exoline®

MARINE AND WATER DISASTERS CASE STUDY

STUDY 3/A - NORMAL SYSTEM

1. Baseline and intervention objective

In the event of a fire and leak on an oil rig, there is a continuous outflow of oil in extreme environments, typically on offshore platforms or at deep-water wells.



The situation is aggravated by the following factors:

- High pressure and temperature conditions (e.g. 1000–3000 m depth in the case of deep-water wells, pressure typically in the order of 300–700 bar);
- Constant risk of fire and explosion, which limits the possibility of human intervention;
- Remote location, strong waves, wind and sea currents that make logistics difficult;
- Environmental sensitivity, especially proximity to marine ecosystems (fish stocks, plankton, coral reefs).

The main goal is to extinguish fires, seal leaks, and minimize environmental damage, in accordance with international regulations (e.g. IMO MARPOL Convention, OSHA Safety Guidelines). A typical reference case is the **Deepwater Horizon disaster in 2010**, where ~60,000 barrels of oil leaked daily for 87 days after the fire, **emitting a total of about** 4.9 million barrels.

2. NATURE OF POLLUTION:

- Continuous oil outflow from the wellhead or damaged pipelines, forming a surface oil film (propagation rate typically as a function of 0.3-0.5 m/s flow);
- Dispersion of oil in the water column with **the formation of micro- and nano-sized oil droplets** ;
- Sediment contamination in deep-water environments, where heavier fractions settle and cause chronic toxicity;
- Evaporation from fire and air and water pollution from combustion products (e.g. PAHs).

The type of contamination is typically crude oil or condensate, which emulsifies over time, making treatment significantly more difficult and causing long-term ecotoxic effects (e.g. fish mortality by 20-30% in the affected areas).

3. TRADITIONAL INTERVENTION METHODS

3.1 Localization

- Installation of floating oil trap dams (booms);
- Deep water closure using ROVs or a capping stack.

Limitations:

- Loss of efficiency by 40-60% in the event of ripples and flows;
- In the case of a deep-water leak, the dams are ineffective;
- Long installation time (24-48 hours).

3.2 Surface removal

- Mechanical skimmers;
- Continuous application of absorbent loops and sheets.

Limitations:

- Decrease in efficiency due to water saturation (30-50%);
- Risk of back-down;
- Significant generation of hazardous waste (5-10× weight ratio).

3.3 Surface and structure treatment

- Spraying of dispersants (e.g. Corexit);
- In-situ burning.

Limitations:

- Increased toxicity risk, especially for microorganisms and plankton;
- PAH emissions and air pollution;
- Deep-water applicability is limited.

4. OPERATIONAL CHALLENGES

- Time-critical decision-making in extreme environments;
- Coordination of several actors;
- Weather and logistical constraints;
- Extremely high costs (the total cost of Deepwater Horizon is in the order of ~60 billion USD).

5. RESULT (NORMAL SYSTEM)

- Pollution can be partially localized (efficiency 50-60%), but in the case of a deep-water leak, residual oil is dispersed;
- There remains a significant need for post-cleaning (e.g. years of recultivation, as in the case of Deepwater Horizon);
- High waste management costs (up to 50% of the total cost, e.g. $62 billion for Deepwater);
- Increased secondary pollution risk, with long-term ecological damage (e.g. biodiversity loss affected by 30-50%

Summary - Status without exoline

Conventional systems offer reactive, partial solutions **for severe offshore events** that are not able to provide full control over water column and sediment contamination, especially in the case of long-term, continuous outflows.

STUDY 3/B - EXOLINE® OIL STOP

In the event of a fire and leak on an oil rig, there is a continuous outflow of oil in extreme environments, typically on offshore platforms or at deep-water wells.

1. Initial situation and intervention target (**with Exoline®** system) In the event of a fire and leak on an oil rig, especially on offshore platforms or deep-water wells, the purpose of using **Exoline® Oil Stop** is not to replace traditional intervention steps, but to stabilize and supplement them at a systemic level.

The main goals of the intervention with the use of Exoline®:

- Immediate physical immobilization of continuous oil outflow on the surface and in the water column,
- Preventing secondary migration of pollution
- Reducing the risk of fire by creating a stable, non-permeable state,
- Creating an environmentally safe, controlled state under which the platform's operations partially maintained or the closure can be carried out safely.

The **application of Exoline® Oil Stop** is compliant with the requirements of the IMO MARPOL Convention, OSHA Safety Guidelines and the EU Offshore Safety Directive, as it does not disperse, emulsify or increase toxicity while having fireproof properties.

A typical reference case is the 2010 Deepwater Horizon disaster, where ~60,000 barrels of oil leaked per day for 87 days after the fire, emitting a total of about 4.9 million barrels, and the use of Exoline-like stabilization systems could have prevented extensive dispersion and permanent ecological damage.

2. **The nature of the contamination with the use of 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 propagation slows down or stops significantly, even with strong currents.

2.2 Vízoszlopban diszpergált olaj
- **Exoline® Oil Stop can** be applied with deep-water application (e.g. ROVs).
- The further dispersion of micro- and nano-droplets is reduced.
- The oil does not become mobile again, reducing chronic toxicity.

2.3 Sediment contamination
- Oil migration slows down, heavier fractions stabilize locally. The long-term effects of PAHs and aromatic hydrocarbons are reduced.

The system does not create a secondary pollution phase and supports natural degradation (~60-180 days).

3. Methods of intervention with the Exoline® Oil Stop system
3.1 Localization and stabilization
- **Exoline® Oil Stop** can be used alone or in combination with perlite/zeolite/PP absorbents.
- In case of a deep-water leak, it can be integrated with ROVs or a capping stack.

Advantages:
- It does not rely solely on physical barriers.
- Due to its fire-resistant properties, it is safer in extreme environments.
- The time of localization can be measured in minutes at the surface layer.

3.2 Surface removal and disposal
- The bound oil does not saturate with water, it does not drain back.
- It can be operated mechanically (pumping, skimming).

Result:
- Reduction of waste (by 30-50%).
- Lower hazardous waste disposal costs.
- Improved logistics management at remote locations.

3.3 Surface and structure treatment
- **Exoline® Oil Stop** reduces the need for dispersants.
- There are no PAH emissions during in-situ incineration.
- The structures of the platform can be handled stably without requiring aggressive washing.

4. Operatív kihívások Exoline® rendszerrel
- Fast decision support: instant stabilization → more time for firefighting and closure.
- Less human risk in flammable environments.
- Better cooperation with authorities and operators.
- Logistics are simpler, as **Exoline®** is fireproof and easy to apply.

5. Result - Exoline® with Oil Stop System
- Fast and stable localization (efficiency > 80% in critical zones).
- Minimal secondary contamination and dispersion.
- Shorter post-cleaning time (e.g. weeks instead of months).
- Lower total cost of remediation (up to 30-40%, reduced to ~$40 billion in a Deepwater Horizon case).
- Significantly reduced long-term ecological and infrastructural risks (e.g. biodiversity loss < 20%).

FINAL NOTE:
Exoline® Oil Stop in an offshore environment is not another absorber, but an operational stabilization tool that saves time, reduces risk and creates a controlled decision-making situation. This is particularly valuable in extreme conditions where fire, pressure and depth complicate interventions, as in the case of Deepwater Horizon, where conventional methods have proven insufficient.