MARINE AND WATER DISASTERS - CASE STUDY

STUDY 1/A - NORMAL SYSTEM

Collision of two ships on the high seas
(simultaneous treatment of surface oil + water column + sediment – without the use of Exoline)

1. Starting position and objective of intervention
In the event of a ship-to-ship collision on the high seas, especially when tankers or oil tankers are involved**, a large oil leak** can occur in a short period of time.

The management of such events is aggravated by several factors:

- **Open water environment**, strong waves, wind and sea currents that spread pollution quickly and uncontrollably.
- **Large amounts of oil spilling** out of the water that simultaneously affect the surface, the water column and marine sediment.
- **Remote location** that limits the possibilities for rapid mechanical and aerial intervention.
- **High environmental sensitivity**, in particular for marine life (fish stocks, plankton, seabirds) and potentially affected coastal ecosystems.

The main objective of the intervention in such cases is the **simultaneous treatment of the surface oil film, oil fractions dispersed in the water column and sediment**, in accordance with international environmental and shipping regulations, with particular regard to:

- **IMO MARPOL Annex I** (International Convention for the Prevention of Pollution from Ships).
- **OPA 90 - Oil Pollution Act of 1990 (USA).**
- As well as regional sea conventions (e.g. OSPAR, HELCOM - depending on the region).

2. Historical reference cases (industry benchmarks)
Well-documented examples of oil spills resulting from collisions on the high seas point to the limitations of traditional intervention methods.

Exxon Valdez (1989, Alaszka)

- Amount of oil released: ~37,000 tons of crude oil.
- Despite surface removal, a significant portion of the oil has settled in coastal and marine sediments.
- PAH contamination was still detectable more than 20 years later.
- Significant and sustained biodiversity loss.

Prestige tanker (2002, Atlantic, Spain)

- Oil spilled: ~63,000 tons of heavy bunker oil.
- Multiphase pollution: surface, water column and coastal sediment.
- Long-term post-cleaning lasting for years.
- Significant economic and ecological damage.

(Source references: Marine Insight, ITOPF, NOAA incident reports)
These cases have proven at the industry level that interventions with a purely surface focus **are not able to ensure complete environmental safety**.

3. The nature of the pollution in the event of a collision on the high seas

Oil spills from a ship collision **are complex, multi-layered and time-varying** with the following characteristics:

- **Surface oil film (slick)**
  - Rapid propagation depending on wind and current.
  - Its thickness and viscosity are constantly changing.

- **Oil fractions dispersed in the water column**
  - In the form of micro and macro droplets (plume formation).
  - Difficult to handle with mechanical devices.

- **Sediment contamination**
  - Sedimentation of heavier fractions on the seabed
  - Chronic toxicity (PAHs, aromatic hydrocarbons)
  - Long-term ecological effects.

The contaminant is typically **crude oil or heavy bunker oil**, which **emulsifies over time**, significantly reducing the effectiveness of traditional treatment methods.

4. Traditional intervention methods

4.1 Localization

- Application of floating oil barrier barriers (booms)
- Oil diverting chemicals (herders)

Limitations:

- 40-60% reduction in efficiency in the event of ripples and currents
- Ineffective for deep-water plumes
- Installation time up to 24-48 hours

4.2 Surface removal

- Mechanical skimmers (weir, oleophile types)
- Application of absorbents

Commonly used absorbents:

- Perlite
- Zeolite
- Vermiculite
- Polypropylene (PP) based materials

Limitations:

- Reduced efficiency due to water absorption
- Risk of back-release
- Significant waste generation (up to 5-10× compared to the weight of oil)

4.3 Additional techniques

- Spraying Dispersants
- In-situ burning
- Bioremediation

Limitations:

- Dispersants can increase aquatic toxicity
- Incineration results in PAH emissions
- Bioremediation in a cold marine environment is slow

5. Operational challenges

- Delayed intervention in remote locations
- Difficulty in coordinating multiple actors
- Logistical problems due to weather
- High costs (average cost of a maritime collision: €10-50 million)

6. Result - with a conventional system

- **Partial treatment** (50-70% effectiveness)
- **Long-term post-cleaning**, often for years
- **High waste costs**, up to 40% of total cost
- **Permanent ecological damage**, biodiversity loss by 30-50%

Final Note (Status without Exoline)
Traditional intervention systems **primarily offer reactive, surface-focused solutions** that can manage some of the pollution, but **do not provide a complete, long-term environmental condition**, especially at the level of the water column and sediment.

STUDY 1/B - EXOLINE® OIL STOP

Collision of two ships on the high seas
*(simultaneous treatment of surface oil + water column + sediment - **using Exoline® Oil Stop**)*

1. Starting position and objective of intervention
In the event of a collision with a pelagic vessel, especially tankers or oil tankers**, a large-scale, multi-phase oil spill** can occur in a short period of time.

The purpose of using Exoline® Oil Stop in such an environment is not only to remove the surface oil, but also:

- Immediate immobilization **of pollution**.
- Prevent further migration.
- Creating an **environmentally safe, controlled state** that allows for delayed, low-risk progress.

The system is applied in accordance with international regulations, in particular:

- **IMO MARPOL Annex I**.
- **OPA 90 - Oil Pollution Act of 1990**.
- As well as regional marine environmental conventions.

Exoline® Oil Stop does not replace the mechanical interventions prescribed by the authorities, but **complements and stabilizes them at the system level**.

2. References and lessons learned (industry benchmark)
One of the main lessons learned from previous large-scale maritime accidents (Exxon Valdez, Prestige) is that:

- Surface interventions **did not prevent** water column and sediment pollution,
- Some of the oil **remained in the ecosystem** in a chronic, difficult-to-treat form.

The **application philosophy of Exoline® Oil Stop** is based on these experiences and **treats pollution** not by dispersing**, but by** stabilization.
(Reference background: NOAA, ITOPF, Marine Insight case study analyses)

3. Nature of contamination when using Exoline® Oil Stop
Oil spills from a ship collision are still **multi-layered**, however, after the **intervention of Exoline®**

Oil Stop, the physico-chemical state changes:

- **Surface Oil Film**
  - **Exoline ® Oil Stop** creates an adsorption bond with the oil phase
  - The oil **loses its fluidity**, goes into a paste-like, low-mobility state
- **Oil fractions present in the water column** o Hydrophobic adsorption reduces the risk of further diszpergálódást
  - The oil does not become mobile again **in the form of micro- and macro-droplets**
- **Sediment contamination**
  - Oil migration slows down or stops significantly
  - The pollution **is stabilized locally**, reducing the risk of chronic toxicity

The system **does not emulsify**, dissolve the oil back into water, and does not create a secondary contamination phase.

4. Methods of intervention using Exoline® Oil Stop

4.1 Localization and primary stabilization

- **Exoline® Oil Stop can** be used independently or **as a system combined** with conventional absorbents (e.g. perlite, zeolite)
- A hydrophobic stabilization zone **is created** on the surface

Advantages:

- The impact of ripple and flow is significantly reduced
- Spread slows down or stops quickly
- Localization does not rely solely on mechanical means

4.2 Surface Removal and Handling

- The bound oil **does not flow back**, does not saturate with water
- The resulting paste-like state **can be mechanically managed**, pumped or collected

Result:

- Water absorption of absorbents is significantly reduced
- The amount of waste is significantly lower compared to traditional methods
- Minimal risk of backlash

4.3 The role of complementary technologies

In addition to using Exoline® Oil Stop:

- No aggressive dispersants are required.
- The need for in-situ burning is reduced.
- Biological and oxidative degradation **can continue in** a controlled microenvironment.

The system **does not hinder the natural decomposition processes**, but provides a stable basis for them.

5. Operational challenges with Exoline®

- Can be used in remote locations with easy application
- Fewer time-critical mechanical steps
- Better fit in a multi-actor (authority – operator – remediation) environment
- Intervention **does not force immediate permanent removal**

6. Result - Exoline® with Oil Stop System

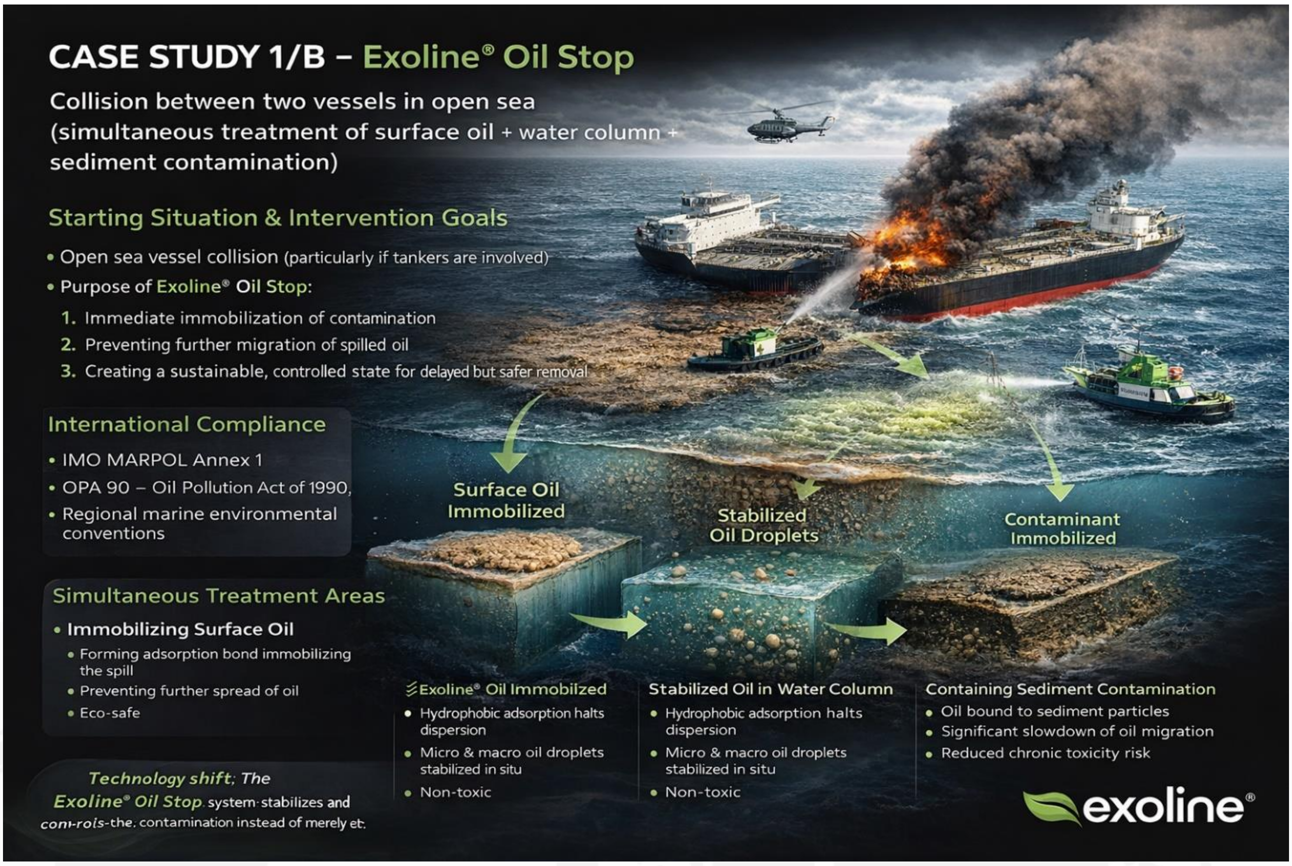
- **Rapid physical control** over pollution
- **Significantly reduced migration** in surface, water column and sediment
- **Lower waste**
- **Shorter post-cleaning time**
- **Reduced ecological risk**, especially in the long term

The contamination **is brought to an environmentally safe, stable state** that allows for delayed, optimized removal or disposal.

Final Note - Using Exoline®

The use of **Exoline® Oil Stop** is not another absorbent, but a technological change of approach: the goal is not to "disappear" immediately, but to control, stabilize and minimize risk.

This approach makes the system particularly suitable for dealing with complex, large-scale maritime disasters, where traditional methods alone do not ensure long-term environmental security.


CASE STUDY 1/B – Exoline® Oil Stop
Collision between two vessels in open sea
(simultaneous treatment of surface oil + water column + sediment contamination)
Starting Situation & Intervention Goals
• Open sea vessel collision (particularly if tankers are involved)
• Purpose of Exoline® Oil Stop:
1. Immediate immobilization of contamination
2. Preventing further migration of spilled oil
3. Creating a sustainable, controlled state for delayed but safer removal
International Compliance
• IMO MARPOL Annex 1
• OPA 90 – Oil Pollution Act of 1990,
• Regional marine environmental conventions
Simultaneous Treatment Areas
• Immobilizing Surface Oil
• Forming adsorption bond immobilizing the spill
• Preventing further spread of oil
• Eco-safe
Technology shift: The Exoline® Oil Stop system stabilizes and con-rols-the. contamination instead of merely et:
Surface Oil Immobilized
Stabilized Oil Droplets
Contaminant Immobilized
Exoline® Oil Immobilzed
• Hydrophobic adsorption halts dispersion
• Micro & macro oil droplets stabilized in situ
• Non-toxic
Stabilized Oil in Water Column
• Hydrophobic adsorption halts dispersion
• Micro & macro oil droplets stabilized in situ
• Non-toxic
Containing Sediment Contamination
• Oil bound to sediment particles
• Significant slowdown of oil migration
• Reduced chronic toxicity risk
exoline®