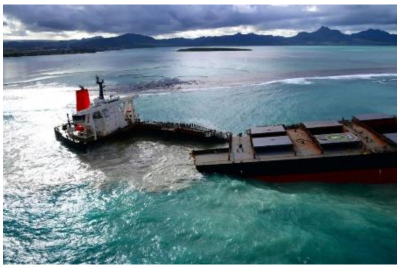
MARINE AND WATER DISASTERS CASE STUDY

STUDY 2/A - NORMAL SYSTEM

1. STARTING POSITION

In a port environment, damage to a tanker results in oil or fuel being released into the water.



The situation is aggravated by the following factors:

- Limited water space, which causes the rapid spread of contamination;
- Permanent or intermittent vessel traffic that may cause further turmoil and secondary leakage;
- The presence of concrete and steel structures that facilitate the adhesion and infiltration of oil;
- Proximity to canals, lock systems, coastal infrastructure, increasing the infrastructural and ecological risk of pollution.

The main goal is to quickly locate and prevent secondary pollution, taking into account the need to continue port operations and the strict requirements of environmental regulations (e.g. EU Water Framework Directive). A typical example of such an incident is the 2020 Mauritius oil disaster (MV Wakashio ship), where the ship ran aground on July 25, and by August, about 1000 tons of VLSFO (low-sulfur fuel oil) had leaked in an ecologically sensitive coral reef area, complicating the intervention due to the proximity of limited space and infrastructure. Economic damage has exceeded USD 15 billion, including tourism and fisheries.

2. NATURE OF POLLUTION

- Surface oil film on the water surface of the port, which spreads rapidly under the influence of waves and currents (propagation rate depending on winds of up to 0.5-1 m/s);
- Oil ingress into quay structures, where it adheres to concrete, steel or rubber walls, increasing the risk of corrosion;
- Oil floats and adheres to concrete, steel, rubber walls, which can cause long-term pollution;
- Potential infiltration into rainwater and industrial drainage systems, which can result in groundwater and drinking water contamination.

The type of pollution is usually light to medium crude oil, diesel or bunker oil, which float on water due to their hydrophobic properties, but can emulsify over time, making handling difficult. In the case of Wakashio, the VLSFO spread rapidly and caused months of ecological damage, e.g. biodiversity loss by 20-30% in the affected areas.

3. TRADITIONAL INTERVENTION METHODS

3.1. Localization

- Installation of floating oil trap dams that physically limit the spread of oil;
- Temporary physical closures, e.g. sandbags or temporary barriers.

Limitations:

- Undulation and boat movement reduce efficiency by up to 30-50%;
- Oil can pass under and next to dams, especially in strong currents;
- Installation time can be up to 1-2 hours, during which the pollution can spread further.
- At Wakashio, the installation of the dams took days, while the oil continued to leak.

3.2. Surface removal

- Mechanical skimmers, which absorb oil from the water;
- Absorbent loops and sheets that absorb oil.

Absorbents used:

- Perlite (porous volcanic glass, absorption up to 3-5 times by weight);
- Zeolite (mineral absorbent, good ion exchanger);
- Vermiculite (similar to perlite, heat-resistant);
- Polypropylene (PP) based materials (synthetic, oleophilic).

Limitations:

- Absorbents are saturated with water, reducing their effectiveness by 20-40%;
- Some of the absorbed oil is drained back, increasing secondary pollution;

Large quantities of hazardous waste are generated (up to 10 times the weight of the contaminated oil) with high treatment costs (e.g. incineration or landfill). In Mauritius, the cost of waste management contributed to the average incident cost of EUR 1-5 million.

3.3. Surface and structure treatment

- Collection and removal by mechanical means.
- High-pressure washing with water or detergents.

Limitations:

- Oil often spreads during washing, increasing the spread by 50%;
- Secondary contamination may occur, e.g. due to toxicity of detergents;
- Risk of corrosion on steel structures with long-term maintenance costs.
- High-pressure washing with water or detergents;
- Collection and removal by mechanical means.

Limitations:

- Oil often spreads during washing, increasing the spread by 50%;
- Secondary contamination may occur, e.g. due to toxicity of detergents;
- Risk of corrosion on steel structures with long-term maintenance costs.

4. OPERATIONAL CHALLENGES

- Time-critical decisions, where the delay of the intervention increases the degree of pollution exponentially (e.g. a delay of 1 hour can cause up to 2-3 times propagation);
- the simultaneous presence of several actors (authorities, operators, rescue teams), which raises coordination problems;
- Limited room for manoeuvre in the port due to ship traffic;
- Rapid access of pollution to infrastructure, which increases costs (e.g. the cost of an average port incident is EUR 1-5 million, including waste management and restoration). In the case of Wakashio, the insurance claim exceeded USD 10 billion.

5. RESULT (NORMAL SYSTEM)

- Pollution can be partially localized (efficiency 60-70%), but residual oil often seeps into the infrastructure;
- There is a significant need for subsequent cleaning (e.g. recultivation lasting months);
- High waste management costs (up to 40% of the total cost);
- Increased secondary pollution risk, which can cause long-term ecological damage (e.g. biodiversity loss in areas affected by 20-30%).

STUDY 2/B - EXOLINE® OIL STOP

Damage to a tanker in port - limited space, quick localization, prevention of secondary pollution.
Starting position and intervention goal (with Exoline® system)
In the event of tanker damage in a port environment, the purpose of using **Exoline® Oil Stop** is not to replace traditional intervention steps, but to stabilize and supplement them at a systemic level. In cases like Wakashio, the rapid deployment of Exoline could have prevented widespread spread and reduced economic losses.

1. **The main goals of the intervention with the use of Exoline®:**
   - Immediate physical immobilization of spilled oil on the surface,
   - Prevention of secondary migration of pollution (infrastructure, sewers),
   - Bringing oil adhering to port structures to a stable, non-permeable state,
   - To create an environmentally safe, controlled state under which the operation of the port can be partially maintained.

The **application of Exoline® Oil Stop** is compliant with the requirements of the EU Water Framework Directive and the environmental and operational regulations of ports, as it does not disperse, emulsify or increase aquatic toxicity.

Nature of pollution with Exoline®
The physicochemical behaviour of the oil changes after the intervention.

2.1 Surface Oil Film
- **Exoline® Oil Stop** creates a hydrophobic adsorption bond with the oil phase.
- The oil loses its fluidity, it goes into a paste-like, low-mobility state.
- Surface spread slows down or ceases significantly, even with ship movement.

2.2 Port structures (concrete, steel, rubber walls)
- **Exoline® Oil Stop** can be applied: o directly to the contaminated surface, o or as part of an improved absorbent system.
- The oil does not spread further into the pores, it stabilizes along the surface.
- Reduced: o risk of corrosion, o repeated washout, o long-term structural damage.

2.3 Protection of sewer and drainage systems
- **Exoline® Oil Stop can** be used as a preventive barrier for sewer inlets.
- The oil does not enter the drainage network in the form of an emulsion.
- The risk of groundwater and drinking water contamination is reduced.

Methods of intervention with the Exoline® Oil Stop system

3.1 Localization and stabilization
- **Exoline® Oil Stop**: o can be used alone, o or in combination with perlite/zeolite/PP absorbents.
- A hydrophobic stabilization zone is created on the surface.

Advantages:
- It does not rely solely on physical barriers.
- It retains its effect even when boats are moving and swelling.
- The time of localization can be measured in minutes, not hours. This could have reduced the spread of Wakashio by up to 50-70%.

3.2 Surface removal and disposal
- The bound oil: o does not saturate with water, o does not drain back, o can be handled mechanically (shoveling, pumping).
- The absorbent system does not become a secondary source of pollution.

Result:
- Significantly reduced waste (typically by 30-50%).
- Lower hazardous waste disposal costs.
- Better logistics management.

3.3 Surface and structure treatment
- The **application of Exoline® Oil Stop** reduces or replaces aggressive washing.
- No detergents are required.
- Surface cleaning can be carried out in a controlled manner without retransmission.

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Operational challenges with Exoline®

- Fast decision support: immediate stabilization → more time for organization.
- Fewer parallel interventions are required.
- Better cooperation with authorities and port operators.
- The partial operation of the port can be restored sooner.

Result - Exoline® with Oil Stop System

- Fast and stable localization (efficiency typically >80% in critical zones).
- Minimal secondary pollution.
- Shorter post-cleaning time.
- Lower total cost of remediation. For example, in a case like Wakashio, the total cost can be reduced by up to 30-40% due to lower waste management.
- Significantly reduced long-term ecological and infrastructural risk.

Final Note - Lessons Learned from the Port Application

Exoline® Oil Stop in a port environment is not another absorber, but an operational stabilization tool that: saves time, reduces risk and creates a controlled decision-making situation. This is especially valuable where space is tight, damage spreads quickly and infrastructure protection is critical. It is recommended for the prevention or treatment of similar incidents as Wakashio, where traditional methods have proven insufficient.