INDUSTRIAL AND LOGISTICS ACCIDENTS – CASE STUDY

STUDY 10/A – NORMAL SYSTEM

1. Starting position and objective of intervention

Typically, during a warehouse oil spill, **a significant amount of oil is released** in confined spaces**, such as logistics warehouses, industrial storages, or chemical depots, due** to failures in tanks, barrels, pipelines, or connections.

Contamination spreads quickly on the concrete floor and results in immediate secondary risks:

- Slip hazard,
- Fire and explosion hazards,
- Deterioration of air quality (VOC/PAH load),
- Infiltration in cracks.

Factors aggravating the situation

- **Limited ventilation indoors: the risk of toxic vapour** concentration → inhalation can increase rapidly due to evaporating fractions.
- **Slippery surface:** endangers the movement of the responding personnel, increases the accident rate.
- **High outflow volume:** up to *5–50 m³* → rapid spread, infiltration into cracks is increased (*0.1–0.3 m/h in aerated concrete*).
- **Risk of environmental migration:** if the oil enters the sewer or the soil under the floor, groundwater pollution can also occur.
- **Urgent need for intervention, "clean" work compulsion:** in many cases, water cleaning is prohibited/should be avoided (increasing slipping, spreading).

Intervention Objective (Normal System)

The goal:

- Rapid localization **of spilled oil**,
- Reducing **the risk of slipping**,
- Limiting the spread of pollution,
- Safe **return of the warehouse** in accordance with industrial HSE protocols, EU IPPC/IED principles and OSHA-like occupational safety requirements.

Reference case

2018 Texas (USA) warehouse oil leak: ~20 m³ of oil in confined space, slip hazard + air pollution, **~2 million USD** incident cost (evacuation + recovery).

2. Nature of pollution (normal system)

The pollutant is typically crude oil or refined products, **hydrophobic in nature**, but its evaporation in a closed space generates a significant **human risk** .

Typical effects and processes

- **Surface film formation** on the concrete floor → rapid spreading.
- **Infiltration into cracks** and connection joints (*0.1 to 0.3 m/h*).
- **Critical slip hazard** → occupational safety risk.
- **VOC/PAH evaporation in confined spaces** → irritation, toxic exposure, restriction of work.
- **Secondary migration** into sewers/under the floor → soil and groundwater involvement.
- **Long-term adhesion** and contaminated surface residues → difficult post-cleaning.

3. Traditional intervention methods and their limitations

3.1 Localization

Typical solutions:

- Sandbag, temporary dam
- Dry absorbent materials: sand, sawdust

Limitations:

- Oil spreading in cracks is not stopped → *50-70% efficiency*
- Dry fillers can increase slippage
- Installation indoors is time-consuming (*30-60 minutes*)

3.2 Surface removal

Typical solutions:

- Mechanical suction (industrial vacuum cleaner, dredging)
- Conventional absorbents: perlite, zeolite, vermiculite, PP-based

Limitations:

- Efficiency decreases due to saturation (*30-50%*)
- Dredging/vacuuming can generate dust and air pollution
- Significant amount of waste (*5-10×* weight ratio)

3.3 Surface and structure treatment

Typical solutions:

- High-pressure washing with detergents
- Bioremediation / chemical cleaning

Limitations:

- Washing can spread the oil and increase slippage
- Bioremediation indoors is slow (months)
- Cost intensive: *200-400 EUR/m²*

4. Operational challenges (normal system)

- Intervention on slippery surfaces → increased risk of injury
- Fire brigade / disaster management coordination
- Ventilation and access restrictions (confined space)
- Incident costs typically EUR **1-3 million**

5. Result (normal system)

- Localization **60-80%,** but there may be adhering oil film and cracked contamination
- Post-cleaning can take days
- High waste and disposal cost
- Health and long-term environmental risks persist

Summary - Status without exoline®

Conventional systems are reactive in the **event of a warehouse oil spill** and often do not provide a sufficiently fast, clean and safe solution in a confined space because:

- The control of propagation in cracks is weak,
- The intervention may increase the risk of slipping,
- Air pollution limits work,
- Waste generation is significant.

STUDY 10/B - EXOLINE® OIL STOP

1. Starting position and intervention goal (with Exoline® system)

The baseline event is the same as in Study 10/A. The **role of Exoline® Oil Stop is not to replace the classic steps**, but to improve and stabilize **the traditional intervention** where traditional methods are weak:

- Rapidly deteriorating air quality indoors
- Slip hazard over the entire work area
- Control of pollution spreading through cracks
- Water Use Ban/Restriction

Intervention goal with Exoline®

- Immediate immobilization of **oil** on concrete floors → reduction of slip hazards
- Interruption of spreading **into cracks**
- Fast, clean treatment with minimized waste
- Fast and safe return of the area (business continuity)

Based on the designed operating logic, Exoline can be compatible with EU IPPC/IED and OSHA type principles in an industrial environment, and does not disperse pollution **.®**

2. Pollution behavior with Exoline® (behavior change)

2.1 Stabilization of surface oil film

- **Exoline®** creates a selective hydrophobic bond with the oil phase
- A paste-like, low-mobility state can be created
- Reduced risk of spreading and slippery surfaces
- Evaporation intensity can be reduced → improved air quality

2.2 Crack control

- Rapid adsorption → capillary spread can be stopped
- Reduced remobilization and chronic pollution

2.3 Reduction of secondary migration

- The load on ducts and underfloor zones may be reduced
- More controlled aftercare: targeted cleaning / restoration

3. Improved intervention methods with Exoline® system

3.1 Localization + Stabilization

- **Exoline®** application at the source of the spill and in the spreading zones
- Can be combined with barriers, demarcation

Advantages:

- Quick Setup (Minutes)
- Intervention logic that does not increase the risk of slipping
- Works better indoors where water technology is limited

3.2 Surface Removal + Disposal

- The bound oil is less likely to "disintegrate"
- More manageable with mechanical collection (shovelling, dredging, industrial collection)
- The mass of hazardous waste generated can be reduced

Result:

- Waste reduction in the range of **30-50%** (location-dependent)
- Lower logistics and disposal costs
- Faster space freeing up

3.3 Surface and structure treatment

- Reduce the need for pressure washing
- Post-cleaning can become more targeted
- Bioremediation or restoration can be performed in a smaller zone, in a controlled manner

4. Operational impact (with Exoline® system)

- Rapid stabilization → less risk to the intervention staff

- Better work organization in enclosed spaces can be combined with ventilation
- Simplified logistics, fewer repetitive interventions
- Incident costs may be reduced, especially on the side of waste and post-clean-up

5. Result - with Exoline® Oil Stop System

- Fast localization in critical zones **>80%**
- Minimal remediation and less restoration
- Total cost can be reduced **by 30-40%** (depending on location and protocol)
- Reduced long-term health and environmental risk
    - **Target to** reduce biodiversity health risk **to less than <20%** with an appropriate SOP

Final Note - Lessons for Warehouse Application

Exoline® Oil Stop is a stabilizing and risk-reducing technological element **in a warehouse environment**, which, improving the traditional intervention:

- Accelerates the return of enclosed space,
- Reduces slippage and inhalation risks,
- It minimizes dispersion and waste, especially where water-based cleaning is not permitted or unsafe.