Methods of Pollution Removal after Tanker "Erika" Accident

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Marine accident of the Maltese tanker Erika is the biggest environmental disaster ever to hit France. 12th of December 1999, on the way from Dunkerque (France) to Livorno (Italy), Erika broke in two and sank near the French coast, spilling around 20.000 tons of heavy fuel oil into the sea. About 11.000 tons of dangerous cargo, trapped inside the sunken wreck, presented a danger to the environment. Severe weather conditions prevented any offshore clean-up operations. Oil trapped inside the wreckage was pumped out, while the on-shore clean-up operations lasted for another two years. This accident had a direct impact on the economy of affected regions and resulted in numerous lawsuits against the ship owners, charterers and classification societies. This paper aims to provide an overview of oil spill pollution clean-up methods and technologies after the accident of tanker Erika.

KEY WORDS
~ Oil spill
~ Offshore clean-up operations
~ Oil pumping
~ On-shore clean-up operations

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1. INTRODUCTION

The Maltese tanker *Erika* was 24 years old. From the economic point of view her old age was an advantage, i.e. her chartering cost was 50 % lower than that of a newer tanker. In December 1999 the ship left *Dunkerque* (France) for *Livorno* (Italy) with 31,000 tons of heavy fuel oil (N°6).

On 11 December 1999 in the Bay of Biscay *Erika* faced extremely heavy weather conditions (westerly wind, force 8 to 9 according to *Beaufort* scale) and suffered constructional damages. A day after, on December 12, 1999 the ship started breaking in two, and French authorities immediately started the salvage operation. The crew were evacuated from the ship in naval helicopters. At 8:15 local time *Erika* finally broke in two some 30 miles south of *Penmrach'* in the county of South Brittany. According to some estimation in that occasion between seven and ten thousand tons of cargo were spilt into the sea.

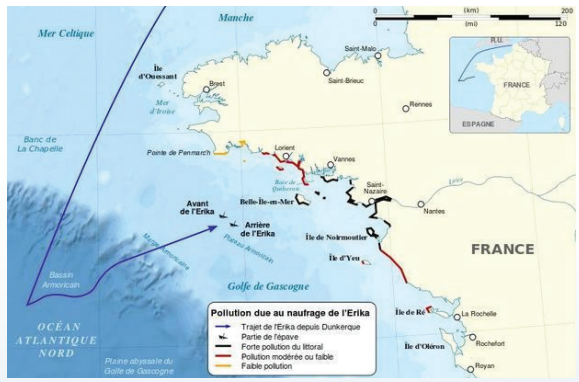

Figure 1. Trajectory of the Erika.
Source: http://www.digitaljournal.com/image/126501(14/05/2012)

The bow sank the following night not far from the place where the tanker broke in two. In order to prevent floating of the stern towards the island of *Belle – Ille*, the French authorities ordered her towing, but it also sank a day later about 2:50 local time. Parts of the wreck sank at the distance of 10 km from each other. In the bow that sank there were still 6.400 tons of cargo, and in the stern 4,700 tons. One of the priority tasks was finding the separate parts of the wreck. After they were located using underwater ROW (Remotely operated vehicle), the recovery procedure started. The French *Naval Command* in Brest was in charge of response operation at sea according to the French *POLMAR Plan*.

The recovery of oil spilt in the accident of the tanker *Erika* in the first days after the accident was thwarted by severe weather conditions that had lasted for several weeks then. Surveys from the air helped to confirm that oil stains were floating eastward at the speed of 1.2 knots. New air surveys carried out in the following few days confirmed that the stain broke into a series of smaller ones 5 to 8 cm thick that continued floating parallel with the coast line. Heavy wind and bad conditions at sea continued breaking the stain into smaller ones, however, smaller stain were heaping as soon as short calming down of conditions occurred. Ships equipped for this type of accident and pollution were brought, according to the regulations of the Bonn Convention, from several European states with the aim of preventing further expansion and allow later recovery from pollution. After 12 days of floating in the open sea and exposure to different physical and chemical processes in the sea, stain went aground the coast in the county of *Finistère*. About 400 km of the coast was struck by pollution. Thousands of volunteers and firemen joined the recovery operation. Due to the heavy wind and high waves, bits of oil reached deep into the mainland and polluted even the cliffs above the inlets. Oil clean-up operations from the shore lasted for years, and some areas even nowadays feel the consequences of the accident. *TotalFina* group was in charge of pumping the oil from the wreck, treatment and disposal of collected oil, clean-up of the coastal areas and the recovery of the affected coastline. TotalFina expenses were estimated at USD 99 million.

2. CHARACTERISTICS OF SPILLED OIL

Heavy fuel oil, transported by Erika, was a mixture of 10 % of light fuel oil, 30 % of heavy fuel oil and 60 % of vacuum distillation products.

Due to the fact that at 10° C viscosity is equal to 20,000 cSt and that the oil had to be heated during transport, chemical dispersion could not be used to clean-up this kind of oil.

After 80 days only 11 % of the oil was biodegraded. The chemical composition of the oil and large quantities of ingredients such as resins, asphaltenes, and polycyclic aromatic components are the main reasons of low biodegradability. The laboratory analysis confirmed that spilled heavy oils tend to be very stable in the environment.

Table 1. Characteristics of heavy fuel oil N°6.
Source: Guyomarc'h , J., Merlin, F.: The Erika Oil Spill: Laboratory Studies Conducted to Assist Responders, IOSC 2001.

Characteristics	
Density	1,0025
Pure point	30 C
Viscosity	38cSt (1000 C) 555cSt (500 C) 20.000cSt (100 C)
Sulphur	2,28 %
Vanadium	82,7 ppm
Nickel	45 ppm
Asphaltenes	3,78 %

Table 2. Chemical composition of oil.
Source: Guyomarc'h , J., Merlin, F.: The Erika Oil Spill: Laboratory Studies Conducted to Assist Responders, IOSC 2001.

Chemical composition of oil	
Saturated hydrocarbons	22 - 30 %
Aromatic hydrocarbons	42 - 50 %
Resins and asphaltenes	21 - 36 %

3. CLEAN-UP PROCEDURES AT SEA

Immediately after the accident of the tanker Erika, many questions were raised related to the identification of oil, its behaviour in the water column, physical features, potential toxicity and various countermeasures of pollution treatment. Several French laboratories simultaneously started an investigation, and the analysis and studies that were conducted of the samples of oil spilt from the tanker *Erika* were used to select optimum strategies of clean up operations after the accident. An impressive fleet of ships that were supposed to take part in the oil clean up operations.

Vessels which participated in clean-up operations were chosen due to their characteristics, equipment-wise and design-wise. All of them had to:

- be able to cope with unfavourable weather conditions like rough sea,
- be rapidly available at clean-up sites,
- have sufficient storage capacity to collect oil, and
- be fitted with equipment suitable for storing and discharging collected oil.

These vessels arrived to the place of the accident on December 13, 1999, however, at sunset the waves exceeded the height of 6 metres which prevented any possible use of the collecting equipment. Characteristics of the oil, such as slickness and high viscosity, complicated the clean-up process furthermore.

Figure 2. Heavy fuel attached to the deck of a vessel.
Source: Peigne, G.: Offshore Operations Following the Erika Oil Spill, IOSC 2001.

The first clean-up attempts were made on December 15, 1999, but were disturbed again by extremely bad weather conditions and due to break up of booms for the control of pollution. By December 19, 1999, five rescue vessels were on standby due to severe weather conditions. All clean-up attempts were discontinued by December 23, 1999. Immediately after the spill, the crewmembers of the pollution recovery vessels set up 300 metres of booms (Figure 1) and attempted to collect the oil using *Transrec* 250 skimmer.

Figure 3.
Setting up booms.
Source: http://www.cedre.fr/en/spill/erika/sea.php

The TRANSREC 250 is a combined oil recovery and transfer system with self-containing abilities, used to contain spilled oil, in oil recovery operations and to offload oil from grounded vessels. It is equipped with portable offloading hydraulic pumps capable of transferring fuel oil to recovery vessels or any other type of storage facility available at the clean-up site. The pump is used primarily to offload oil trapped inside a damaged vessel. The recovery unit of Transrec 250 is a combination of free-floating weir skimmer and subsidiary disc and belt cassettes. Disk cassettes are used for recovering thin oil slicks, while the belt skimmer cassette is used for recovering high-viscosity oil slicks. The head of the skimmer is connected to a hose lifting arm by a floating hose with integrated hydraulic lines, electrical cable and cargo hose. The Transrec 250 system has the maximum capacity of 400 m^3/h. The hose of the Transrec 250 skimmer has an internal diameter of 5 inches and is approximately 80 m long. These two characteristics were the main reason for constant pressure losses hindering oil recovery operations. Also, the skimmers were not successful due to the thickness of the oil stain and its characteristics (30-50 % of water).

Finally, on December 16, 1999 all further use of the *Transrec* system ceased in favour of the beginning of utilization of the *Foilex* TDS 250 weir skimmer fitted with a screw pump - oil collecting equipment of lower capacity than the *Transrec* system (up to 70 m^3/h). The Foilex TDS 250 consists of a skimmer, hydraulic powerpack and hose package. The skimmer collects the oil into the collecting tank. The deployment of the Foilex system was a risky move, but the salvage crew hoped that unpolluted water would be pumped out together with the oil,

Figure 4. Transrec 250 skimmer.
Source: Peigne, G.: Offshore Operations Following the Erika Oil Spill, IOSC 2001.

Figure 5.
Foilex 250 skimmer.
Source: Peigne, G.: Offshore Operations Following the Erika Oil Spill, IOSC 2001.

thus enabling the pumping process. Unfortunately, even with unpolluted water, the thickness of the oil stain made pumping impossible.

The crew of one of the ships taking part in the clean-up operations started using grippers, but even this attempt failed due to problems in removing the sticky content from the grippers and transfer of the content from grippers to the deck tank. Due to high waves and heavy wind the crew could not control the hanging grippers and their use became highly dangerous. On December 18, 1999 the booms set up broke and working conditions were so bad that in order to ensure safety there could not be any further attempts of collecting the oil. The last step was to use collectors in the form of arms sweeping the spilt oil. Weather conditions were not favourable for the use of any kind of booms. Twelve days after the accident, on December 23, 1999 the oil clean-up operations at the open sea were interrupted because the oil stain reached the French coast. Of all the vessels that participated in rescue operations, most oil was collected by the crew of vessel Arca. Arca was equipped with a pair of sweeping arms, 400 meters of containment booms and a Marflex pump.

Despite the efforts of the crews aboard all ships, due to unfavourable weather conditions persisting during oil clean-up operations at open sea, only about 3 % of the oil spilt was collected. A total of about 1.100 m^3 of oil were collected, which is negligible in comparison with the total quantity of the oil spilt. Due to the large quantities of oil trapped inside the wreck (about 11 000 t), the selection of the most appropriate method of pumping the oil out of the wreck became paramount.

4. PUMPING OUT OIL

The wreck of the tanker Erika lied at the distance of about 50 miles west of the island of Belle - Ile on a sandy bottom. The bow lied upside down directly on the sea bottom, at the depth of 114 metres. It did not suffer major damages to the outer construction, except at the place of breaking up at its most rearward point. The after part, 10 kilometres distant from the forward part, lied on the keel at the depth of about 125 metres. Around it there were plates and fragments torn off the tanker at the instant of its breaking in two. The outer structure of the hull and deck was mostly intact, except at the place of breaking up at the forward part. Shortly after it sank the French Navy began the mission of searching for parts of the wreck. Information on the position of both the forward and after parts was extremely accurate. The first photos of the bow were taken using the remotely operated vehicle. The photographing was additionally made difficult by poor visibility and the size of the wreck compared to the robot's field of vision. A more detailed investigation was carried out with the research ship *Marianos* chartered by *TotalFina* company. The information gained on the state of the wreck was greatly helpful in selecting the method of neutralizing the oil remaining in the wreck. For the preparation of both parts of the wreck and participation in the operation of pumping out the oil an impressive fleet was mobilized that included three ships equipped with dynamic positioning devices. During pumping out operations, at the place where works were carried out there were all the time present several salvage ships equipped with various

Table 3. Rescue vessels and their equipment. Source: Peigne, G.: Offshore Operations Following the Erika Oil Spill, IOSC 2001.

Vessel	Flag state	Length (m)	Storage capacity	Heating	Oil recovery equipment
Ailette Alcyon	FRA	57	500	yes	- *Transrec* 250 skimmer - *Foilex* 250 skimmer - 300m booms
Neuwerk	GER	79	1000	yes	- 2x sweeping arms - Suction pumps (320 m^3/h) - Gripper - 2x200 m booms - Deck storage tank
Arca	NED	83	1000	yes	- 2x sweeping arms - 400 m booms - *Marflex* pump (450 m^3/h)
British Shield	UK	98	3800	yes	- 400 m booms - *Terminator* skimmer - *Sea Devil* skimmer - Two work boats - 3 screw pumps (385 m^3/h each) - CCN 150 pump
Alonso de Chaves	ESP	64	-	-	- booms

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oil collecting devices in order to prevent any further accidents. In the operation a certain number of divers took part having at their disposal underwater units for collecting minor oil stain below the surface of the water. Except the ships that were at the place of the accident, there was a whole series of ships standing by, some of which were summoned from the neighbouring countries (Figure 6). The French Navy determined the zone of exclusion extending to the distance of two NM around the parts of the wreck. Two aircrafts for pollution surveillance continuously flew over the traffic lanes around the coasts of Brittany.

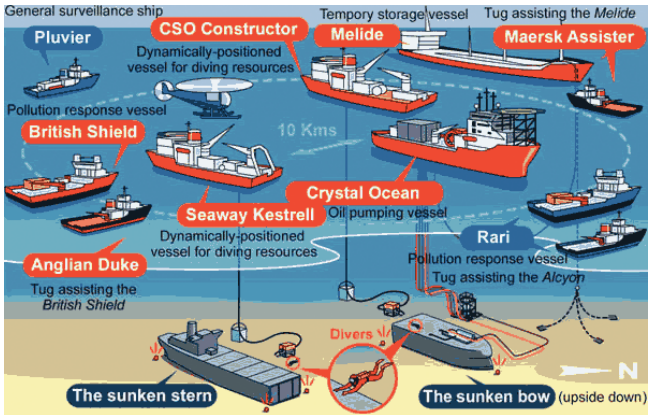


Figure 6. Positioning of the ships around the Erika wrecks. Source: http://www.cedre.fr/en/spill/erika/pumping.php

In the middle of May 2000 the phase of reconnaissance and installing new equipment started the preparations of both parts of the tanker *Erika* wreck. In early June with the use of remotely operated vehicle the hull drilling equipment and the system for connecting the pumping device was installed. In areas where the approach to the wreck was difficult divers were employed. First the equipment was installed at the bow, and then at the stern because the deck that was 30 meters above the seabed represented an obstacle and affected the complexity of the procedure. The procedure of oil pumping out aimed at eliminating the threat that the remaining cargo of the tanker *Erika* represented for the environment posed four challenges. The first challenge was the depth of the sea in the Bay of Biscay - about 125 meters, and the bay had already been famous for heavy storms and long-lasting periods of bad weather conditions. The second challenge was the condition the tanker *Erika* wreck was. Since the construction of the ship at the point of breaking was weakened, during the operations around the wreck strict precautionary measures had to be kept to. The third challenge referred to possible difficulties in the process of pumping out oil due to fuel oil viscosity at the temperature of 100 at the seabed where the wreck lied. The fourth challenge was the short time period available for completing the pumping out operation – by the end of summer 2000 in order to avoid the threat posed by the oil within the wreck for the environment. All the challenges mentioned above were successfully overcome and in June 2000 the pumping out of oil from the tanker *Erika* wreck started. The pumping out operation started with a relatively long-lasting interval of fair weather in June 2000, and it was successfully completed in the course of three months. The pumping out process (Figure 3) consisted of getting out hydrocarbon components based on the differences in hydrostatic pressures between the wreck and the spare tank that was on the seabed, and in which relative under-pressure was continuously maintained. In the suction hoses, that were taking the oil out of the wreck, a constant under-pressure was also maintained. Each litre of oil taken out of the wreck was automatically replaced by sea water entering the tanks by free flow. The under-pressure was strictly limited and controlled in order to avoid damaging of the tank construction in the wreck. The oil viscosity was reduced so as to decrease the loss of pressure in the hoses taking the oil out of the tanks, and to enable pumping the oil out using double-screw pumps. To facilitate the transfer of the oil, during flow it was mixed with an environmentally friendly dilutant – a biodegradable "green gas", a derivate of rapeseed. Mixing was performed using static mixer, and it was done at the moment of the outflow of oil from the wreck, but before it reached the spare tank. At the moment the oil reached the spare tank, the mixture of oil and dilutant was directed to the surface by a continuous flow through the double-screw pumps. The experts designed a special underwater module that allowed the functioning of the pumps below the surface of the water. The flexible risers stretched from the ships located at the surface to the underwater module, taking the environment-friendly dilutant, hydraulic power and nitrogen towards the pressure valve (regulator) on the spare tank and taking towards the surface the mixture of oil and dilutant, as well as various signals that informed the personnel at the surface about the conditions below. Such a working operation allowed collecting all the oil located in parts of the cargo tanks without any obstructions. The inner walls of the cargo tanks in tankers are not flat surfaces. Therefore, inside tanks steel girders are mounted, and tanks thus form series of compartments that are not entirely separated from each other, but still have the possibility of keeping the oil whose viscosity is too high. To remove the oil remaining in the tanks environment-friendly bio-degradable oil was also injected because such oil is lighter than heavy fuel oil and *escapes* towards the top of the tank pressing heavy fuel oil below the steel girders. When the heavy fuel oil gets below the girders, it can be pumped out through rear pumps, until only biodegradable oil remains in the tanks. The final step was pumping out of biodegradable oil. Suction pump rose towards the top of the tank so that bio-oil, due to its fluidity, *was escaping* through the existing openings towards the suction

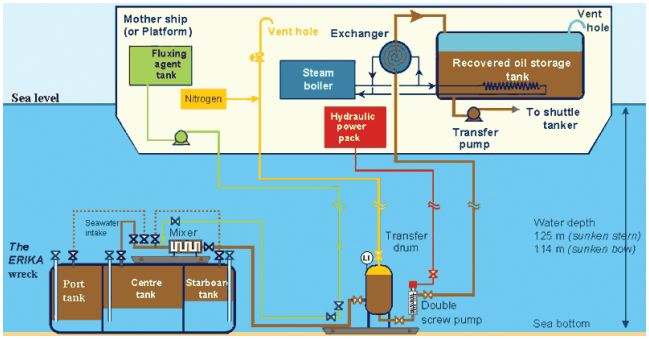


Figure 7. The pumping system principle.
Source: http://www.cedre.fr/en/spill/erika/pumping.php

points at a higher-level. Upon reaching the high-level points, it was pumped out.

The phase of fine cleaning of the wreck consisted of removing the greatest possible quantity of the oil that remained in the tanks and was carried out by injecting the dilutant. After having completely removed the cargo from the wreck, various nutrients were introduced into all tanks before their sealing. Their function was speeding up the process of natural biodegradation in case traces of bio-oil or lighter fractions of the cargo that had been carried remained in the wreck.

4.1 Achievements of the pumping-out process

To prepare both parts of the wreck an impressive fleet was mobilised that included three ships equipped with dynamic positioning devices. The pumping-out project was carried out smoothly and there was not a single incident registered. The wreck preparation process was carried out according to the schedule provided so that the activities were terminated 25 days before the scheduled date. Taking into consideration the quantity of the oil pumped out and the short time period for carrying out works, the project *Erika* was carried out in an impressive way and demonstrated that despite challenges it is possible to achieve satisfying results. In the course of the main pumping-out operations approximately 10,000 tons of heavy oil were taken out. By fine cleaning-up another 1,200 tons were removed.

5. ON-SHORE CLEAN-UP OPERATIONS

A heavy storm and south-westerly wind on December 24 and 25,1999 stranded the oil that poured out of the tanker *Erika* onto the coasts, dunes and rocks (Figure 4). Even earlier booms had been installed in the most endangered areas. In other areas new booms were urgently installed. However, heavy weather conditions made any clean-up operations impossible.

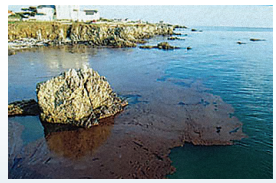
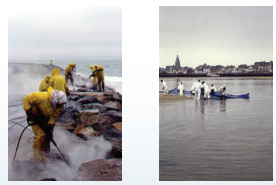


Figure 8.
Oil strandings in Loire Atlantique.
Source: http://www.cedre.fr/en/spill/erika/shore.php

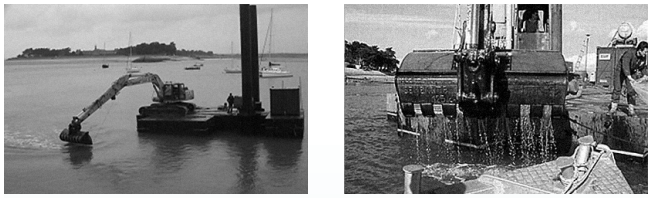
Thousands of volunteers joined the on-shore oil-clean-up teams, but it caused problems because the volunteers were unprepared and did not have sufficient knowledge about procedures to be followed. After several weeks, due to calming down of the weather a progress in the clean-up operations could finally be seen. By the end of the January the teams for pollution removal worked uninterruptedly on all the areas struck. The first clean-up operations were organised on beaches and in rocky areas as soon as the oil stain reached the coast (Figures 5 and 6). More than 5,000 professionals and volunteers participated in the tiring on-shore pollution clean-up operations.



Figures 9. & 10.
Clean-up of the rocks and sandy beaches.
Source: http://www.cedre.fr/en/spill/erika/shore.php

High viscosity of the oil made it impossible to use various devices so that manual pollution removal remained the only appropriate solution in many areas. Screening belts proved extremely effective in collecting oil beads stranded on sandy beaches. Heterogeneous rocks were cleaned by hoses under high pressure while waste waters produced by flushing rocks and by natural flushing of pebbles in sea-water were filtered through fishing nets and nets from building sites. In the areas that were less affected by pollution absorbents were used. To remove the oil beads buried 25 – 30 centimetres in the sand on the beaches processing devices and screening belts were used. After completing the operations of initial i.e. rough clean-up, fine clean-up of beaches and rocks could begin. Unfortunately, the oil started to reappear in many areas and it polluted again some already cleansed areas. In the areas of *Loire Atlantique* and *Vendee* heavy wind and currents buried the oil under several tens of centimetres of sand in stratified deposits that were afterwards exposed to phases of erosion and in-growing, and expanded as high-water level increased. Despite extensive clean-up operations carried out in the spring of 2000, in the northern and southern parts of the Bay of Biscay the oil concentration in sea-water (500 ng/l) and among bivalves (2.5 mg/l) was still at the high level. The content of polycyclic aromatic hydrocarbons was systematically higher than allowed (15 ng/l for sea-water and 0.5 mg/l among bivalves) that resulted in closing

down the oyster beds and salt pans in the area affected. Since new oil strandings were continuously reported in the area of *Pen Bron* the Government realised that at the entrance to the bay in *Pen Bron Channel* there was an unremoved underwater oil stain causing chronic pollution. The area polluted extended on more than 10,000 m^2 while the oil stain varied from 0.15 metres in diameter to the oil beads. At the centre of the stain there was an area sized 700 m^2 where there was a high concentration of sediment and oil mixture. Since the area polluted is subject to strong currents great attention had to be paid to remove even the least possible amount of sediment in order to facilitate the subsequent transport and removal operations. The clean-up operation was divided into two phases. The first phase included dredging of the central part of the oil stain where the oil concentration was highest using mechanical dredgers with filters mounted on pontoons.



a) b)

Figure 11. Dredging the centre of the slick where the oil concentration was the highest; a) Mechanical dredger fitted on a floating pontoon; b) Refinement filter.
Source: Le Guerroué,P., Cariou, G., Poupon, E., and F. Merlin: Recovery of Sunken and Buried Oil in Coastal Water During the Erika Spill, IOSC 2003.

This clean-up operation was carried out in ten subsequent days, but only at the time of low water. 800 tons of highly polluted sand was removed from the depth of 30 centimetres. This technique proved to be extremely fast and efficient.

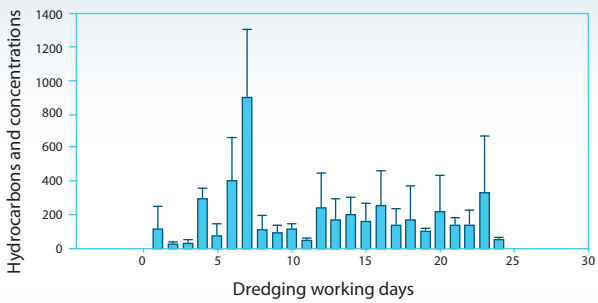


Figure 12. Oil content in the treated sand.
Source: Le Guerroué,P., Cariou, G., Poupon, E., and F. Merlin: Recovery of Sunken and Buried Oil in Coastal Water During the Erika Spill, IOSC 2003.

The second phase included removal of the sediment polluted from the edge of the stain using suction dredger with pump system to take the content to the beach for disposal (Pen Bron beach). On the beach the water, sediment and oil were separated in the settling and filtering basin. The water filtered and sand were taken back to the place previously polluted, and the polluting contents were sent for clean-up (sand also, if not cleansed in the basin).

a) b) c)

Figure 13. Removal of contaminated sand; a) Two suction dredgers used for sand removal, fitted with the hose system for delivering contaminated sand to disposal beach b) Pumping of contaminated water-sand mixture to disposal beach ; c) Disposal and filtration pools at Pen Bron beach.
Source: Le Guerroué,P., Cariou, G., Poupon, E., and F. Merlin: Recovery of Sunken and Buried Oil in Coastal Water During the Erika Spill, IOSC 2003.

The process consisted of five stages:

- Recovery of polluted sand by suctioning and moving of polluted material to nearby treatment facilities,
- Separation of sand and pollutant
- Primary filtration of dredged out water,
- Secondary filtration of dredged out water,
- Restoration of cleaned water and sand to contaminated area.

After cleaning operations, oil concentration in seawater was reduced to 12 ng/l and oil concentration in shellfish to 0.2 mg/kg. Soon it became apparent that the waste gained, its storage, transport and disposal would represent a serious problem. For this reason a series of temporary and four large disposal sites were opened. *TotalFina* Company, with the assistance of a board consisting of a number of experts in the field, managed the waste disposal, and the operation was supervised by experts familiar with *Polmar* (engl. Pollution Maritime) plan in case of spill. For storage of the waste gained temporary and large disposal sites were opened. The collecting teams stored waste at about 33 temporary disposal sites. These areas were along the coast, in the vicinity of the beaches affected. They consisted of a hole dug directly in the soil. Plastic membranes were used as protection for underground soil. When there was no need for temporary disposal sites any longer, they were dismantled, and any polluted

soil was removed and sent to large disposal sites in order for the temporary disposal site to return to its original state and thus be considered an unpolluted area. Large disposal sites were in the vicinity of *Elf Antar France Donges* refinery, 30 km from *Nantes*. Four such disposal sites were opened all together in which by September 2000 about 220,000 tons of waste were collected.

6. CONCLUSION

The accident of the tanker *Erika* pointed to a number of problems with which the International Maritime Organisation had to cope so as to prevent similar incidents in the future. Due to her economic cost effectiveness (ratio between the age of the ship and the charter price), Erika was a favourite to many shipping companies that aimed at achieving the maximum profit, not paying much attention to possible safety or technical drawbacks. Certainly, one of the most frequently asked questions referred to the fact that the ship, that had already been well-known for her technical defects, possessed all the necessary certificates allowing her operating in the maritime transport. When the numerous technical defects are accompanied by extraordinary heavy weather conditions and sea state affecting maritime transport, it can be concluded that the tanker *Erika* accident was almost inevitable. The accident caused such an ecological disaster that France had never seen before. It was only due to an appropriate response to the spill and the efforts made, despite the fact that the weather conditions and characteristics of oil made the attempts at removal of the oil almost impossible, that the consequences of the accident were not even more extensive. The characteristics of oil made its collection the only option. Several collectors were used: *Transrec,* due to its capacity to collect high-viscosity oil; however, the viscosity of the oil spill was too great for the system, which also proved to be impractical because of the permanent loss of pressure in the pipes. *Foilex* was chosen for its lower capacity, but even it was incapable of collecting oil of such high-viscosity. Sweeping arms were tested when all other collectors failed, but weather conditions precluded the use of this device. The lack of trained staff was yet another disadvantage. In the of response to the spill, the *Erika* case introduced certain innovations, e.g. it was the first time that professional alpinists were engaged in the operations of oil clean-up from shores and participation of botanists - gave advice on vegetation and monitors the treatment of contaminated plants. The specifics of this accident, are voluntary assistance arriving from all parts of Europe (namely, thousands of volunteers joined the operations of oil clean-up from shores) as well as first time organisation of oil pumping operation that neutralised the cargo trapped inside the wreck. The circumstances of the accident (as well as the later accident of the tanker *Prestige*) forced the International Maritime Organisation to issue a number of measures that gradually excluded from navigation tankers without double shell plating. These packages of safety measures were symbolically called *Erika* I, II and III, as a reminder of disastrous consequences of the spill that could have been avoided if more care had been taken of the safety of sea transport, and less of economic cost effectiveness provided by ships such as *Erika* - older tankers with single shell plating. Further preventive methods can focus on developing a better Contingency Plan and educating people to respond to the spill more efficiently.

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