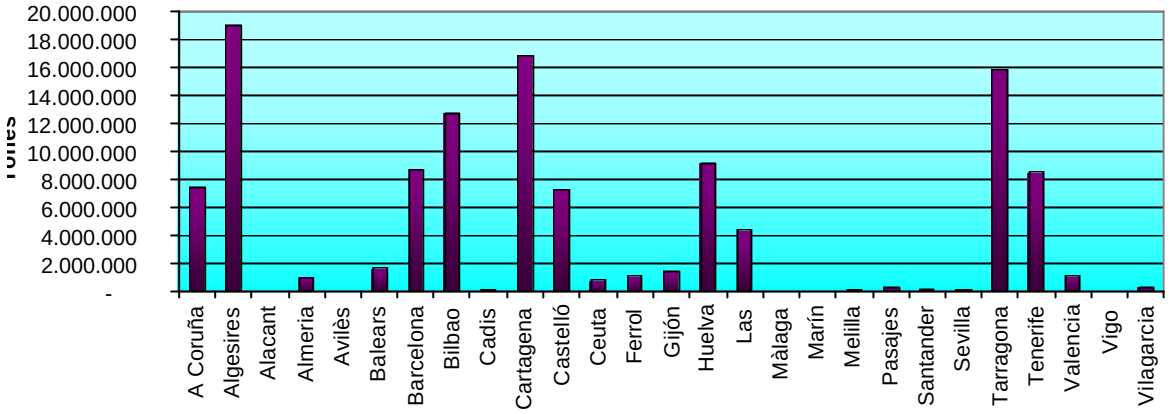


Figure 27: Traffic of hydrocarbon products in tonnes in the main Spanish ports. Source Ministry of Transport, 2003.

4.3. Parameters to calculate de oily residues production, generated by the hydrocarbons transport

As it has been mentioned before, the overall movement of hydrocarbons in tankers in Europe is evaluated in around 500 million of tonnes of crude oil, together with its derivates, that supposes more than 800 million of tonnes in total. The amount of generated oily residues is also approximate. During 1997 the EU carried out an study in order to assess the volume of such residues and the needed capacity of port reception facilities. The way for calculate these quantities is coming from the called MARPOL – guide values, elaborated by the IMO.

This method keeps in mind the next parameters:

- Regarding the total freight in volume contained in the ship's tanks:
4.8% of cleaning water
0.2% of crude residues or cargo residues
0.01% to 0.1% of semisolid cargo residues

- Regarding the ships with diesel propulsion:
2 to 3% of daily consumption volume in form of sludge.

The generation of residues by ship, depending on the used fuel can be:
1.5% to 2% in the case of heavy fuel
0.5% in the case of diesel oil

If we take these last two variables, we can assess the annual volume of residues generated by tanker ships in Europe.

The average rate of consumption for a ship's engines is around 0,35 tonnes / GRT and per year[12], so we can consider that a medium size tanker of around 45.000 GRT can burn around 15.750 tonnes of fuel per year.

0.35 tonnes of fuel / (1GRT * 1ship * 1 year) * 45,000 TRB = **15,750 tonnes / 1 ship * 1 year**

Now we take the above mentions relationship between residues generation per burnt fuel and we obtain that the same size tanker generates around 315 tonnes of residues per year, only caused by the fuel consumption.

15,750 tonnes / (1 ship * 1 year) * 2 tonnes of residues / 100 tonnes of fuel =
315 tonnes / 1 ship * 1 year

If 2,000 tanker ships sails around Europe, the overall fuel consumption is in the order of 31.5 million of fuel tonnes, generating 630,000 tonnes of residues per year.

315 tonnes of residues / (1 ship * 1 year) * 2000 ships = **630,000 tonnes of residues / 1 year**

4.4. Data from the European Community

4.4.1. Oily residues production in Europe

Following is showed another estimation of the oily residues production in Europe, published by the pollution responsible board in the UE. Those figures represent the overall oily residues generation in Europe due to the total trade of freight.

Zone	**m^3**
Eastern Mediterranean	40.000
Iberian peninsula	4.730.000
North of Europe	8.000.000
South of Europe	4.940.000
Scandinavia	1.370.000

[12] TRESHIP (2002). Treship Thematic Network. Technologies for Reduced Environmental Impact from Ships. State of the art report. Issue 8. December 2002.

United Kingdom - Eire	3.520.000
TOTAL	**22.600.000**

However these figures don not include other oily residues as the ones coming from the fuel consumption, lube oils or bilge oils.

INTERTANKO association considers that with the "load-on-top" method (to derivate the waters from tank cleaning to other settling tanks, with the aim of separate water from crude oil by decantation, so the crude oil remains on top and the clean water down can be returned to sea. The residual crude oil will be mixed with the new cargo, however not all the freight contracts accept this technique) the quantity of residues generated by a tanker after two cleanings per year, is around 6.000 m^3, so that if there are 2,000 tankers sailing per year to Europe, they can produce some 12 millions of m^3 of oily waters.

OCDE[13] uses to elaborate statistics showing the overall cargo carried by a tanker, if the 0,35% remains on the tanks sides and bottom, this means 252,000 tonnes of hydrocarbons residues in Spain and around 1.7 to 2.8 millions in Europe.

Oily residues production in Spain

Data coming from European Commission regarding Spain, says that heavy oils traffic in the state can generate more than 3.5 million of tonnes of residues. Only sludge and oil transport wastes could reach more than 250,000 tonnes.

[13] OCDE (2003). Cost savings stemming from non-compliance with international environmental regulations In the maritime sector. Maritime Transport Committee. Organisation for Economic Co-operation and Development. DSTI/DOT/MTC(2002)8/FINAL.

Oily residues quantity in Spanish ports generation estimation, due to heavy hydrocarbons transport[14]

Port	Total heavy hydrocarbons	Cleaning waters	Oily residues	Semisolid residues	Total residues
A Corunna	5.857.500	281.160	11.715	5.857	298.732
Alicante	2.705	727.483	30.311	15.155	772.949
Almeria	76.400	129	5	2	136
Algeciras	15.155.900	3.667	152	76	3.895
Avilés	2.450	117	5	2	124
Balearic	311.000	14.928	622	311	15.861
Barcelona	261.130	12.534	522	261	13.317
Bilbao	9.205.630	441.870	18.411	9.205	469.486
Cadis	65.120	3.125	130	65	3.320
Cartagena	11.386.900	546.571	22.773	11.386	580.730
Castellón	4.684.100	224.836	9.368	4.684	238.888
Ceuta	544.600	26.620	1.109	554	28.283
Ferrol	737.350	35.392	1.474	737	37.603
Gijón	234.100	11.236	468	234	11.938
Huelva	5.344.700	256.545	10.689	5.344	272.578
Las Palmas	1.996.090	96.812	3.992	1.996	102.800
Málaga	650	31	1	1	33
Marín	-	-	-	-	-
Melilla	21.250	1.020	42	21	1.083
Pasajes	-	-	-	-	-
Santander	-	-	-	-	-
Sevilla	340	16	1	1	18
Tarragona	10.075.200	483.609	20.150	10.075	513.834
Tenerife	5.848.300	280.718	11.696	5.848	298.262
Valencia	145.210	6.970	290	145	7.405
Vigo	-	-	-	-	-
Vilagarcia	133.000	6.384	266	133	6.783
TOTAL	**72.089.625**	**3.461.773**	**144.192**	**72.093**	**3.678.058**

These estimations do not include the bilge residues, burning oil and fuel residues or residues coming from the oil derivates transport as gasoline, gas oil or gasoline. So that we can say that the residues generation quantity in Spain can exceed the **3,68 millions of tonnes per year**. If we rest the 25% that is disposed and registered in ports (0.88 millions of tonnes), we find that around **2.62 million of tonnes of oily residues we do not know where are going.**

[14] Estimation based on the IMO guide values, related to statistic annual port traffic data from Spanish government.

The case of Algeciras port, where is registered the biggest cargo movement in Spain (14th in Europe), it only receives the 25% of oily residues that would correspond because the traffic volumes. This means more than **19 millions of barrels of oil**, or the daily production in the year 2000 of the 5 biggest OPEP oil productors (Saudi Arabia, Iran, Venezuela, Iraq and UAE), that is lost or nobody knows where is going. In fact this means that this is the same that the mentioned production is released directly at sea.

4.5. Residues reception facilities quantities

Observing the number of ships calling at European ports and the generated residues, the reception facilities, would receive quantities bigger than 20 million of m^3 per year.

But real records from the reception facilities are difficult to obtain and there is no an homogeneous system to count them. But we can confirm that those facilities only receive a very small part of the overall quantities.

Within Europe Rotterdam is the biggest port in terms of cargo movements, but there only the 7% of calling ships, release their MARPOL I residues. From these figures only the 1% are oily mixes from the engine rooms and the 3% residues form the Gas Oil.

In Spain occurs the same, as during the year2003, the Ministry of transports[15], reported one year after the Algeciras Bay special Plan beginning (and the EU Directive in force) that the oily residues received at port facilities, were only 200,000 m^3. However UE understands that because the traffic volumes[16] the ort should be the number 14 in Europe, receiving around 4% of hydrocarbons[17], and this means that the oily residues reception should pass the 800,000 m^3, or four times the received quantity.

4.6. Released at sea quantities

As a routine action, ships crossing the Mediterranean Sea, releases around 600,000 tonnes of hydrocarbons per year there[18], even that Mediterranean has a protected status related to the

[15] MFOM (2003). Special Control Plan in the Bay of Algeciras, has one year old. Government reports. Ministry of Transport. Madrid, 11 September 2003.
[16] EC (2002). Energy and transport in figures. Good transport. Sea Port Traffic. European Commission. Commission of Energy and Transport. Brussels, Belgium.
[17] APAB (2003). Annual Memory 2002. Algeciras Bay Port Authorities.
[18] Written question E-0947/02 by Marie Isler Béguin (Verts/ALE) to the Commission. Subject: Making sea traffic safe (2002/C 301 E/077). 9th April 2002.

polluting substances release, due to its sensible oceanographic particulars. We all know that it is declared Special Zone together with the Baltic Sea, the Black Sea, the Red Sea, the Persian Gulf, the Aden Gulf, the Antarctic and now the North Sea / NW of Europe; by MARPOL convention.

4.6.1. The legal releases

The hydrocarbon releases should be done far from the coast, at least 50 miles and sailing. It is not possible to release more than 30 litres / sailed mile, and the total quantity should not exceed de 1 / 30,000 (or 1 / 15,000 if ship older than 1980) of the cargo. This means that legal releases of ships carrying crude oil in the world are 120,000 tonnes of hydrocarbons in the world or between 33,000 to 53,000 tonnes in Europe. There is no concordance with the 5,6 to 6.3 millions of tonnes of sludge and residues or between 1.75 to 2.8 million of tonnes in Europe, generated by ships.

In the North Sea: 10 to 20,000 tonnes per year[19]
In the Mediterranean Sea: 400,000 tonnes per year,
In the Baltic Sea: 1,750 to 5,000 tonnes per year

4.6.2. The illegal releases

The air patrols to observe illegal releases are scarce, but when carried out, they have detected significant cases in Europe.

In the Baltic Sea, are detected between 500 to 700 spills after carrying out 5,000 hours of flights per year[20]. It is easy to suppose that, there are a lot more because flights are not done during the 24 hours nor all the year round.

In the North Sea after 3,500 hours of flights, there were counted 700 illegal spills, or one for every 7 to 8 flying hour. It is calculated that there are from 15,000 to 60,000 tonnes per year.

In the Mediterranean Sea there is used a software to recognise satellite images and during 1999, there were detected 1,638 spills[21]. This figure makes this sea as the biggest receiver of spills with a percentage on all Europe of the 45%, what is supposed to amount around 490,000 tonnes.

[19] Estimacions besades en: Peet G. (1994), 'International Co-operation to Prevent Oil Spills at Sea: Not Quite the Success It Should Be', in Helge Ole Bergesen and Georg Parmann (eds.), Green Globe Yearbook of International Co-operation on Environment and Development 1994 (Oxford: Oxford University Press), 41–54.
[20] HELCOM (2002). Proposal for an indicator report "illegal discharges of oil - in the Baltic Sea". Helsinki Commission HELCOM response 1/2002. Response Group. First Meeting. Szczecin, Poland, 23-25 October 2002.

These quantities sum up to almost 0.5 millions of tonnes of hydrocarbons spilt in the European waters. This is around 0.6% of the 800 millions of tonnes of hydrocarbons arrived to Europe.

We have before mentioned that every year are detected some 3,000 illegal spills of hydrocarbons in the European waters. The studies done, estimates that the quantity of spills floating on the sea surface is of 109,000 tonnes per year, 62% of them are 90,000 spills less than 20 tonnes that would cover 242,000 Km^2, almost half the territory of Spain.

The Group of Experts on Scientific Aspects on Maritime Pollution (GESAMP)[22] in 1990, were convinced on the poor effectiveness on International Conventions to prevent pollution, but that it was compulsory and necessary to accomplish, because in other case every year would be spilled between 8 to 10 million of tonnes of oil, coming from the tank cleaning and dirty ballast.

4.6.3. The accidental releases

This is not the main topic in this report, however it has been before mentioned that annually there are 300 accidents among tanker ships, provoking spills of 240,000 to 960,000 tonnes of hydrocarbons.

4.7. Port reception facilities

Following is showed the information published in the EU, related to ports with recovery facilities.

4.7.1. In Europe

Below follows the chart with the different type of recovery facilities:

[21] EC (2001). On the monitoring of illicit vessels discharges. A reconnaissance study in the Mediterranean Sea. European Commission. EUR 19906 EN.
[22] GESAMP (1990). The State of the Marine Environment. IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP).

Reception facilities under the Annex I del MARPOL in Europe							
Country	**Ports**	**Dirty ballast waters**	**Tank cleaning**	**Oil mixes with chemical contents**	**Sludge from tank cleaning**	**Bilges**	**Refined Fuel Oil residues**
Germany	56	36	30	12	19	56	45
Belgium*	-	N/A	N/A	N/A	N/A	N/A	N/A
Cyprus	1	1	1	1	1	1	1
Croatia	4	3	3	-	1	4	1
Denmark	63	35	39	45	43	62	51
Spain	46	6	6	30	30	46	30
Eastland	2	2	2	2	2	2	2
Finland	29	6	6	23	6	29	29
France	31	15	13	4	7	12	8
Georgia	1	1	1	-	-	1	-
Greece	14	9	9	2	4	10	8
Holland	14	8	8	3	7	11	14
Ireland	19	10	10	9	9	10	10
Island	7	1	1	-	-	7	7
Italy	47	30	27	11	18	29	25
Latvia	2	1	2	-	-	2	-
Lithuania	1	-	-	-	-	1	1
Malta	1	1	1	1	1	1	1
Norway*	-	N/A	N/A	N/A	N/A	N/A	N/A
Poland	2	2	2	1	2	2	2
Portugal	4	4	4	-	-	4	-
United Kingdom	100	68	65	59	46	63	97
Russia	21	9	7	-	6	21	8
Sweden	51	18	17	8	13	50	49
Turkey	25	13	13	4	9	19	2
Ukraine	11	3	3	-	1	11	2

**Note: Belgium and Norway have information of more than 60 facilities, most of all mobile ones.*

4.7.1. In Spain

Spain is member of the IMO from 1962 and signed the MARPOL protocol from 1984. In 1998 through the MARPOL, were published the list of residues reception facilities in ports, covering the requirements contemplated in the MARPOL Annex I. Below we have the following data. It is possible to note that only 6 ports are offering the residues reception services, coming from the tank clearing. This kind of facilities are related to the type of commodities a port receive, so

Reception facilities under the Annex I del MARPOL in Spain						
Port	**Dirty ballast waters**	**Tank cleaning**	**Oil mixes with chemical contents**	**Sludge from the tank cleaning**	**Bilges**	**Refined fuel-oil residues**
Bilbao	Yes	Yes	Yes	Yes	Yes	Yes
Pasajes	No	No	Yes	Yes	Yes	Yes
Santander	No	No	Yes	Yes	Yes	Yes
Avilés	No	No	Yes	Yes	Yes	Yes
Gijón	No	No	Yes	Yes	Yes	Yes
Ferrol	Yes	Yes	Yes	Yes	Yes	Yes
A Corunna	Yes	Yes	Yes	Yes	Yes	Yes
Vilagarcia	No	No	Yes	Yes	Yes	Yes
Marín	No	No	Yes	Yes	Yes	Yes
Vigo	Yes	No	Yes	Yes	Yes	Yes
Huelva	Yes	Yes	Yes	Yes	Yes	Yes
Algeciras	Yes	Yes	Yes	Yes	Yes	Yes
Tenerife	No	Yes	Yes	Yes	Yes	Yes
Las Palmas	No	No	Yes	Yes	Yes	Yes
Almeria	No	No	Yes	Yes	Yes	Yes
Garrucha	No	No	Yes	Yes	Yes	Yes
Carboneras	No	No	Yes	Yes	Yes	Yes
Águilas	No	No	Yes	Yes	Yes	Yes
Cartagena	No	No	Yes	Yes	Yes	Yes
Valencia	No	No	Yes	Yes	Yes	Yes
Alicante	No	No	Yes	Yes	Yes	Yes
Burriana	No	No	Yes	Yes	Yes	Yes
Sagunto	No	No	Yes	Yes	Yes	Yes
Gandía	No	No	Yes	Yes	Yes	Yes
Castellón	No	No	Yes	Yes	Yes	Yes
Palma	No	No	Yes	Yes	Yes	Yes
Ibiza	No	No	Yes	Yes	Yes	Yes
Mahón	No	No	Yes	Yes	Yes	Yes
Barcelona	No	No	Yes	Yes	Yes	Yes
Tarragona	No	No	Yes	Yes	Yes	Yes

it is surprising that Tarragona and Cartagena with important refineries and petrochemical industries have no tank cleaning reception facility.

5. Civil associations

In Spain there are civil associations that are compromised with the environment. They are not dependent from the state but can receive funds from the private and their own members. Below there are showed the most important ones in Spain dedicated to the environment protection and active against the pollution.

Ecologistas en acción, C/ Marqués de Leganés, 12. 28004 Madrid, Tel: 91 531 27 39, comunicacion@ecologistasenaccion.org

Federación conocer y proteger la naturaleza, N.R. San Diego bl. 9 Bajo C.P. 41015 Sevilla, phone: 954388525, fcpn_andalucia@yahoo.es, fcpn.blogia.com

Greenpeace, C/ San Bernardo 107, 1º 28015 Madrid, Tel: 91 444 14 00,msaenz@antevenio.com, www.greenpeace.es

Movimiento clima: WWF/ADENA, INTERMÓN, OXFAM, OCU and C.C.O.O. join to fight against the climate change. Ronda de Valencia, 2. 28012 Madrid. www.movimientoclima.org.

Oceana, Global organisation with representatives in Europe and America, Leganitos 47 – 6, 28013 Madrid, Spain, phone: + 34 911 440 880 email: europe@oceana.org

Red Cross, Spain, Central office in Rafael Villa s/n, 28023 El PLANTIO. Madrid, phone: 91 335 44 44, www.cruzroja.es.

World Vision International, Central office in Calle Orense, 9, 1 D, 28020 Madrid, phone: 91 354 50 20, espana@wvi.org

WWF/Adena. Gran Vía de San Francisco, 8. phone: 91 354 05 78, www.wwf.es.

5.1. What would be their contribution to the project

At the moment of the project development was not possible to contact directly with some of this organisations as not all of them have permanent representatives in Barcelona.

However and prior the visit the department of Nautical sciences and engineering, contacted Mr. Xavier Pastor Executive director of the organisation for a recycling and treatment plant state of the art analysis in Spain study.

We think that in order to develop more in deep the project topics, he would be a good contact.

5.1.1. What points are the civil societies more active?

This kind of societies in Spain are more aware on educate and teach the people what is going on regarding the pollution, the energy and resources spent. The main goal is the environment in general.

5.1.2. What contribution would have the civil societies in the project?
As non profitable entities they could be interested on the dissemination and publicity activities, coming form the results of the project.

6. Education and prevention of sea pollution from maritime schools

6.1. Introduction[23]

At this in Spain there are seven Nautical Faculties and Schools found in the maritime provinces of Barcelona, Gijón, Santander, Bilbao, La Corunna, Cádiz and Tenerife that have been offering Merchant Navy studies for quite a number of years.

These specialist centres are known as *Escuelas Superiores de la Marina Civil (Merchant Navy Schools of Higher Education).* Some of them have been integrated into the university framework becoming Nautical Faculties of the province where they are situated.

All of theses centres were teaching a common syllabus, established in the year 1977, that was structured into different subject matter for each department with a proprietary academic calendar. The syllabus was modified in the year 1995 but not in a homogeneous way. In some of the centres the reform of the teaching structure was adopted with the aim to become more integrated into the university community, dividing the contents of some subjects and changing the calendar and the attendance load of the different courses. In other centres the previous syllabus is still maintained, whilst others have suffered further modification including a new Plan in the year 2000. This is the case of the Nautical Faculty of Barcelona.
Such a difference has arisen among different Schools and Faculties that subjects and contents have lost their homogeneity.

Maritime studies provided in Spain have been divided into two cycles and several specialised courses. The first cycle ends when the Diploma Degree (license) has been obtained. This includes the specialisation of Sea Navigation and Naval Engineering, and has a durations of 3 years. The second cycle contemplates the same specialisation but lasts up to 5 years before acquiring a higher degree in Navigation and Maritime Transport or Naval Engineering. In the centres in Tenerife and Cádiz, another specialisation is provided called Naval Radio-Operator that also lasts 3 to 5 years, depending on the cycle chosen.

[23] Martínez de Osés, F.X. "Women in the merchant marine". https://e-prints.upc.edu/handle/2117/224/browse-author.

The presence of women in the old Nautical Schools has been non/existent for centuries up to the second half of the XXth century when a very slow integration started with a reduced number of women. The fight to access a sector socially considered as traditionally for men, has rewarded by the increasing presence of women in Maritime Education until a relatively constant position was reached although remaining a minority. During the last quarter century, it has been calculated that between 20 – 25% of the pupils accessing higher education cycles were women. Additionally the number of graduating female students reached 8% of the annual total.

The advent of Plan 95 has provided a change in the way subjects are distributed, evaluation tools and the legislation. As an example of such changes it is specified that all students finishing some of the cycles are asked to obtain the proper diploma or degree before accessing a higher level. Due to this question, the number of students with finished studies has increased each year, even though Plan 00 is very recent in its implementation.

6.2. The Specific Case of the Nautical Faculty in Barcelona

The Nautical Faculty in Barcelona (F.N.B.), depending on the Universitat Politècnica de Catalunya (U.P.C.), teaches the specialisations of Maritime Navigation and Naval Engineering in their first and second cycles. However, in 1998 they offered a new career they call Technical Engineering in Propulsion and Ship's Services that, lasting for a period of three years, has been consolidated as the specialisation with the biggest demand amongst all the courses given at this centre. The current syllabus was established in 2000 and supersedes the previous Plan of 1995.

The demand of this new title over the last 4 years, has doubled the figures that up to this moment were maintained by existing specialisations. Taking a look at the way things are going it is obvious that the tendency is for continued increase.

6.2.1. Topics taught on sea pollution

During the year 2003, the Faculty of Nautical Studies of Barcelona was approved by the Ministry of Promotion (transport) to endorse the theoretical part of the *Basic safety training* under the VI/1 STCW rule and the *Basic fire fighting* under the VI/3 STCW rule.
The faculty organises outside the practical part and the student that passes the "safety" subject and the practical part, can get the mentioned certificates. As it has been mentioned before the Plan 2000 begins to be a little bit apart from other Spanish faculties as the own centre can established the subject structures, and in the Barcelona case are approved by Royal Decree

614/1997 (25th April) and 779/1998 of (30th of April), within the BOE 239 of 5th/10/2000 in the case of navigation section, but at least covering the next topics:At the diploma degree in nautical branch the topics taught for 120 hours in 15 weeks are the next ones:

- Ship's safety at sea and in port
- Generic and specific fire fighting methods
- Survival at sea
- International regulations
- Pollution prevention and prevention methods
- SOLAS and MARPOL conventions
- Analysis of maritime activities on marine environment.

For the engine branch during 90 hours, the topics are the next ones:

- Ship's safety at sea and in port
- Generic and specific fire fighting methods
- Emergencies. Survival at sea
- International regulations
- Pollution prevention and prevention methods
- SOLAS and MARPOL conventions

For the case of the degree (5 years) the topics dealt are the next ones, nautical with 75 hours in 15 weeks:

- Search and rescue methods
- Safety in the exploitation systems
- Dirty waters elimination systems
- Biological dangers
- Pollutant substances elimination and dispersion
- National and international regulations.

For the engines branch with 60 hours:

- Search and rescue methods
- Safety in the exploitation systems
- Dirty waters elimination systems
- Biological dangers
- Pollutant substances elimination and dispersion
- National and international regulations.

7. Searching the systems which were developed for detecting the sea pollution physibility and cost their establishment

Some of the solutions proposed for detecting the sea pollution are explained, being mainly the water quality control, the pollution tracking and tracing, environmental indicators, new designs or the education inter alia.

7.1. Water quality control

Nowadays only a few ports carry out a quality control in their waters and sometimes this is done by the own administration. However in the near future the law is going to improve the situation through the installation of automatic buoys for data acquisition. Those buoys are going to obtain data on inner circulation, temperatures, salinity, solved oxygen, organic material, phytoplankton, nutrients or hydrodynamic parameters interalia, together with their evolution.

7.2. Pollution tracking and tracing

The EU will promote the inter states collaboration with the aim to compensate the lack of resources to control the uncompliments and to designate budget for maintaining from airplanes and satellites to tracking and tracing systems, in order to assign responsibilities.
There are conventions establishing the following of pollution levels as OSPAR, HELCOM or BARCOM.

7.2.1. Teledetection

The pollution teledetection should be addressed through:

Airplanes and satellites, operating at different spectral bands as Infrared (IR), to obtain ocean surface temperature maps and to study big scale movements of currents and waves breaking at open sea (sign of close storms) together with to obtain information on the fishing resources in certain areas.
The sensors equipped on board the satellites are the AVHRR[24] together with the ATSR and HCMM.

[24] Advanced Very High Resolution Radar.

The Ultra Violet or microwaves sensors, afford to study the sea surface independently the weather conditions and to detect the recent oil spills, as the old ones present a very weak signal. The SAR sensor affords to detect the surface roughness of a specific sea wave length, detecting internal waves, fronts, divergence zones, eddies, life detection, currents or oil slicks.

The sensors operating on board satellites in the visible range are specified below:

- CZCS, Coastal Zone Colour Scanner, it affords to measure the oceans colour.
- AVHRR Advanced Very High Resolution Radiometer has 2 channels (only one on board GOES and METEOSAT) used to elaborate sea surface temperature maps.
- MSS Multi-Spectral Mapper that has 4 bands.
- TM Thematic Mapper, has 4 infra red bands.
- HRV High Resolution Visible

The used sensors on board airplanes, very much utilised for a short scale tracking are:

- AVIRIS (Airborne Visible Infrared Imaging Spectrometer), 224 of visible and infra red bands.
- FLI (Fluorescence Line Imager), to examine the pigments distribution.
- AOL (Airborne Oceanographic Lidar).

The **active sensors** on board satellites, measure the surface answer to the emitted radiation by the own device. They can obtain data on the surface properties as roughness, wave height and others.

The **passive sensors** measure the radiation coming from the sea surface temperature, depending on the used spectral band, acquiring data as sea water properties like temperature, colour, turbulence, etc. The colour for example permits to detect the water quality.

In Europe most of the northern countries have very efficient equipment compared with the southern countries (as Spain), that have visual identification methods.

	Satellite	Airplane						Others		
Country	SCA	SLAR	IR/UV	MWR	LFS	FLIR	Camera	SOED	OED	Visual

Denmark	?	?						?	?	?
Finland		?	?					?	?	?
Sweden		?	?	?		?	?	?	?	?
Germany		?	?	?	? ?		?	?	?	?
Norway	?	?	?	?			?	?	?	?
Portugal		?	?	?			?	?	?	?
Holland	?	?	?	?			?	?	?	?
United Kingdom	?	?	?	?			?	?	?	?
Italy								?	?	?
France								?	?	?
Spain									?	?

Satellite	**SCA**	Combined system of satellites and airplanes
	SLAR	Side airplane radar
	IR/UV	Infra red / Ultra violet detection
Airplane	**MWR**	Micro Wave Radiometer
	LFS	Laser Fluoro Sensor
	FLIR	Front Infra red Detection
	Camera	Photo - video on board airplanes
	SOED	Spatial System of Hydrocarbons Detection
Others	**OED**	Oil Detection System
	Visual	Visual Detection

7.3. Environmental Indicators

The European Environment Agency, has proposed the DPSIR system, based on the OCDE State-Pressure-Answer system. This model considers the relation ship between the humans and his environment, through the influence evaluation of the named Driving Forces (Propelling forces linked to sectorial tendencies regarding the pressures suffered by the environment.

Those environment indicators are parameters evaluating the environmental situation of a specific place. They afford to assess the efficiency of certain environment policies adopted by administrations, institutions or companies. Within the Spanish Port system there is the

INDAPORT indicator, that keeps in mind certain aspects of the industrial and logistic activities, developed at ports together with dredging activities and its effects on he shore.

7.4. Legal improvements

IMO and other international forums should be the main actors when referring to pollution fighting, to solve the lack of very important crude oil productors signing the MARPOL convention.

The European Commission has also its paper, proposing new directives to be approved by the Council. In 1993 it was proposed an improvement of the sea patrol in the area where the traffic of oil tankers and dangerous goods passing, is heavier. However this was not done[25]. Even later the Commission proposed to increase the watching in order[26] to enforce the international conventions on oil pollution prevention including penal sanctions for the responsible.

But it is needed the international collaboration in order to find the penal actions as they use to do them in international waters and sometimes by ships flagged in non international conventions signatory countries. Appearing a big legal gap.

It is needed also a guide to assess with confidence the quantity of residues spilled at sea, as nowadays every quantification done, gives a very different or incongruent figure.

7.5. The inspections

Also today we should hope a very high number of detentions and sanctions due to MARPOL rules inobservance, carried out by the administration. However the number of deficiencies related to MARPOL Annex I by Paris MoU inspectors[27] are very low.
We must remind that the following countries have signed the Paris MoU agreement: Belgium, Canada, Croatia, Denmark, Finland, France, Greece, Holland, Ireland, Iceland, Italy, Norway, Poland, Portugal, Russia, Slovenia, Spain, Sweden and United Kingdom.

[25] EC (1993). Proposal for a Council Directive Concerning The Setting-Up Of A European Vessel Reporting System In The Maritime Zones Of Community Member States. COM/93/647 FINAL. Official Journal C 022, 26th January 1994.
[26] EC (2003) Proposal for a Directive of the European Parliament and of the Council on ship-source pollution and on the introduction of sanctions, including criminal sanctions, for pollution offences. Brussels, 5th March 2002. COM(2003)92 final.
[27] Paris MOU (2003). Annual Report 2001. Paris Memorandum of Understanding on Port State Control. 6th July 2003. The Hague, Netherlands.

	Nº deficiencies related to Annex I	Share related to total number of recorded deficiencies
Year 2000	4.875	7,2%
Year 2001	5.116	7,4%
Year 2002	4.421	6,4%

The IMO results regarding MARPOL inspections on board ships, says that only 1,1% of surveyed ships around the world were detained or had no permission to enter at port.[28]

The number of inspections carried out by Paris MoU from June 2000 to June 2004, reached the 28.545 actions. The surveyed ships with EU flag were 7,883; the rate of overall inspections done was 3.62%. The number of detected deficiencies during 14,565 surveys reached 51.08% with an average of 2.75 deficiencies per inspection.

This means that almost 40% of ships with EU flag had showed deficiencies or had violated the MARPOL convention. And that figure grows to 75% if we include every type of deficiencies (id est. navigational equipment, communications, engines, documentation,).
The final figures explain us that around 3 to 4 inspections on average have been done on every European ship. Half of these inspections have detected deficiencies, the 16% of them have been MARPOL deficiencies and only 25% of them have passed the survey with no deficiencies.

However there have been ships that have showed deficiencies in the whole number of inspections suffered as for example Lithuanian tankers, Latvian chemical and oil tankers, manufacturing ships from Malta and Cyprus, refrigerated cargo ships from Spain and Latvia or some bulk carriers and ore carriers from Spain, Finland and United Kingdom. However there are examples of some ships with MARPOL deficiencies in 100% of the inspections as in some Lithuanian tankers, polish chemical tankers, Latvian oil and chemical tankers, Irish container ships, passenger ships from Eastland or Spain, special ships from Portugal or Italy and Slovenian bulk carriers.
The EMSA is deciding with paces a big ship for pollution fighting in each of the 4 designed as priority areas like: the access to English Channel, the Spanish and Portuguese Atlantic Coast, the Northern Mediterranean and the Baltic Sea[29].

[28] IMO (2003). Port State Control. An update on IMO's work in 2003. Based on the outcome of the 11th session of the Sub-Committee on Flag State Implementation (FSI) held from 7 to 11 April 2003, the seventy-seventh session of the Maritime Safety Committee (MSC) held from 28 May to 6 June 2003 and the forty-ninth session of the Marine Environment Protection Committee (MEPC) held from 14 to 18 July 2003.
[29] *Boletín Informativo*. ANAVE nº440. July 2005.

Also the creation of an observer's group under the IMO dependence, to verify the MARPOL rules accomplishment, at port or making a sound on the log book or residues book.

7.6. The economical questions

Maybe the biggest question because it is conditioning the effective arrival of residues at port. There are some solutions as new ship's design avoiding the releasing of illegal residues or techniques to use the crude oil several ways, to clean the tanks instead of water.

But mainly the question is the tax. It is thought to establish ecological taxes in some other services in order to fund the recovery facilities. Below we have an example on how to fund the

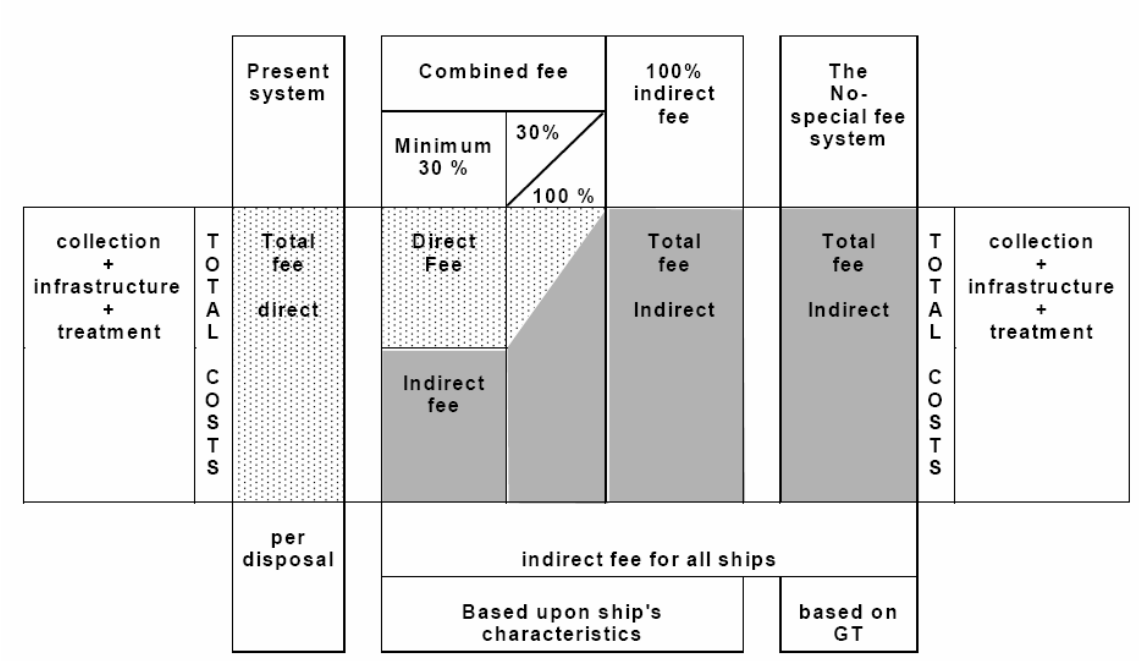


Figure 28: Cost recovery systems and principles for establishing fees.[30]

There are seen three possibilities in a fees payment system, where the more ships discharging the residues, the cheaper will be the fees. In the end there will be no direct costs and only indirect ones.

One is convinced that the actual cost of port services, would be reduced when a free market enter the port services. Nowadays the costs are high because there is no competence within the

[30] WorkShop ESPO-IAPH 2001. Cost recovery systems and principles for establishing fees.

port and the big share of labour forces. Also a clear accounting system of the port authorities could improve the situation.

Port administrations should carry out an environmental accounting system.

7.7. The education, dissemination, reporting ands sensibilisation

It can be said that the environmental attitudes are done more facing the legality than because a responsible action.
It is needed the various specialised groups implication as the stevedores, carriers, ship's agents, owners, tugs, pilots, berthers, forwarding agents, yards, administrations and users, to get a consciousness on the pollution matters.

One way is to carry out guides for good environmental practices together with a kind of following in order to assure the proper content reaching.
Pollution has a lot of interrelations and influences, affecting social and economic questions, with increasing difficulty degrees.

8. Comparing the cost of cleaning of the pollution which was created by the sea and by the land

The cost of cleaning pollution depends on the pollutant substance. If we talk about the treatment in itself, we can say that industrial residues treatment cost vary a lot depending on the source, components and the process in itself. However there is a range from 20 to 200 €/Tm. The cost for hydrocarbon residues recovery (id est the ones coming from the oily waters of ships) vary from 30 to 40 €/Tm.

9. Interview ship owners or any authorities and to get their view on the topic

There was interviewed a fleet head by telephone on the projects topic. His main thinking was that we are becoming cleaner but not enough. The discharge of residues or MARPOL substances is not expensive but it is a cost to be added to the operational ones. If a cubic metre of MARPOL residue can cost between 30 to 40 € to be released on a clean way, there will be companies that will pump out part of them while at sea during night and other ones that will use those services. However the question is to enforce to pay such services as it is compulsory to pay the pilot if the Master is not exempted to take it.

Talking about the periphery maritime administrations as Port Masters, they were more aware on the administrative and bureaucratic process. For example in Spain the Directive dealing with pollutant residues recovery, entered in force in due date but there were a transitory disposition where the ports had up to 6 months to update to the law requirements their facilities.

Meanwhile the authority would inspect the facilities and finally endorse the aptitude certificate according to the royal decree 1381/2002.

There were left also some question on legal definitions, not interesting for the purpose of this report but some other questions regarding fishing and pleasure, boats were dealt.

Generally fishing vessels and pleasure boats are dispatched for a period of three months, so only at the moment of the dispatch they can be asked for the certificate or notification of residues

release. Additionally the boats less than 6 metres of length only are dispatched when they renew the navigation certificate (every 5 years) and a case apart is the foreign pleasure yachts.

The bilge discharge from the fishing and pleasure boat would be more easy installing reception tanks beside the bunker station, and then as the same time the boat is loading fuel she can release the bilges. This measure would easy the user participation and implication, a possible reduction in the taxes and most of all to avoid the sudden appearing of oily waters in the early morning at ports.
The only question is to know who is gong to control such facilities.

10. To contact with persons or foundations that were affected by sea pollution directly and get information from them

The National Association of MARPOL Agents, proposed to the maritime administration some application requirements in reference to the reception facilities.

10.1. Interview to a Tarragona fishing association master

The interview written below has been carried out by the author to a master of a fishing association, dedicated to the coastal fishing.
He recognised that the pollution problem has not been dealt in seminars or journeys on fishing he has attended, maybe because the coastal traffic of tankers is very low. However we have seen in a few days, up to two ships stranding in Spanish waters of general cargo vessels, with almost no spill but of course there is the risk of bunkers dissemination in the sea.

Talking with him, he explained that within the sector there are a lot of topics dealt on commercial techniques, the over fishing, the maintenance of living stocks, the resources but not on pollution. The feeling within the sector is that fishing is finishing due to the over fishing techniques, but there is not looked the pollution; however he said me that the pollution is another parameter to keep in mind.

10.1. The effect on marine ecosystem of shore pollution

There are important effects on the marine birds and cetaceous linked to the pollution, however the interviewed talked about fishing. It is known that marine accidents represent only the 5% of hydrocarbon spills at sea. And almost the 80% are coming from shore.

This is an important thin to note because the media tic effect of oil spills due to accidents as the Prestige, Erika or Exxon Valdez, were maybe enlarged by the mass media.

Around 60% of marine diversity are living within a narrow area close to the first 60 km close to the beach, but also almost the 30% of population at least in Europe, live close to the sea, increasing the rate during summer. This is a point to keep in mind because it is very logical that marine live is going to be affected by human activities on shore.

The shore pollution can arise for example because a larger quantity of nutrients on the water, this supposes an exaggerated growing of certain kind of algae that take all the solved oxygen on the water. This phenomena supposes the death of the life at sea and is called "anoxia" and provoking the appearance of large areas with no life, also called "eutrofization".

Other pollution source affecting the marine life are the metals. These substances are accumulated in the lower life chain entities and then pass to further fishes. One of the most common toxic substances is the Hg. The food chain implies that some small fishes polluted by Hg will be eaten by a big fish, and this by another bigger fish. The fact is that the last fish in the chain will stock the whole quantity of Hg and despite the fish will not die, that one would arrive the consumer and eat it, receiving the Hg previously taken by the whole food chain.

The pollution phenomena is evident at open seas but in close waters as bays, estuaries or small seas, the fishes most of the time can not be fished or consumed because they are ill as the pollution in the water can not be dispersed as in open waters.

10.2. The effect on marine ecosystem of marine pollution

From long time ago, marine ecosystems have received oil and hydrocarbons, so it is not strange that certain bacteria and micro organisms eat oil and do not transmit it to the tropics chain. In a first view it is not a problem this accumulation of oil in the smaller live entities. However a big quantity of these substances will affect the consumers.

The reaction of different species to the pollution is also distinct, for example in front of oil spills the bivalves as mussels have a very poor capacity to eliminate the pollution and keep it with it. This is because this type of molluscs takes the water and filters it, retaining the substances that they use to feed them. So that they accumulate toxins but they not die, the risk is in the fact of eat them.

In the other side the biomass, is not affected because they can accept up to 1000 parts per million without problems.

One of the most sensitive groups within the sea is the fish grubs, that not support high concentrations of products, as cases in which with only 1 part per million the grub can die. We must point out that most of the species ergo to the beach to put the eggs and are more vulnerable to pollutant substances. And not only is the problem the quantity but also the season and type of oil.

Most of the marine species can be recovered after three years of a crude oil spill, however in the case of refined products on cold seas; the time for recovery can double or triple.

10.3. Conclusions

- Fishermen are in general not properly informed on the pollution at sea.
- The most of the pollution at sea comes from the shore and is anthropogenic.
- The spills have a big mass media impact, much more than the ones coming from shore.
- The major part of pollutants is due to nutrients excedents.
- The most dangerous pollution is coming from chemicals and metals.
- Metals are accumulated in the tropic and chain.
- The pollution is more patent in bays and estuaries.
- 60% of species live in a narrow area of 60 km close to the coast.
- A portion of oil is metabolised by bacteria's and micro organisms.
- The bivalves are big accumulators of toxins.
- Most of the organisms and biomass support oil concentrations up to 1000 ppm.
- The fish grumps are more affected by the oil.
- Most of the species go to the coast to put the eggs.
- It is very important in which zone and season is produced the spill.
- The recovery of the sea after a refined oil spill could be double or triple.
- Also the sea temperature can suppose that spills will last at sea for double or triple the time.

10.2. Administration point of view

Port authorities consider very important, the collaboration of the receiving facilities, in order to take data from the last years of activities as:

- Volume received on a day of each type of residue and any prevision of increasing in the future.
- The average of simultaneous receptions and any possible increase in the near future.
- The number of services done with a barge and any possible increase in the near future.
- The technical resources of each company with permission to do the recovery service of each type of residue.

Ships have the obligation to fit the universal or MARPOL connection [31] and the proper pumps to do the discharge, but sometimes there are demurrages due to different reasons. This demurrages should not be charged to the ship but to control previously the ship' means in order to avoid delays.

The notification or Residues declaration, must be sent to the administration together with the last residues reception invoice, in order to be compared with the real ship's situation. It is possible that depending the precedence of the last port the last residues declaration can not be so true.

It is also considered that the ship's residues stock age capacity, should be controlled under two cases:

1. The ships do not ask for releasing any type f residue.
2. The ship only wants to release a part of any type of residue.

With the aim t avoid these situations, is intended to establish some rules as for example:

- The residues accumulation on board, only can be done in the tanks designed for this purpose with no risk of fire, flooding or any wealth problem for the crew (smells, dirtiness, parasites, …) and keeping in mind their real capacity.

[31] International Convention MARPOL 73/78, Annex I, Rule 19.

- Consider the residues generation for each residue type per sailing day, depending the ship's type

10.3. Directives from the Spanish Port Board

The Spanish Port board (Ente Público de Puertos del Estado - EPPE) is the main public body managing the 27 big commercial ports in the state. The residues reception Royal Decree, obliges the ports to approve and apply a plan for managing and handling residues, warranting the proper environmental management and even including proceedings to easing the ship's Master, their utilisation.

The mentioned planed should include all kind of ship's cargo generated residues, calling at port and must be properly designed depending on the type of ships coming to the port.

The estimation of the needed facilities to take the residues from the normal traffic in a port, can be done by means of different ways of analyse documentation as:

- The MARPOL residues record that can have the Authorised Companies for the ship's and cargo residues reception.
- The residues declaration coming from the Unified Calling Document[32], received by each Port Authority from the ship or ship's agents.
- The document "A Waste Management Plan For Ship Generated Waste" (ESPO MARINE COMMITEE) from January 2002, or any other proceeding recommended by a competent organism.

Every residues manager cab be asked for their own proceedings for reception, recovery, management, treatment or elimination; according to the impact reduction environment plan[33] of this kind of activities. Together to be registered in the EMAS (Environmental Management Auditing Scheme), this system is based in the ISO 14.001 during the first implementation period but further will be elaborated a certification document together with AENOR (Spanish Standardisation Association). Of course the authorised companies would be certified under this new ruling and the Port Authorities approval.

[32] Order FOM/3056/2002, Spanish Ministry of Transport.
[33] Under the (CEE) nº 1836/93 of the Council of 29th of June 1993, affording the industrial companies to voluntary adhere to a Community Environmental Management Auditing Scheme (EMAS).

10.4. Residues generation calculation

There are several sources establishing figures not all the same but we show the most feasible ones:

Oily Sludge generation

Around **2%** of daily heavy fuel oil consumption (HFO) remains as bottom oily sludge.
Around **0,5%** of daily marine diesel oil consumption (MDO) remains as bottom oily sludge.

The total quantity of oily sludge depends on the sailing days but when the ship is berthed there is a consumption coming from the auxiliary engines, that is minimal and is not accounted.

Bilge Oily Waters generation	
Ships < 5000 DWT	1,25 m^3 /1000 DWT / sailing month
Ships from 5000 to 15000 DWT	0,83 m^3 /1000 DWT / sailing month
Ships from 15000 to 30000 DWT	0,77 m^3 /1000 DWT / sailing month
Ships from 30000 to 60000 DWT	0,58 m^3 /1000 DWT / sailing month
Ships > 60000 DWT	0,31 m^3 /1000 DWT / sailing month

The total volume of oily residues in the bilge waters, is depending on the ship's age and the engine. The oil content in the bilge waters is assessed around 15%.

Cargo associated waste generation

Obviously depends on the ship's size and type:

Ship's type	**Residues generation**
Cargo in bulk (grain and ore)	8.2 kg/day
Container carriers/RoRo	1.4 kg/day
Ferries	2 kg/person/day *
General Cargo	49,3 kg/day **

Reefers	22,2 kg/day
Tankers	< 0,01 kg/day

* 500 to 1500 passengers

** More than 50% kg/day of lashing wood

We must point out that also there is a urban assimilated generation of residues:

RSU or Solid Urban Residues on board:

The quantity depends on the crew number and sailing days but not from the ship's type. It is assessed in 3 kg/person/day of RSU generation.

11. What is the effect of sea pollution on ecological equilibrium?

The idea to preserve the environment in general, has suffered different changes as the time passes. During the year 1972 within the United Nations Summit on the Human Development celebrated in Stockholm, it was questioned for first time, that the pollution would be a load or limitation against the economic and technological development.

In 1992 (20 years later) there was the Rio Summit on Development and Environment, again it was suggested the term "Sustainable development" keeping in mind the social and economical dimensions. The result was the Rio declaration and the Agenda 21, together with some agreements on the climate change, bio diversity, desertification and vegetation.

Every time this kind of summit is carried out, they intend to celebrate international agreements as the creation of a World Funding Organisation on Environment, coordination with the WTO, the global fiscality, and the agreements tracking.

The environmental thinking evolution has adopted the concept "sustainable development", what means a step forward the quality of life improvement in the dimensions of the environmental, social and economical, development.

In June 1998 the European Council asked the Commission to elaborate a European strategy on sustainable development, approved in 2001 in Gothenburg. This report acquired a new external dimension because took the prevention and warning principles¡, together with the internalisation of environmental costs with the aim to the rational use of resources. The future tendency of

development political directives was divided in four areas as climatic change, transport, public health and natural resources. But the EU within the 4h Community Action Programme on environment (2002-2010), integrated the residues and bio diversity.

The transport report pointed the maritime one as the most respectuos with the environment, but not completely in the climatic change because they must reduce some kind of pollutant emissions. In the bio diversity part, was contemplated the sustainable use of the sea, the marine ecosystems preservation and an integrated shore management.

12. Conclusions

There are a lot of topics dealt in this report, maybe not more in deep but as a brief sample among the different interviewed stakeholders.

However and regarding the marine pollution we should have a look to some points as the increase of marine transport and the ports impact.

The transport increase imply in some geographical points, traffic congestion limiting the commercial or personnel mobility in modes as conventional road transport. However those problems affect far from the physical roads collapse as far as to endanger life's, safety and environment.

It is known by the European white paper on transport[34] and confirmed in the mid term review of the first, that commercial exchanges and thus transport needs, will increase and the only way to make transport sustainable is to move part of these volumes to other more sustainable modes. One example is by far the maritime transport, that integrated in a multimode chain, should pass through the ports, where very specialized operations are carried out.

The repeated tanker accidents from the beginning of seventies have deepen in the environmental conscience within the maritime transport sector. The appearing of international conventions boosted by IMO for the marine environment protection, have brought us to adopt some corrective measures but most of the time once the mistake has been done.

[34] "White paper on transport policy towards 2010: time to decide", European Commission October 2001 and its review in July 2006.

Within this context ports can play an important role trough programmes of effective inspections and also effective residues recovery capacities and management together with information dissemination.

From the fifties the long distance navigation has grown thanks to the open registries and increased mobility of ships and nowadays is the first global industry in the world, characterised by the international capital, labour force and technology global market. Most of the international commerce is done through maritime way and less on rail or road transport.

However the medium and short distance transport still plays a secondary role. The reasons can be found as the poor flexibility (calling, loading, dispatch, customs) or the vulnerability in front of global markets. But the real transport facts faces us to potentate short sea shipping as the most environmentally respectuous transport mode.

Some EU studies contemplate this mode of transport as the chance to release cargo from road, taking profit of the big transport capacity and the minor indirect facilities costs. Here the ports play an important role.
The White Paper on Transport poses the question to redistribute the transport modes share as a solution to avoid congestions, accident ability and environment respect. However in a multimode transport chain, the ports are exchange nodes that should provide a smooth and continuous pass from one transport to another transport mode. Also the third generation ports could take profit creating Logistical activities areas or zones (ZAL) and even become information and knowledge management nodes becoming 4^{th} and 5^{th} generation ones.

The today tendencies on maritime transport, points to an increase of exchange volumes and an enlarging of existing ports but also a decrease in the commercial margins among them. These could provoke the vertical integration of shipping companies and port facilities or terminals and also with shore transport operators. Although is foreseen a horizontal integration among operators in different ports.
In the end this scenario brings us a situation in which a few big operators or port terminals will be the main actors and the ones who will invest in facilities (as residues reception ones) instead of the port authorities.

Be careful with short sea shipping, as the volume of the commercial exchanges increase would mean the increase in the number of accidents and the need to enlarge ports and then the need to

modify or degrade the littoral (as in Barcelona or in the future Pasajes) with the further negative consequences.

Of course than maritime transport releases much less CO2 emissions to the atmosphere, but the question us to solve the NOx and HC and also SOx (this last limited in the MARPOL Annex VI) and of course the increase of the energy consumption and noise.[35]

Other question is the quality of the waters, as it is estimated that 33% of the total quantity of hydrocarbons spills in the sea are coming form the port waters. We have seen in the report that accidents represent 12% but the 35% come from the shore industries and urban draining..

Within the ports the pollution consequences and the low rate of water exchanges, reduces the animal regeneration capacities and most of all the bentonic species very linked to the local substrates.

The environment impact can be reduced into three directions:

1- Physical room occupation, most of the times a valuable and scarce space.
2- Beaches regression due to the interruption of natural sedimentary fluxes.
3- Occupation and overloading of fisheries areas

From the interviews of the mentioned stake holders in the report, the identified weak points considered during the project development and related with the administrative structure, have been mainly the lack of a unique power with responsibility on marine matters.

As an example on pollution fighting, any spill detected within a port from a berthed ship or a terminal, is responsibility of the Port Authority who will deploy its own resources to combat it. If the pollution is coming from outside the port is competency of SASEMAR.

Another example maybe not so closely related is the traffic control. In Spain the coastal VTS have only responsibility on traffic passing outside the port. From the point a ship enters the port waters the responsibility is from the pilot station and almost no communication is carried out among both entities.

[35] Coustic pollution D2000/14/CE and D2002/49/CE.

The authorities are investing in new and better means to fight pollution but the main responsible is the Master of the ship and his owner. An effort should be done to teach an environmental culture in order to avoid volunteer spills.

Figure 29: Image of the stranded Amoco Cadiz off Brittany coasts.

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