WASTE MANAGEMENT & CIRCULAR ECONOMY MODEL

EXOLINE® OIL STOP

TREATMENT AND STABILIZATION OF OIL-LOADED ABSORBENTS

LOW-COST MODEL

Stabilizing Saturated Oil Spill Absorbents with 10–15% Exoline Addition

💰 COST-OPTIMIZED SOLUTION

Reduced free-oil mobility (dripping risk)
Lower VOC emissions and odor during handling
Improved storage and transport conditions
Potentially reduced disposal risk and logistics cost
Exoline dose: 10–15% (vs. 20–30% standard enhancement)

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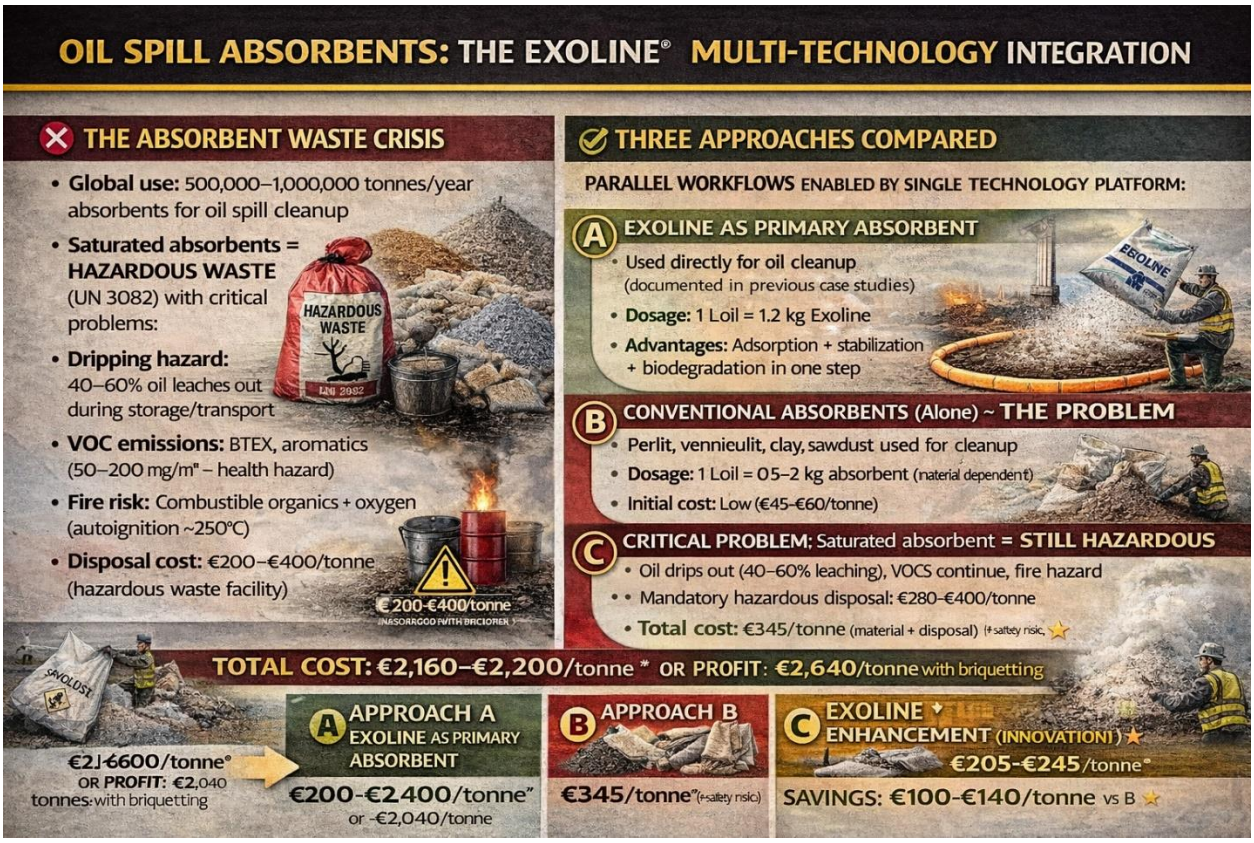
EXECUTIVE SUMMARY

Global oil spill cleanup consumes approximately 500,000–1,000,000 tonnes/year of absorbents (expanded perlite, vermiculite, expanded clay/LECA, sawdust, commercial pads). While these materials absorb oil efficiently, the saturated absorbent waste stream remains difficult and costly to manage due to free-oil mobility (dripping/leaching), VOC emissions, odor, handling hazards, and high disposal fees when classified as hazardous waste.

The Exoline® Absorbent Enhancement – LOW-COST MODEL provides a practical post-treatment approach for stabilizing saturated conventional absorbents under controlled conditions by adding only 10–15% Exoline by weight to the saturated material. This approach is intended to reduce dripping risk, suppress VOC emissions, and improve storage and transport safety, while keeping Exoline consumption and overall project costs at a controlled and predictable level.

☑ KEY OUTCOME

- Reduced free-oil mobility (dripping risk) under controlled handling and storage conditions
- Lower VOC emissions and odor during handling
- Improved storage and transport conditions
- Potentially reduced disposal risk and logistics cost (subject to testing and local rules)



1. THE ABSORBENT WASTE CRISIS

1.1 Global Absorbent Market

Absorbent Type	Global Use (tonnes/year)	Oil Capacity (L/kg)	Cost (€/tonne)
Expanded perlite	150,000–200,000	1.5–2.5	€80–€150
Vermiculite	80,000–120,000	1.2–2.0	€100–€180
Expanded clay (LECA)	200,000–300,000	0.8–1.5	€50–€100
Sawdust	100,000–150,000	0.5–1.0	€20–€50
Commercial pads/socks	50,000–80,000	10–20 (product dependent)	€1,000–€3,000
TOTAL	~750,000 tonnes/year	Variable	Weighted avg. ~€120/t

1.2 The Post-Absorption Problem

CASE EXAMPLE: 1,000 liter diesel spill cleaned with perlite

- Perlite used: 1,000 L ÷ 2 L/kg capacity = 500 kg perlite
- Saturated mass: 500 kg perlite + (1,000 L × 0.85 kg/L diesel) = 1,350 kg total
- Initial cost: 500 kg × €0.12/kg = €60

⚠ **AFTER ABSORPTION, THE MAIN OPERATIONAL RISKS BEGIN:**

- Residual oil migration and dripping during transport
- VOC emissions (BTEX/aromatics) during storage and handling
- Potential fire and safety risks in poorly controlled conditions
- Higher disposal cost if classified as hazardous waste

1.3 Current Disposal Options for Saturated Absorbents

Disposal Method	Cost (€/tonne)	Availability	Key Limitations
Hazardous waste incinerator	€200–€400	Limited capacity	High cost, permits
Landfill (hazardous cell)	€150–€300	Declining	Regulatory restrictions
Thermal desorption	€300–€500	Rare	High energy use
Cement kiln co-processing	€100–€200	Limited	Strict acceptance specs
Energy recovery (briquetting)	Often restricted	Limited	Dripping/VOC risks

2. THREE APPROACHES COMPARED

Using 1,000 liter diesel spill as baseline:

2.1 APPROACH A: Exoline as Primary Absorbent

- Dosage guideline: 1 L oil = 1.2 kg Exoline

- For 1,000 L spill: 1,200 kg Exoline
- Cost (Exoline @ €9/kg): 1,200 kg × €9/kg = €10,800 (+ disposal or recovery)

✅ **Strong performance and control, but highest upfront material cost.**

2.2 APPROACH B: Conventional Absorbents Alone (Perlite Example)

- Perlite purchase: €60
- Packaging/logistics estimate: €50
- Hazardous disposal: 1.35 t × €300/t = €405
- **Total = €515 (+ safety/logistics risks)**

✅ **Lowest initial cost, highest downstream waste-management burden.**

2.3 APPROACH C: Exoline Enhancement – LOW-COST MODEL ☆

Concept: stabilize saturated absorbents using only 10–15% Exoline.

3-STEP PROCEDURE:

1. **STEP 1:** Initial Cleanup (Conventional Absorbent) - Use perlite / clay / sawdust for rapid bulk absorption

2. **STEP 2:** Exoline Enhancement Mixing (LOW-COST DOSE) - Add Exoline: 10–15% by weight of saturated absorbent
   - → Mix thoroughly: Mechanical mixer (5–10 min) or manual tumbling (15–20 min)
   - → Dwell time: 1–4 hours

3. **STEP 3:** Stabilized Waste Stream (Expected Benefits)
   - → Reduced oil mobility and dripping risk
   - → Lower VOC and odor emissions during handling
   - → Improved transport and storage conditions
   - → Lower risk of secondary contamination incidents

3. LOW-COST ENHANCEMENT EXAMPLE (1,000 L DIESEL SPILL)

STEP 1: Perlite cleanup

- Perlite: 500 kg = €60
- Saturated mass: 1,350 kg

STEP 2: Exoline enhancement (10–15% low-cost dose)

OPTION: 10% Exoline

- Exoline: 1,350 kg × 10% = 135 kg
- Exoline cost: 135 kg × €9/kg = €1,215
- Total mixture: 1,350 + 135 = 1,485 kg

OPTION: 15% Exoline ☆ (Recommended)

- Exoline: 1,350 kg × 15% = 202.5 kg
- Exoline cost: 202.5 kg × €9/kg = €1,822.5
- Total mixture: 1,350 + 202.5 = 1,552.5 kg

STEP 3: Disposal scenario (conservative assumption)

- If still managed as regulated waste:
- Disposal cost example: €200–€300/t (site dependent)

COST SUMMARY (1,000 L EXAMPLE):

Approach	Total Cost (typical)
Perlite alone	~€515 (+ risks)
LOW-COST Enhancement 10%	€60 + €1,215 + disposal ≈ €1,275–€1,520
LOW-COST Enhancement 15% ☆	€60 + €1,822.5 + disposal ≈ €1,900–€2,290
Exoline primary	~€10,800 (+ disposal/recovery)

✅ **RESULT: INTERMEDIATE SOLUTION BETWEEN COST AND PERFORMANCE**

The LOW-COST model provides:

- Noticeable improvement in safety, handling characteristics, and compliance readiness compared to untreated absorbents
- Cost higher than 'perlite alone', but far below Exoline primary
- Practical balance: controlled cost + enhanced risk mitigation

4. ENHANCEMENT PERFORMANCE TARGETS (LOW-COST RANGE)

Exoline %	Dripping Reduction	VOC Reduction	Handling Safety	Notes
10%	40–60%	30–50%	Partial improvement	Entry-level stabilization
15% ☆	55–75% ☆	45–65% ☆	Stronger improvement	Recommended low-cost target
20%	70–85%	70–85%	High	'Standard' enhancement level

✅ **Recommended LOW-COST target: 15% (best balance)**

Indicative reduction ranges based on laboratory-scale testing and controlled handling scenarios; actual results may vary depending on absorbent type, oil composition, and mixing quality.

5. IMPORTANT LIMITATIONS (LOW-COST MODEL)

⚠ **THIS MODEL IS DESIGNED FOR CONTROLLED COST AND BASIC STABILIZATION:**

- May not fully eliminate dripping in every case
- May not guarantee reclassification to non-hazardous waste
- Requires mixing quality control and minimum dwell time
- Local waste classification must be confirmed by testing/authorities

6. TECHNICAL DATA (REFERENCE)

Physical state: Fine-grained powder with positively charged surface
Particle size: 4 µm (optimized for uniform dispersion)
Color: White
pH value: 11.5-12.5 (aqueous suspension)
Bulk density: ≈ 0.65 kg/dm³
Specific surface area (BET): Up to 26 m²/g maximum
Hydrophobic surface: 15.97 m²/g (oil binding capacity)
Hydrophobic properties: Strongly water-repellent
Gas permeability: O_2 and H_2O vapor permeable
Thermal stability: Stable up to 370°C
Ignition temperature: 700-800°C
Composition: Mineral and organic components of natural origin, VOC-free, in compliance with applicable chemical and environmental regulations
Oil binding capacity: Baseline: 1 liter oil = 1.2 kg Exoline Oil Stop
Adsorption capacity: 0.3-0.5 kg oil per kg Exoline

LOW-COST ENHANCEMENT PARAMETERS:
Dosage: 10–15% by weight of saturated absorbent
Mixing: Mechanical 5–10 min / Manual 15–20 min
Dwell time: 1–4 hours before packaging

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Regulatory support (UN classification, ADR compliance)
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EXOLINE ABSORBENT ENHANCEMENT
Upgrading Conventional Materials to Circular Economy Standards