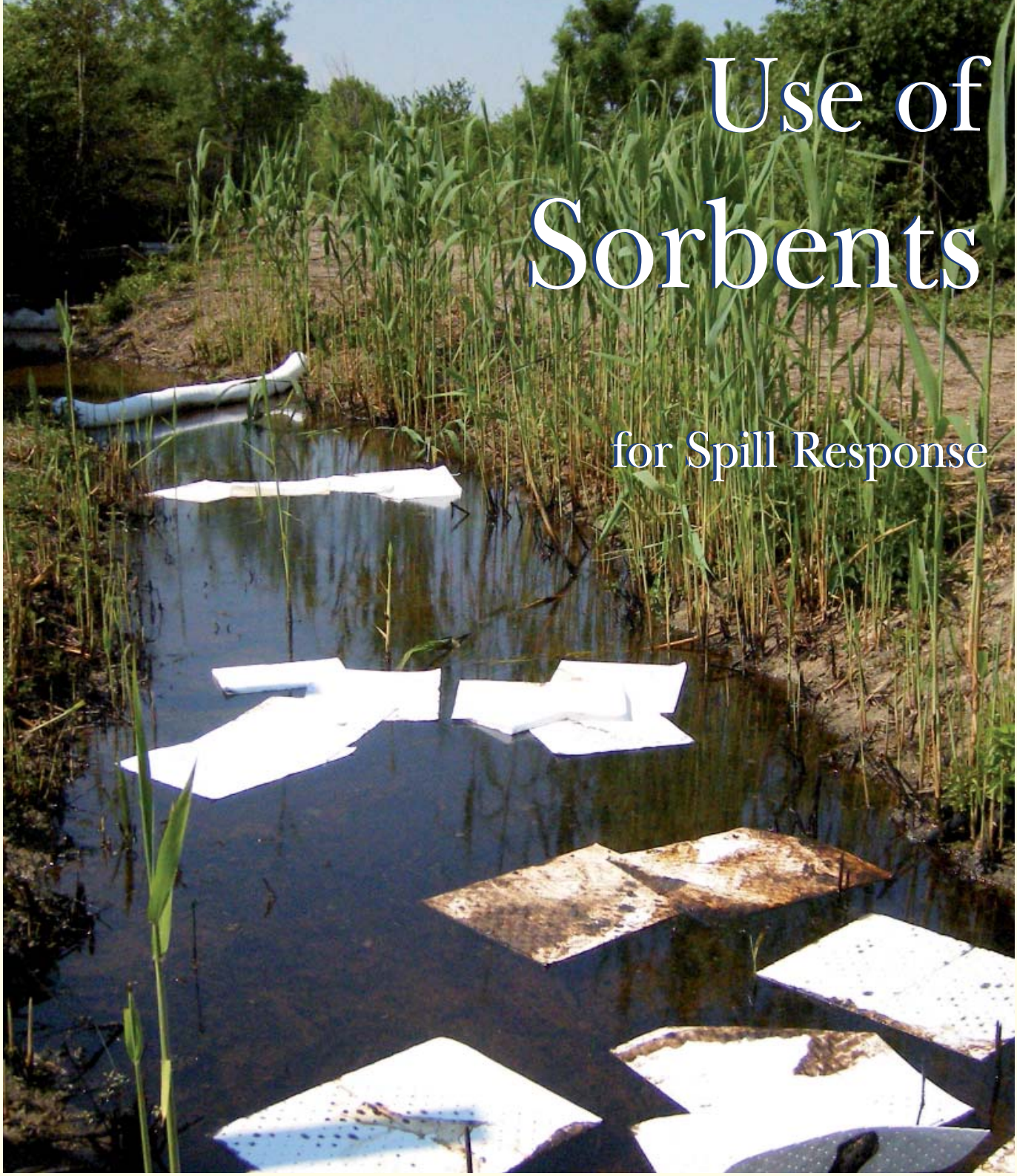

Use of Sorbents

for Spill Response

OPERATIONAL GUIDE

Cedre

Cover photo:
Sorbent pads and boom in a marshland channel
Source: Cedre

Use of Sorbents

for Spill Response

OPERATIONAL GUIDE

This guide was produced with financial support from the Maritime Affairs Directorate, Total and the French Navy.
It replaces the guide published on this subject by *Cedre* in 1991.

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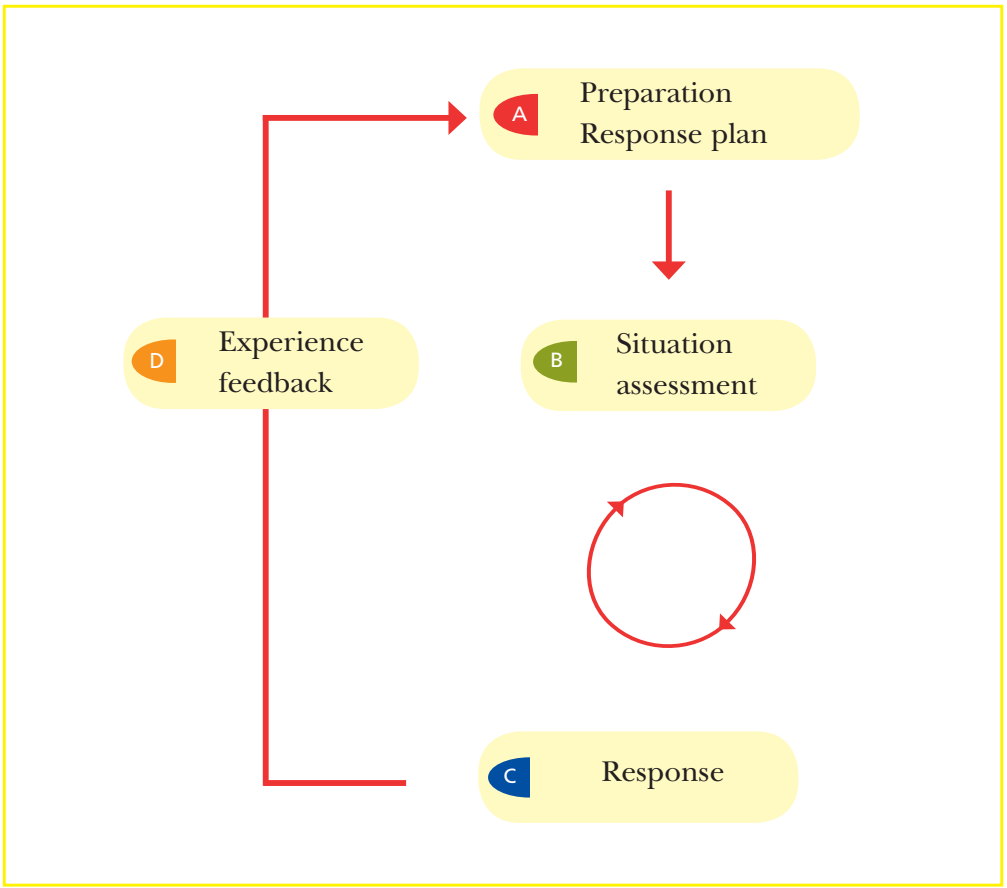
Purpose and structure of this guide

The distribution of the results of studies, experiments and feedback from accidents in the form of operational guides is an important part of *Cedre*'s activities, emphasised by its strategic committee.

This publication on the theme of sorbents is an update of the guide "Practical instructions manual for floating absorbents" from 1991. It seemed necessary both to our specialists and our operational partners to update this guide in the light of the evolution in practice and knowledge of the subject, structuring the information according to an operational approach (see diagram below).

The guide is aimed at operators liable to use sorbents as part of response operations to accidental oil or chemical pollution.

The contents of this guide remain very practical. It provides information on sorbent types, specifications, particularities, regulations, deployment techniques, waste disposal and precautions of use.



Operational organisation

Contents

Preparation
Response plan

A

Why use sorbents?

Sorbents are solid products capable of trapping liquid pollutants.

Sorbents are used to:

- reduce the spread of a spill of pollutant
- fix a pollutant by impregnation to facilitate its recovery for small spills
- recover the pollutant from effluents generated by clean-up operations
- filter pollutant that cannot be recovered from a water mass (channels, rivers, water intakes and washing effluents).

Sorbent pads and booms used to reduce spreading and recover the pollutant

⚠ In terms of waste management: it is more difficult to dispose of a mixture of oiled sorbents than pure pollutant. See p41.

How do sorbents work?

A2

The pollutant is fixed on the sorbent by two processes:

- **adsorption: retention of the pollutant on the surface of the sorbent**
- **absorption: retention of the pollutant within the sorbent itself.**

This guide refers to sorption without differentiating the two processes.

Furthermore, the sorbent acts as an obstacle to spreading and therefore constitutes an additional containment means.

When in contact with a pollutant, the sorbent soaks up the pollutant like a sponge. The "sorbent + pollutant" mixture is then recovered.

If the sorbent is **far from saturated with pollutant**, the pollutant has a good chance of being definitively fixed.

If the sorbent is **saturated with pollutant** (or nearly), the pollutant may not be completely fixed. Part of it may therefore be released when subject to stress: pressure, twisting, run-off...

If the pollutant is a **fluid product** (e.g. light refined diesel), impregnation is rapid (a few seconds to a few minutes) but retention is less effective (risk of re-emission).

If the pollutant is a **viscous product** (e.g. heavy fuel oil), the pollutant only becomes stuck to the surface by adsorption and is not impregnated.

This phenomenon consequently considerably reduces the retention capacity of the different types of sorbents. For example, sorbent booms will only become saturated at the surface and are therefore mainly used as a containment means. On the other hand, bulk substances have a greater capacity due to their large surface area in contact with the pollutant. Slight agitation or mixing action of the sorbent with the pollutant improves contact, which can be of particular interest in the presence of a viscous pollutant.

Sorbent rolls deployed on a beach

Sorption process

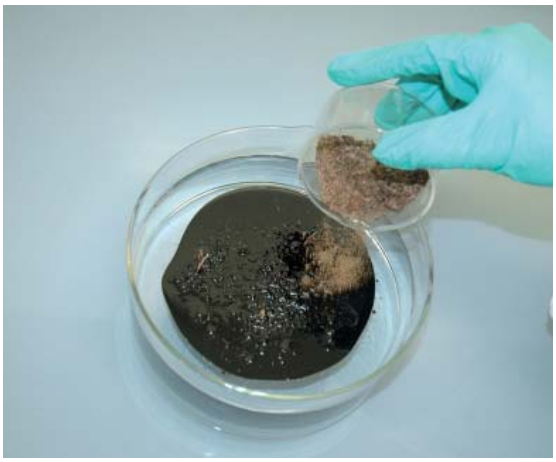
Oil deposited on a tray: impregnation, then recovery using a scraper

1 - Applying the sorbent on the pollutant

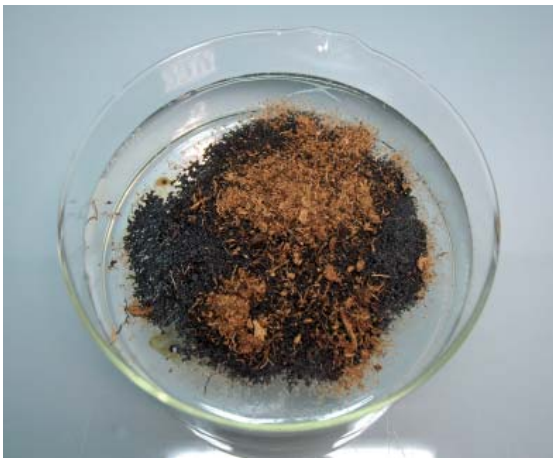
2 - Impregnation

3 - Recovery

Oil floating on water: impregnation, then recovery using a net



1 - Applying the sorbent on the pollutant



2 - Impregnation

3 - Recovery

Photos © *Cedre*

What types of sorbents exist?

A3

According to their constituent matter

There are three main categories of products:

- products of **mineral origin** (e.g. expanded perlite, glass wool...)

- products of **animal or vegetal origin**, possibly fossilised, (e.g. peat, cellulose...)

- **synthetic products** and **organic polymers** (e.g. polypropylene, polyurethane...)

According to their selectivity (hydrophobic - hydrophilic)

(French standard NF T90-362)

For response to pollution on land and on water, there are two main types of sorbents which can be used on liquid pollutants:

- **floating hydrophobic sorbents** (also known as "oil-only sorbents") are designed to recover non-polar pollutants (i.e. non-miscible with water, e.g. oil). These sorbents are light and float. They can be deployed on water or on land.

Recovery of oiled floating bulk sorbents (type A) on water

This type of sorbent can be hydrophobic by nature (e.g. polypropylene) or be treated to be hydrophobic.

⚠ **Never use a hydrophobic sorbent with a surfactant (dispersant, detergent...) as it will lose its hydrophobic capacity, i.e. will also absorb water or any polar liquid.**

- **hydrophilic or "universal" sorbents** are designed to recover polar products (water, substances soluble in water) and non-polar products (non-miscible with water). These sorbents soak up water and do not necessarily float (variable density). They can only be used on land (hard surface).

Recovery of pollutant on land using a sorbent pillow (type D)

Natural organic universal sorbent
- fireproofed wood -

Fossilised organic universal sorbent
- calcium carbonate and magnesium carbonate -

According to their form

(French standard NF T90-362)

Bulk (type A)

Bulk or loose sorbents are products without a shape of their own made up of particles without any links between them. Bulk sorbents are powders or short fibres, of mineral origin (treated substances: expanded perlite, vermiculite...), vegetable origin (treated or untreated substances: sawdust, peat...) or synthetic origin (polymers: polyurethane, polypropylene, polystyrene, epoxy...).

Pads (type B)

Pads or sheets are thin, flexible products (thickness less than or equal to 3 mm) whose length and width, although less than a metre, are far greater that their thickness (ratio of at least 10 between the width/length and the thickness). They are sufficiently resistant to be handled as they are (e.g. felts, polypropylene sheets).

Rolls (type C)

Rolls, also known as blankets, are products which can be up to several dozen metres long. They are usually made up of unwoven fibres (felted).

Particularity: they can be reinforced by a rope (filament). In this case they are often known as sweeps.

Photos © *Cedre*

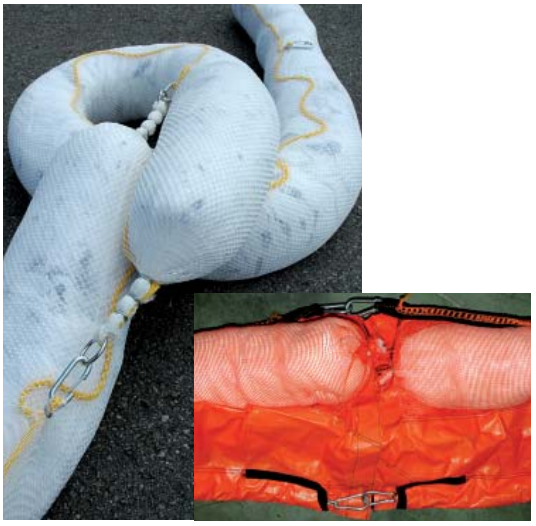
Pillows - Socks (type D)

Pillows, sometimes called cushions, and socks are flexible products in which the absorbent material is contained in a permeable envelope, sufficiently resistant to be handled as it is. The length of this envelope is far greater than the thickness and is less than a metre.

Booms (type E)

Products in which the loose sorbent material is contained in a very oil-permeable tube. The length is far greater than the other dimensions and is in excess of one metre.

Particularity: certain models, designed for use on water, have a "skirt", a flexible ballasted band, which improves their ability to contain a floating pollutant. These products combine the properties of "physical" booms (containment) and sorbent booms (trapping, sorption).



Mops - Pompoms (type F)

These sorbents are made up of thread-like strands joined together to form a light, open structure, suitable for trapping viscous oil e.g. pompoms.

Special products (type G)

Products which do not fit into above-listed categories A to F, e.g. solid block of absorbent material to place under machines to absorb drips.

Photos © *Cedre*

Other types

Sinking sorbents

There exist sorbents with a density higher than that of water. Used on water to treat floating pollution, these sorbents act as sinking agents by fixing the pollutant before sinking. This technique is not recommended as it simply implies transferring the pollution from the surface to the bottom of the water column. Generally speaking, it is preferable to avoid using heavy sorbents on floating pollution.
On land however, these products can be used in the same way as oil-only or universal sorbents.

Sorbents for use on roads

These types of products are designed to be used to clean up oiled roads after an accident.
These products are primarily selected based on safety criteria and are chosen in particular to ensure a sufficient level of road adhesion for vehicles driving over treated surfaces. These products are often high density sorbents like the sinking sorbents described above (e.g. mineral powder).

Biodegradable sorbents

Certain products are presented by manufacturers as capable of trapping a pollutant and ensuring (or accelerating) its biodegradation. These products work by increasing the bioavailability of the pollutant (e.g. increasing the surface area) and/or providing nutritive elements (e.g. nitrogen, phosphorous...) and/or bacterial groups.
The efficiency of these products as biodegraders is not proven and should be tested before use.

Overwintering film

Polypropylene overwintering films, originally designed to protect plants from the cold, can be used as sorbents. Large (up to 100 m), lightweight (around 30 g/m^2) films are suitable for retaining washing effluents containing oil particles on large surface areas.

Geotextiles

Certain polypropylene geotextiles of varying weights (e.g. 90 to 375 g/m^2), which let water through, can also be used as a sorbent on damp ground (e.g. mudflats) or to help recover effluent from clean-up operations. More cost-efficient than sorbents rolls (type C), geotextiles can be used on large surface areas (to protect riprap, to line retention trenches, to form a covered pathway...)

Eel nets

Originally designed for eel fishing, these polyethylene (plastic) nets, sold by 100 m lengths, can be placed on the foreshore in 5 to 10 m sections in order to trap oil in the sea with the tidal movements.

Makeshift sorbents

Makeshift sorbents are formed by assembling materials available onsite in order to trap/absorb a pollutant. These systems are generally composed of locally available vegetal fibres. The material is packed into a makeshift "sock" (e.g. chicken wire, potato sack, net) to make a sorbent boom or filter system. Makeshift sorbents can also be used in bulk to assist recovery (see C8).

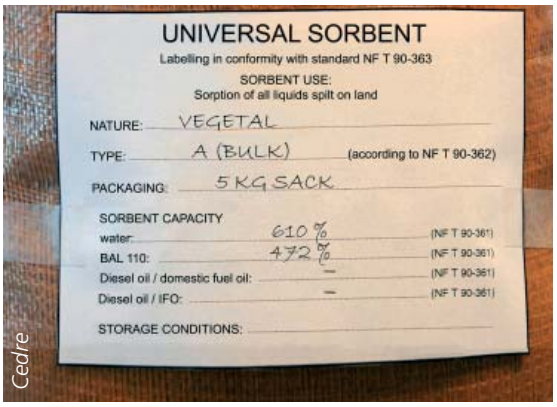
Regulations

In France, 4 technical standards have been established by AFNOR. These standards are the reference in terms of classification, labelling and performance measurements for sorbents.

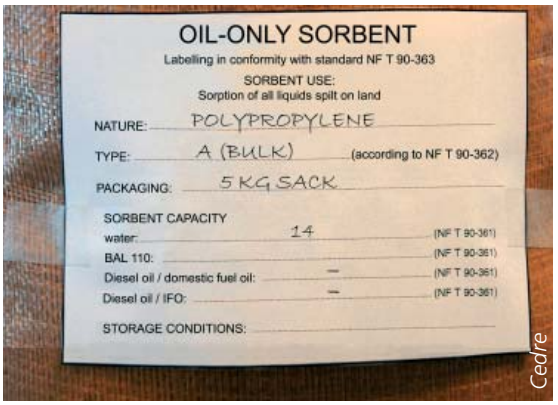
Classification and labelling

NF T90-362 - Response products for water and land pollution - Classification of sorbents - August 1998.
Sorbents are divided into two categories (oil-only and universal) and into seven groups according to their form (see A3), based on the US ASTM standards. In real pollution response situations onsite, this labelling system is the only indicator which can differentiate floating oil-only sorbents from universal sorbents.

NF T90-363 - Response products for water and land pollution - Labelling of sorbents - August 1998.
This standard defines the characteristics and phrases which must appear on the packaging labels of marketed sorbents.



Universal sorbent label



Oil-only sorbent label

▼ Lists of products tested by *Cedre* whose performance has been proven in terms of sorbency and, for floating sorbents, also in terms of hydrophobicity and retention capacities are available from *Cedre*'s website, www.cedre.fr, in the "Response/Response products" section. These lists also include additional information: manufacturer, nature and appearance of the product's constituent matter.

Sorption capacity

Sorbency measurements aim to measure the retention capacities, to compare products and to select the best products.

NF T90-360 - Water trials - Determination of sorbent power - Oil retention capacity - September 1997.
Determination of oil retention capacity of floating oil-only sorbents when saturated.

NF T90-361 - Water trials - Determination of universal sorbent power - September 1997.
Determination of the water and oil retention properties of universal sorbents and/or sorbents for use on land when saturated.

Sorption test for oil-only sorbents **NF T90-360**

This test procedure is used to measure the saturated retention capacity by weight of hydrophobic sorbents on low viscosity oil (10 to 50 cSt).

Sorption test for universal sorbents **NF T90-361**

This test procedure is used to measure the oil (10 to 50 cSt) and water sorption capacity by weight of universal sorbents.

Sorbents for use on roads

Sorbents for use on roads are subject to particular regulations and assessment methods [**NF P98-190** - Equipment and products for road maintenance - Sorbents for use on roads - Specifications, February 2002] in which the safety aspect, in particular road adhesion of vehicles, takes precedent over the sorption capacity.

Use of sorbent on a road

This standard lays out the specifications to be taken into account for these products:

- sorbent power by weight for water (requirement > 66 %)
- sorbent power by weight for oil (requirement = 100 %)
- dust emission (requirement < 10 %)
- adhesion to road surface after treatment (requirement ≥ 90 % of the initial value before clean-up)
- chemical signature of sorbents (mandatory)
- scientific labelling (mandatory).

The "NF Environment" label

"NF Environment" is a label awarded to products according to environmental criteria such as the nature of the product, which must be natural, recyclable and not generate waste, without taking into account the severe constraints for the performance and the sorption rate of these products.

AFNOR extended the "NF Environment" label to "Universal sorbents for use on land" (**NF 336** – December 2001).

However, for spills in the natural open environment, this label is not relevant as it does not target the most suitable products for this type of situation.

In the case of a spill in the open environment, these are the last performance criteria which should be prioritised, as the primary aim is to trap as much pollutant as possible as quickly as possible, before it spreads and infiltrates into the ground.

A5

Right-sizing and managing stockpiles

Sorbents are generally stable products without a use-by date. They should however be stored in a relatively dry place to prevent them from soaking up water and thus becoming less effective for absorbing the pollutant when deployed. This precaution is all the more important if the product in question is not or only slightly hydrophobic.

In order to be prepared to respond to emergencies, it is important to establish a stockpile in advance. The stock should be defined according to the types of incidents with which you are liable to be confronted (scenario studies).

The types of products to choose, the quantities to order, their packaging and their location will depend on the type of pollutant considered, the extent and frequency of response, available deployment means (application, installation, retrieval...) and the possible disposal options for oiled products after use.

Furthermore, *Cedre*'s experience shows that sorbents used intermittently for spill response exercises lose some of their efficiency (do not use all the stock for exercises).

Finally, particular attention should be paid to protecting the stockpile from damage by rodents.

Sorbent stockpile in Le Havre

Situation assessment

In an emergency situation, sorbents can be used on small to moderate spills on the ground, on water bodies, on streams and rivers and in coastal areas.
They are also often used on clean-up sites to recover washing effluents.

When and where can sorbents be used?

Sorbents are used to assist recovery in the case of small spills on water or on land, or as filtering materials.

Main uses of sorbents:

- static and dynamic containment and recovery by rapid deployment in coastal areas, ports and harbours, estuaries and on rivers
- containment of a slick in association with a standard boom (to improve watertight seal)
- protection of areas which are difficult to clean (riprap, reed beds, mangroves...)
- fixing or recovery of a floating pollutant on a lake or in stagnant waters
- rapid application on a spill on the ground surface to prevent, or at least reduce, infiltration of the pollutant
- sorption of leaks below a recovery worksite
- sorption of effluents from clean-up of rocks, structures, embankments
- sorption by filtration of pollutants in suspension in the water column (water intakes, rivers)
- clean-up or decontamination of personnel and equipment on clean-up sites
- lining and protection of pathways.

⚠ **Each of these uses requires the choice of one or more types of sorbent** (see C1 and C2).

Mops used to fix oil contained in effluents on a clean-up site

Sorbent booms

Selection criteria

Retention capacity by weight

This is the quantity of pollutant that can be fixed by a given quantity of sorbent.
This value should be determined accurately, using a laboratory method, in controlled conditions on a referenced oil (standards NTF T90-360 and NTF T90-361 used in France) (see A4).

Theoretical price per litre of pollutant treated

For each product, it is possible to determine the theoretical price per litre of pollutant treated (efficiency criteria to compare sorbents) by combining the retention capacity by weight with the price of the sorbent:

$$\frac{\text{sorbent price (€/kg) x pollutant volumic mass * (kg/l)}}{\text{sorbent retention capacity by weight (kg/kg)}}$$

Retention capacity by volume

For each product, the retention capacity by weight should be converted to volume, taking into account the apparent density of the sorbent.
This retention capacity by volume can be calculated by combining the retention capacity by weight with the volumic mass (density) of the sorbent and of the oil:

$$\frac{\text{sorbent retention capacity by weight (kg/kg) x sorbent volumic mass (kg/l)}}{\text{pollutant volumic mass* (kg/l)}}$$

Given the inaccuracy associated with the apparent density, this value is not exact, but allows operators to estimate the volume of sorbent needed to treat a given quantity of pollutant, and thus to anticipate the logistical implications involved in the use of a given sorbent.
For instance: if 3 m^3 of sorbent is needed to recover 1 m^3 of oil, the logistics will have to be adapted to deploy, recover and store the 3 m^3 of sorbent used.
This assessment should be conducted taking into consideration the apparent density of sorbent in its packaging (e.g. in sacks).
A good product should have a minimum sorption capacity by weight (pollutant/sorbent) of 5 for types A, B and C, and of 10 for types D and E. In terms of volume, the retention capacity should be at least 0.5 (generally between 0.5 and 1). Certain compressed sorbents, due to their packaging, can present values greater than 1.

Hydrophobicity of oil-only sorbents

Oil-only (hydrophobic) sorbents can be used on non-polar pollutants (i.e. non-miscible with water, in particular oil). They must be hydrophobic to be used in the presence of water (e.g. treatment of oil slicks on water) and to be able to be stored in a damp environment. The sorption of water diminishes, or can even eliminate, a hydrophobic sorbent's retention capacity for oil pollutants. In order to prevent this, these products should be either hydrophobic by nature (e.g. polypropylene fibre), or treated to be hydrophobic (surface treatment with paraffins, silicons...).

* Take 0.9 as a mean value

Non-hydrophobic products ("universal" sorbents) can only be used on land (e.g. to trap oil under equipment or stop a stream of polar or non-polar pollutant.

Particle size of bulk sorbents

For bulk sorbents (type A), texture and particle size can be important criteria for deployment, both in terms of applying the product and recovering it after impregnation.
Too fine a product can produce dust which may cause respiratory difficulties for operators and require a respiratory protection mask to be worn (valve respirator, dust mask) (see C10). Furthermore, the particle size must be compatible with the mesh or geometry of recovery means (scoop nets, suction units...) you plan to use to recover the product after impregnation.
A fibrous bulk product, whose fibres easily hook onto each other to form clumps, can prove difficult to project or spread on the pollutant but, on the other hand, easier to recover than a product with "fluid" behaviour.

Bulk sorbent

Resistance and size of conditioned sorbents

For conditioned sorbents (types B, C, D and E), the resistance of the product, when dry or impregnated with pollutant, must be sufficient to recover it without it tearing.
The dimensions and resistance of sorbents must be compatible with their anticipated use:

- the size of pads and small pillows should ensure easy recovery according to the selected method, their resistance should be sufficient (e.g. for recovery after impregnation);
- the length and resistance of a sorbent roll are important for use across a stream or river. In this case, the presence of a rope (filament, bolt rope) along the length of the roll to reinforce it and attach it at each end can be very useful.

Sorbent pillow

Sorbent roll equipped with a filament (or bolt rope)

Nature of the sorbent

The nature of the product must be compatible with the envisaged usage.
Some basic information is needed:

- estimate, in the case of chemical pollution, the **compatibility** between the sorbent and the pollutant(s) involved
- plan possible methods of **disposal** and consider their consequences (e.g. in the case of incineration, consider the types of fumes resulting from the combustion of the sorbent itself).

Projecting bulk sorbent onto water (right-sizing volumes of sorbent).

Packaging

The conditioning, packing and packaging (volume, resistance, durability...) must be suitable for the anticipated use of the sorbent and storage conditions.

Case of bulk products (type A)

For products delivered in sacks, it is important to consider:

- the dimensions and resistance of the packaging to facilitate handling operations for use
- the type of packaging: to prevent compaction and crushing of foam-based products which would decrease the sorption performance of the product (rigid packaging required).

Sorbent boom, rolls, pads, bulk sorbent and sorbent boom with ballasted skirt

Operators containing oil around a skimmer using sorbent booms

Response

Choosing sorbents for spills on land

⚠ In the absence of water, sorbents do not necessarily need to float or be hydrophobic. Universal sorbents can be used.

	Fluid pollutant (light refined product, light crude oil, chemical product...)	Viscous pollutant (cold heavy fuel oil, weathered emulsified crude oil...)
1 Leak from equipment	Place pillows (D) or pads (B), or possibly rolls (C), under the leak or a boom (E) around the equipment.	Use bulk sorbent (A) or sorbent pads (B), or even rolls (C).
2 Run-off on the ground	According to the width, stop run-off using booms (E) or pillows (D). Spread bulk sorbent (A) or sorbent pads (B) upstream to reduce infiltration into the ground.	According to the width, stop run-off using booms (E) or pillows (D). Spread bulk sorbent (A) or mops (F) upstream of the boom (mix to promote impregnation).
3 Puddle	Spread bulk sorbent (A) on the puddle and scrape away after impregnation, or apply pads (B) or rolls (C).	Spread bulk sorbent (A) on the puddle, mix and scrape or wipe with mops (F).
4 Accumulations in cracks	Soak up the pollutant with pads (B) or pillows (D).	Recover the pollutant with mops (F).

Choosing sorbents for floating spills on water

⚠ In this case, pollutant are non-polar, non-miscible with water and mainly oils.

	Fluid oil (light refined product, light crude oil...)	Viscous oil (cold heavy fuel oil, weathered emulsified crude oil...)
1	In open water with no current	
	Protection/containment: - Standard floating boom or sorbent boom (E)*, failing which, sorbent rolls (C) reinforced by a rope. **Recovery:** - Pads (B), pillows (D) and bulk (A).	**Protection/containment:** - Standard floating boom or sorbent boom (E)*. **Recovery:** Mops (F), bulk (A).
2	In open water with current	
	Protection: - Smooth surfaced embankment: Sorbent boom (E)*, pads (B) or pillows (D). - Rough surfaced embankment: Sorbent boom (E)* or roll (C). **Containment / deflection / recovery:** - Slow current (< 0.2 m/s) and small quantities of pollutant: sorbent rolls (C) reinforced by a rope stretched across the current. - Stronger current, in large water body: standard floating boom or sorbent boom (E)*, failing which, sorbent rolls (C) reinforced by a rope. Deflect the pollutant towards a sheltered site or let it be carried by the current to then carry out recovery as in part 1 (above).	**Protection:** - Sorbent boom (E)* or roll (C), or even mops (F) if current is slow. **Containment / deflection / recovery:** - Standard floating boom or sorbent boom (E)* or, failing which, mops (F) attached to a rope. Deflect the pollutant towards a sheltered site or let it be carried by the current to then carry out recovery as in part 1 (above).

* equipped with a ballasted skirt

C2

Deploying bulk sorbents (type A)

These products can be used in a wide variety of situations, on land and on water. Their divided form gives them a **large surface area** which will come into contact with the pollutant, promoting their impregnation even if the pollutant forms a thin layer or scattered slicks, which may be difficult to access. Do not forget that the polluted sorbent must be recovered after use.
When the absorbed pollutant is viscous, bulk sorbents often tend to form agglomerates after impregnation. These clusters of impregnated particles however show low resistance and are easily broken up when subject to stress (effort, agitation, mixing...)
When floating sorbents are used on open water (sea, lake...), the impregnated particles (or agglomerates) tend to spread, and the more the water is agitated, the quicker the product will spread. This dispersal can make their **recovery delicate**. It may be advisable to deploy containment systems (floating booms) and to avoid applying sorbents in the presence of too strong winds.

Application of bulk (type A) sorbents
according to their particle size (granulometry)
"d" being the average dimension of sorbent particles

d > 30 mm - very coarse particles
- Projection difficult, or even impossible, with existing systems
- Recovery possible with nets (e.g. trawl net), impossible using usual pumping means, except potentially a vacuum truck

10 mm < d < 30 mm - coarse particles
- Projection possible with a blower (only if density < 0.4)
- Recovery possible with nets (e.g. trawl net) and with moderately sized vacuum pump systems

5 mm < d < 10 mm - moderate particles
- Projection possible with usual equipment (only if density < 0.4)
- Recovery possible with nets (e.g. trawl net) and compatible with most pumping equipment without a valve

1 mm < d < 5 mm - fine particles
- Projection possible with usual equipment
- Recovery impossible with large nets (e.g. trawl net), but possible using finer mesh scoop nets or usual pumping equipment

d < 1 mm - dust
- Projection is a delicate operation, especially in windy conditions
- Recovery only by pumping

How to apply bulk sorbents

By hand

Only if the pollution is very limited. This method generally does not ensure equal distribution of the sorbent and proves rather unsuitable when the pollution is spread out.

Using blowers

These are centrifugal ventilators which suck up the product and project it onto the spill. These systems have the advantage of homogenising the sorbent (breaking up any clumps or clusters), sometimes increasing the volume (expansion) and above all equally distributing the sorbent on the spill.

This mode of application is not suitable for sorbents with a high apparent density (in particular mineral sorbents) or fine-particle products producing large volumes of dust.

Low density products must be dispersed **in the direction of prevailing winds**.

⚠ **A lot of bulk sorbents are pulverulent and produce dust and airborne particles when handled. Provide dust masks and goggles for operators (protection of respiratory tract and eyes,** see C10**).**

Applying sorbent using a blower

Using hydroejectors

In the case of hydrophobic floating sorbents, venturi systems, often borrowed from fire fighting stockpiles (e.g. modified foam fire hoses), are used to project the product **with a pressure hose**. These systems have the advantage of preventing dust, partially overcoming difficulties caused by the wind and creating, due to the weight of the falling water, agitation which can promote contact between the sorbent and the pollutant. However, the sorbent, in contact with water, tends to **become wet** (even if it is hydrophobic), which can significantly reduce its sorption capacity.

Applying sorbent using a hydroejector

Using nets

In certain cases, on water, bulk sorbents can be used to fill a net used to trap the pollutant as the net is trailed through the water.

Small recovery boat using a net filled with sorbent

How to recover bulk sorbents

After impregnation, sorbents can be recovered:

On land

- by scraping with a spade or other manual tools
- by suction using a suction unit or vacuum system.

Suction units

On water

- using nets, from small scoop nets to large nets (e.g. surface trawl nets).
  To guarantee good retention of the sorbent in the net, the particle size of the sorbent should be greater than the net mesh size.

Scoop net

Surface trawling

- by skimming using floating skimmer heads or belt or weir skimmers, making sure that the pump connected to the skimmer tolerates solids the size of the oiled sorbent: peristaltic, vacuum or lobe pumps.

Weir skimmer

⚠ These are general rules. It is essential to check the compatibility of the sorbent with the available recovery means.

Deploying sorbent pads and rolls (types B and C)

On land

Place the sorbent in direct contact with the pollutant. Take action as rapidly as possible to prevent infiltration into the ground.

In open water or a basin, with no current

The sorbent is **placed on the pollutant** then recovered after impregnation, either by hand or using forks, rakes or other tools.

If impregnation is insufficient, agitation can be simulated to force the pollutant to come into contact with the sorbent.

In certain cases, it can be useful to set up a floating boom to contain the pollutant, improve sorbent/pollutant contact and facilitate recovery of the sorbent.

Sorbent pads and floating boom

In open water with current

In the absence of a containment system to maintain the pollution in a given area, it is preferable to use sorbent rolls (type C) which, when stretched across a slow current (< 0.2 m/s), can trap small leaks of floating surface pollutant. To do so, prioritise the use of sorbent rolls reinforced with a rope (filament).

Sorbent rolls and pads

For rock and surface clean-up operations

During clean-up, the sorbent is placed at the foot of the structure being cleaned to absorb traces of pollutant present in the washing effluent or on the surface of water which is channelled into a trench specially dug to collect effluents.

Deploying sorbent pillows and booms (types D and E)

On a small scale, sorbent pillows and booms (types D and E) are easier to use than bulk sorbents (type A) but are more costly. Given their relatively compact form, these products are more suitable for fluid pollutants (e.g. light refined products) which can be soaked up rapidly and completely. For viscous pollutants, impregnation may be only superficial, especially if the pollutant/sorbent contact conditions are poor (small contact surface area or short contact time).

On land

The boom or cushion is placed across the run-off.

Sorbent booms to catch run-off

In open water or a basin, with no current

Place the sorbent in contact with the pollutant. However, when these products are compressed, it is difficult for the pollutant to become impregnated in the core of the sorbent.

These sorbents are very light and may therefore need to be lightly ballasted so that they sit deep enough in the water, in particular to act as containment means.

In open water with current

In the presence of current, sorbent booms are not always very suitable, especially when they have no ballast. They can be used in association with standard booms to contain the pollutant which can then be trapped by the sorbent. To use several sorbent booms placed end to end, they must be tightly connected in order to prevent gaps between boom sections through which the pollutant could escape.

Interconnected sections of sorbent boom

For rock and surface clean-up operations

During clean-up, the sorbent is placed at the foot of the structure being cleaned to absorb traces of pollutant present in the washing effluent which is channelled into a specially dug trench.

Sorbent booms, pads and mops

Deploying sorbent mops (type F)

Sorbent mops (type F) are used to **manually recover small quantities of viscous to highly viscous pollutant.**
For these sorbents, the pollutant is not trapped by absorption but simply by the adherence of the viscous pollutant to the mop fibres (adsorption).

These products are mainly used to rapidly recover the main part of small patches of pollutant, often highly emulsified, arriving on the shoreline or small accumulations trapped in cracks in rocks or deposited around a puddle.

On land
Mops are applied manually to the pollutant. It is advisable to mix the mop with the pollutant to promote adsorption (adherence).

Sorbent mops

In open water or a basin, with no current
In the same way, mops are used to capture pollutant at the water surface in addition to sorbent booms (type E). In this case, they are deposited separately on a contained water surface or attached side by side along a rope upstream or downstream of the boom, whether standard or sorbent (type E). They are recovered manually or using a fork, boathook or rake.
They are used in filtration operations to trap oil particles contained in large volumes of water. In this case, they are positioned successively at different stages along the water flow.

Sorbent mops and booms

In some cases, it may be possible to re-use the same sorbent several times by extracting the pollutant by wringing out the sorbent between uses. This practice is however not the easiest and is therefore uncommon.

C6

Examples of use

Rock and hard surface clean-up

The aim is to recover a pollutant (e.g. oil) mixed with washing effluent.

The base of the rock (or structure) is in the water

Surround the worksite with floating boom and/or sorbent boom (type E). Recover the pollutant on the water using pads (type B).

Sorbent booms and pads

The base of the rock (or structure) is dry

Dig a trench (or construct a bund) to receive washing effluent (water + pollutant) and recover the pollutant in the trench as for contained floating slicks.

If it is not possible to dig a trench (or construct a bund), filter the effluent by passing it through a sorbent which will retain the pollutant. In this case, the sorbent must show good hydrophobicity and have a large contact surface area.

It is possible to use sorbent booms, possibly ballasted (type E), pillows (type D), to construct a bund composed of bulk sorbent (such as polypropylene strands, also known as spaghetti) or to use mops (type F) on viscous products.

Retention trench for washing effluents, protected by geotextile

Filtering effluent

Sorbents can be used to remove traces of a non-miscible pollutant (e.g. oil product) from a flow of effluent.
Among these filtrating materials, the most appropriate for building makeshift dams are large fibres (also known as "spaghetti"), loose coarse flakes or natural fibres (such as straw, sisal, kapok, bagasse...).

A filtration unit can be created to:

- filter contaminated water from waste water discharge, whose flow rate can be controlled. This unit is composed of a receptacle (e.g. a 50 or 100 litre bin) with a pierced base to let the water out after passing through the sorbent
- filter run-off (e.g. washing effluent) Filtrating strips can be built and placed flat on the ground to capture a large part of the pollutant before releasing the effluent into the natural environment. It is possible, in this case, to directly employ manufactured products (booms, pillows, pads) or to hand make makeshift arrangements using filtering materials contained in a mesh structure (chicken wire, potato sacks, eel nets, overwintering film...)
- filter a watercourse (stream, channel, river, rainwater drainage system...). The process is the same as described above. The systems will therefore be designed based on the same principle, in order to build a vertical barrier stretching across the flow. In order to reduce pressure loss created by the system, it is preferable to set up the barrier at a significant angle (45° or more) in relation to the water flow direction. This increases the surface area of the filter system without reducing the flow rate.
- protect channels, basins, supply pipes, water intakes for shellfish and oyster farms or thermal installations, run-off drainage channels... In this case, the systems are designed based on existing infrastructures (concrete pipe, stone channels or embankments, pumping wells...) and must therefore undergo a study with a view to integrating the system into the architecture of each site.

Filtration system for industrial discharge

Makeshift filtrating dam

Deploying makeshift sorbents

In addition to manufactured sorbents, spill responders may choose to used so-called makeshift sorbents: products designed for another use but which have useful sorbent/filtrating properties. In the vast majority of cases, these makeshift sorbents are made of vegetation which is locally available, or even directly scythed on the response site.

Among the most common materials used as makeshift sorbents are:

- **straw**, **broom**, **rushes**, **heather**, **reeds** and **dry ferns** in temperate environments
- **bagasse** (sugarcane residue), **sisal**, **kapok** and **bamboo** in tropical environments.

This vegetation can be used loose to trap the pollutant and form an agglomerate which is easy to recover using scoops for instance. It can also be used directly in the conditioned form in which it comes (straw bale, bale of sisal fibre), or custom-conditioned in an "envelope" (wire, net, geotextile...) in the form required by the response team (cylinder for a surface boom, cone for filtering a water intake, stopper for filtering run-off...)

The hydrophobicity of these materials is limited and they therefore tend to become ladened with water and submerged, thus requiring frequent renewal. Due to the weight of such systems when saturated with water, it is preferable to build small sections which operators will be able to handle after water absorption. These systems are linked together, and then disconnected for retrieval.

The oleophilic nature of these makeshift sorbents is limited, and their efficiency is mainly dependent on their ability to trap pollutant between their fibres. If the pollutant is fluid (light crude oil, fuel...) and may pass through the system, it can be advisable to spread bulk sorbent upstream in order to form an agglomerate which will be more easily trapped than the liquid pollutant alone.

Installing a filtrating dam made from straw, branches and wire

Building a makeshift boom: wire, geotextile and bagasse

Makeshift boom surrounded by wire

Reed boom

Installing a straw dam on a river

Makeshift boom on water

Filtration system made of straw on an outflow pipe

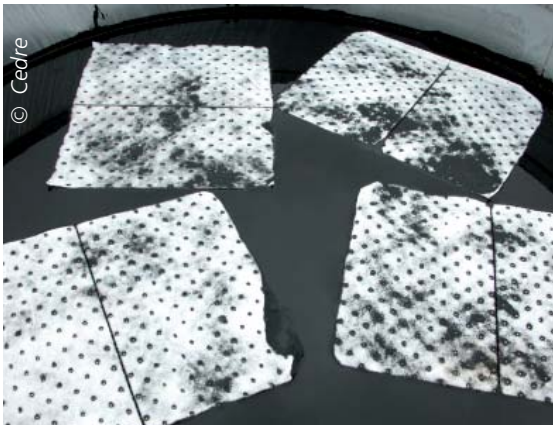
Photos © Cedre

What quantities of sorbent are needed?

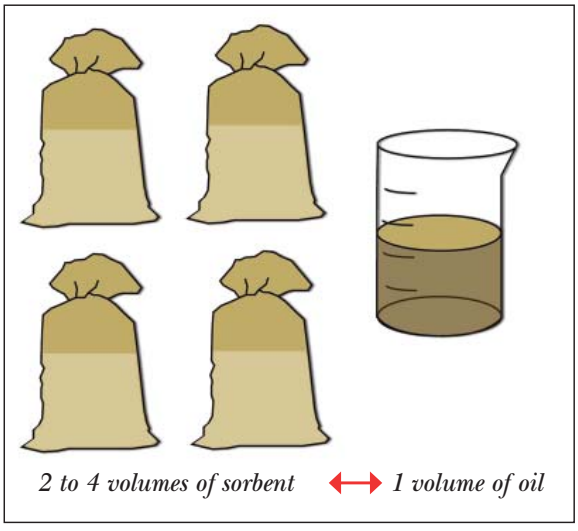
In optimal treatment conditions, sorbents (acting like sponges) can absorb up to their own volume, but often absorb much less.
In the case of bulk sorbents (type A), the expanded volume after projection should be taken as the reference volume.
The retention value by volume can be calculated from the laboratory-measured retention value by weight (see B2).

During real operations in which the pollutant/sorbent contact conditions are not as favourable and saturation of the sorbent must be prevented to ensure total retention of the pollutant (to prevent subsequent release), the quantity of sorbent used should be doubled or even quadrupled.

For practical reasons, the use of sorbents therefore applies to small spills (a few dozen cubic metres at the most).
Practically speaking, enough sorbents must be applied to absorb all the pollutant (no visible free pollutant). It is worth using slightly more than is strictly necessary to ensure that the sorbent does not reach saturation point (no leakage) and is not liable to release pollutant when handled.
Furthermore, for floating oil-only sorbents used on water and remaining in contact with water for a long period of time, it is advisable to check that the sorbent has not become gradually impregnated with water. In this case, it must be changed as its ability to absorb non-polar liquids (e.g. oil) will be reduced if not completely lost.



Sorbent pads



Quantities of sorbent to use *(see B2)*

What precautions must be taken?

Protecting operators

When using bulk sorbents (type A), operators should be provided with personal protective equipment (PPE):

- dust mask
- goggles
- protective suit
- gloves.

These sorbents can be pulverulent and generate dust which can be irritating for operators.

The same problem can be encountered with certain sorbent pillows and booms (types D and E) if the envelope allows the pulverent material inside to escape.
Similarly, it is advisable to check that there is no allergy risk for operators due to the sorbent product used.

Never use a floating sorbent (oil-only sorbent) with a surfactant (dispersant, detergent...) as it will lose its hydrophobic capacity, i.e. will also absorb water or any polar liquid.

Before using a sorbent on a given pollutant, it is essential to check that the chemical characteristics of the sorbent are compatible with the pollutant (no dissolution of the sorbent by the chemical, no reaction between the two...).
After sorption, the mixture of sorbent and chemical will usually present the same dangers as the original chemical: flammability, toxicity, corrosion. **Waste must therefore be handled with care and its disposal method chosen accordingly**: do not hesitate to consult manufacturers or specialised technical organisations (see C11).

Application of peat by operators wearing suitable PPE

Personal protective equipment

All the dangerous aspects of the sorbent impregnated with pollutant must be taken into account when transporting these dangerous goods, and ADR, RID, ADNR and IMDG regulations in force must be followed.

How are oiled sorbents disposed of?

The disposal methods of sorbents after use are varied and depend on:

- the nature of the pollutant
- the nature of the sorbent
- saturation with pollutant
- saturation with water
- the presence of other mineral matters (e.g. sand) or organic matters (e.g. algae) with which the pollutant may be mixed
- the volume of waste to be treated.

Do not mix oiled sorbent with other types of waste, as it will complicate its disposal.

Incineration

Incineration must be conducted in special industrial waste incineration facilities and according to regulations in force.

However, some cement kilns can also accommodate waste with high oil content.

For small quantities (a few cubic metres), it may be possible, providing a derogation is granted by the authorities in charge of waste management and the treatment unit, to dispose of soiled sorbent in household waste incineration facilities. In this case, the oiled sorbent is added in small quantities to the household waste so as not to affect the functioning of the incinerator.
In all cases, it is important to have accurate information on **the nature of the waste** and **the nature of the sorbent** in order to be able to accurately inform the facility manager therefore preventing potential problems (e.g. production of toxic or corrosive vapours).

Landfill after stabilisation

Once stabilised, some oiled sorbents can be deposited at a landfill site or possibly used as backfill (according to national regulations in force).

In the case of oil, the **pollutant/sorbent mixture must be sufficiently stable** to prevent subsequent release of oil (in particular absence of free pollutant). **Waste stabilisation** can be carried out by thoroughly mixing the waste with quicklime and a highly divided mineral substrate (ash, scoria...). The percentage of quicklime must be at least equal to that of oil, and the waste must contain enough water, otherwise water will have to be added (1 kg of quicklime requires 0.3 kg of water to react).

Quicklime reacts strongly with water and generates a high increase in temperature which allows free pollutant to become fixed (adsorbed) onto the mineral substrate. **Check that the sorbent can withstand this rise in temperature without causing the emission of vapours or toxic or corrosive liquids**...

The waste can be mixed with the quicklime in a mixing machine (cement mixer, drum mixer), in a trench using a hydraulic shovel or in windrows using a rotovator.

The oiled sorbent waste must not evolve over time: the sorbent must be **stable** and insoluble, and the mixture must not contain fractions liable to decay or breakdown (organic matter).

For use as backfill, the oiled sorbent waste must have sufficient mechanical strength.

In the case of chemicals, it is important to seek advice from a specialised organisation, as the disposal methods can be very varied: incineration, neutralisation, stabilisation...

Oiled sorbents in a skip

Lightly oiled sorbent booms

It is more difficult to dispose of a mixture of sorbent and pollutant than pure pollutant (recovered on water for instance). Whenever possible, it is therefore preferable to first directly respond without sorbent using a skimmer, reserving sorbents to finish off the clean-up work.

Who to contact for waste disposal questions

- For all questions relating to the disposal of oiled sorbents, contact the competent authority or organisation in your country of residence.

Experience feedback

Erika spill

Use of filtrating dams and other filtration systems during the *Erika spill*

The shipwrecking of the *Erika* in December 1999 and the oil spill it generated resulted in a major response effort to protect sensitive sites both in economic and ecological terms.

One of the protection methods involved building filtrating dams to prevent the oil from entering salt pans and oyster farms, and ensuring the filtration of water intakes to provide a water supply for these basins.

The protection of salt production sites on the salt marshes of Guérande and Mes involved building makeshift filtrating dams (filled with straw, oyster shells or pozzolana) shielding the entire depth of the water column, as well as more complex filtration systems for water supply intakes.

Although these dams may not be able to stop dissolved oil from passing through, they have the advantage of reducing the spread of the pollution and providing an alternative to time-consuming and costly clean-up operations. The use of multiple retention or containment systems, at the surface, at the bottom and at different levels along the channel or stream needing protected, appears to be the most appropriate and efficient solution.

Filtrating dam made of straw

Experimental filtration system made of oyster shells, straw and pozzolana at the entry to a mudflat

D1

Prestige spill

Protection of shellfish production areas from the *Prestige* spill, Bassin d'Arcachon

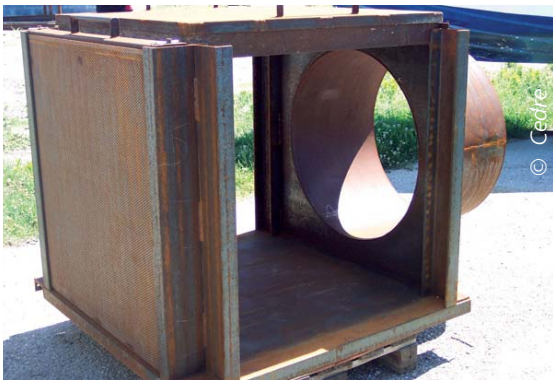
In November 2002, the shipwrecking of the *Prestige* oil tanker caused the second heavy fuel oil spill in French waters in less than 4 years. After oiling the coasts of Galicia, the spill then went on to threaten the coast of the French region of Aquitaine as well as sensitive sites such as the Bassin d'Arcachon.
Shellfish farms located in the Bassin d'Arcachon are supplied with seawater by intakes installed in channels or directly on the foreshore and were therefore threatened by the recurrent arrival of tarballs and patches of oil drifting with the currents. Due to the economic sensitivity of this activity, it appeared indispensable to protect the channels, basins and supply pipes to prevent particulate pollution from entering.

In order to do so, three protection levels were deployed:

- the first level was at the mouth of the channel (for instance some ten metres from the intakes) and was made up of large-mesh nets (approx. 5 cm mesh) designed to retain large floating solid waste and ensure mechanical protection of the second system

- behind this large-mesh net, one or two layers of finer nets (e.g. eel nets) were also set up, in order to catch compact oil slicks pushed by the flow

- a filtration system, set up directly in front of the water intakes, forms the third and last level of protection through filtration by capturing particulate fractions of oil presented in the water column. The pollutant is trapped on a filter made of a mattress of hydrophobic polypropylene fibres ("spaghetti") at least 10 cm thick, installed on a frame placed at the channel entry. Each frame is covered with three filtrating sides (two lateral sides and the front), in which three filtrating drawers can be inserted and extracted from the top. These drawers are made of perforated sheet metal and filled with fibres in the event of a pollution alert.



Filtration system around a water intake (3rd level of protection)

Rokia Delmas spill

Pollutant containment and recovery

On 24 October 2006, the container ship *Rokia Delmas* grounded near the south coast of the Ile de Ré (Charente-Maritime). Attempts to refloat the vessel were to no avail and the authorities decided to order the wreck to be cut up. During these operations, although the different fuels onboard were pumped out of the wreck, a few minor leaks were detected.

The pollution response system, regularly updated by the French Navy according to the progress of operations, promoted the use of sorbents in the confined areas of the vessel: holds, areas of calm water confined by the planking, in addition to skimmers. Sorbent pads (type B), booms (type E) and mops (type F) were used to recover floating traces of oil.

Deploying sorbent mops and booms around the Rokia Delmas

Sorbent booms onboard the Abeille Bourbon

Inside of wreck cut open with sorbents deployed in addition to a skimmer

D3

Ambès spill

Protection of the Garonne, treatment of the pollutant slick and clean-up of marshland channels, pollution in Ambès

On 12 January 2007 at 8 am, a crude oil storage tank on an oil storage depot gave way. The entire contents of the tank, 13,500 m^3 of crude oil, were suddenly released, creating a wave effect causing some 2,000 m^3 of oil to spill over the top of the retention tank. Part of the oil flowed into the drainage system, and then ran into the settler. Another part of the oil flowed out of the depot to pollute the Garonne and nearly 2 km of marshland trenches and channels.
Response to the pollution of the aquatic environment mainly involved protection measures on the Garonne, treatment of the 50 m^3 slick floating on the river and clean-up in the marshland trenches. These operations required the use of large quantities of sorbents in different forms:

- bulk (type A) to construct filtrating booms in the channels and to fill the recovery nets of a small boat
- booms (type E) to reduce spreading and recover oil on the Garonne and in the channels
- pads (type B) to recover oil in the channels, decontamination areas and on polluted ground.

Booms (type E) to reduce the spreading and recover the oil on the Garonne

Pads (type B) used on decontamination areas

Filtrating dam, bulk sorbent (type A) and sorbent boom (type E)

Further information

E

Glossary

Absorption

Properties of certain substances to pick up and retain another substance. Here it implies retention of the pollutant within the sorbent itself.

ADNR

European Agreement concerning the International Carriage of Dangerous Goods on the Rhine river.

ADR

European Agreement concerning the International Carriage of Dangerous Goods by Road.

Adsorption

Physicochemical phenomenon by which a chemical can accumulate on the surface of a solid (at its interface with air or water) and any other gaseous or liquid fluid. Here it implies retention of the pollutant on the surface of the sorbent.

AFNOR

French standardisation association.

ASTM (American Society for Testing and Materials)

American organisation which publishes standards for materials, products, systems and services.

Bagasse

Vegetal residue (e.g. from sugarcane).

Boathook

Pole with a hook on one end.

Bolt rope

Reinforced trim of a sorbent roll, sail or fishing net.

BS (British Standard)

Standard published by the British Standards Institute.

Bund

Construction or earth dyke, possibly held by a stone supporting structure.

CGSB (Canadian General Standards Board)

Canadian organisation which publishes standards.

Effluents

Waste waters or liquid waste released into the water during clean-up operations in spill response.

Emulsion

Mixture of two non-miscible substances (which do not normally mix), such as water and oil, whereby one of the two is in suspension (small droplets) in the other.

Granulometry

Measurement of the dimensions and determination of the shape of particles and grains of a bulk sorbent.

Hydrophilic

Characteristic of a product which attracts and can associate easily with water (polar).

Hydrophobic

Characteristic of a product which has no affinity with or is difficult to associate with water (non-polar).

IMDG code

International Maritime Dangerous Goods code.

Impregnation

Penetration of a substance into another.

Mudflat

Coastal wetland formed by naturally deposited mud.

Non-polar

Characteristic of a product which is non-miscible with water.

Oleophilic

Characteristic of a product which has an affinity for fats, absorbing them selectively.

Perlite

Microscopic constituent of ferrous alloys (Fe3C).

Polar

Product which is miscible with water.

Polypropylene

Product obtained by polymerisation (this terms describes the chemical reaction associated with the production of plastics) of propylene.

Polyurethane

Resin (plastic matter) obtained by condensation of polyesters (or polyethers) with isocyanates.

Pozzolana

Light-coloured, crumbly volcanic ash.

Retention capacity - sorbent power

The retention capacity is the relationship between the mass of oil retained by the sorbent and the mass of the sorbent. The retention capacity by weight corresponds to the maximum quantity in kilos of oil that can be retained by 1 kg of sorbent.

RID

Regulations Concerning the International Carriage of Dangerous Goods by Rail

Saturated retention capacity

The saturated retention capacity is the relationship measured in the presence of excess oil between the mass of oil retained and the mass of sorbent. The saturated retention capacity by weight corresponds to the maximum quantity in kilos of oil that can be retained by 1 kg of sorbent.

Scoria

Solid residues from the fusion of metal ores, the refining of certain metals and the combustion of matters at high temperatures.

Sorbency

Capacity of a product to take up a liquid by sorption.

Sorption

The taking up and holding of a substance through the processes of absorption and/or adsorption.

Viscosity

Resistance of a liquid to flow.

Windrow

Continuous row of hay or grain left on the ground after being cut by a mower or windrower. By extension, long narrow row made with some type of material.

Useful websites

France:

ADEME (French Environment and Energy Management Agency) [online].
Available at: www.ademe.fr (visited on 01.04.2009)

AFNOR (French standardisation association) [online].
Available at: http://www.afnor.org (visited on 01.04.2009)

Cedre (Centre of Documentation, Research and Experimentation on accidental water pollution) [online].
Available at: http://www.cedre.fr (visited on 01.04.2009)

DRIRE (Regional Directorates of Industry, Research and Environment) [online].
Available at: http://www.drire.gouv.fr (visited on 01.04.2009)

NF Mark: NF certification [online].
Available at: http://www.marque-nf.com (visited on 01.04.2009)

SINOE: information, observation, environment. Waste management database. National data [online].
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Other countries:

Canada:
Environment Canada. Sorbent Technology Databases [online].
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Minerals Management Service. Testing and Evaluation of Sorbents [online].
Available at: http://www.mms.gov/tarprojects/180.htm (visited on 01.04.2009)

United Kingdom:
Marine and Fisheries Agency. Oil Spill Treatment Products Approved for Use in the United Kingdom [online].
Available at: http://www.mfa.gov.uk/environment/documents/Oiltreat.pdf (visited on 01.04.2009)

United States:
EPA (Environmental Protection Agency). NRT-RRT Factsheet. Application of Sorbents and solidifiers for oil spills [online].
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AFNOR (Association Française de Normalisation). Essais des eaux - Détermination du pouvoir absorbant tous liquides. Norme NF T90-361. Paris: Afnor, 1997. 8 p. [online]. Available at: http://www.boutique.afnor.org/NEL5DetailNormeEnLigne.aspx?&nivCtx=NELZNELZ1A10A101A107&ts=7587229&CLE_ART=FA045065 (visited on 01.04.2009)

AFNOR (Association Française de Normalisation). Produits de lutte contre la pollution des eaux et des sols - Classification des produits absorbants. Norme NF T90-362. Paris: Afnor, 1998. 8 p. [online]. Available at: http://www.boutique.afnor.org/NEL5DetailNormeEnLigne.aspx?&nivCtx=NELZNELZ1A10A101A107&ts=7587409&CLE_ART=FA046451 (visited on 01.04.2009)

AFNOR (Association Française de Normalisation). Produits de lutte contre la pollution des eaux et des sols - Étiquetage des produits absorbants. Norme NF T90-363. Paris: Afnor, 1998. 8 p. [online]. Available at: http://www.boutique.afnor.org/NEL5DetailNormeEnLigne.aspx?&nivCtx=NELZNELZ1A10A101A107&ts=7587409&CLE_ART=FA046452 (visited on 01.04.2009)

ANNEX: EXAMPLES OF REGULATIONS AND STANDARDS IN DIFFERENT COUNTRIES

Other regulations and standards exist in different countries

In Europe, **Germany** is very advanced in this field. Sorbent products are selected according to a procedure defined by the GMAG expert group (response equipment and means for threats to waters), the working group LTwS (storage and transport of products liable to pollute water) and finalised by the Ministry of the Environment, Nature Conservation and Nuclear Safety.
Publication by the Consultative Committee for the Ministry of the Environment, Nature Conservation and Nuclear Safety, August 1998, entitled: "Requirements applied to oil sorbents" (reference LTwS 27).

Sorbents are classified according to the results of specific tests into 4 types:

- type 1: for use on water
- type 2: for use on the ground or on water for a short contact time
- type 3: for use on the ground only
- type 4: conditioned sorbents used in the same conditions as type 1.

Furthermore, type 4 products are labelled SF when they are in the form of mats or pillows. The reference R is applied to sorbents for use on roads.

Sorbent packaging must also fulfil particular requirements in terms of their colour (Type 1: blue; Type 2: red; Type 3: black; Type 4: green) and in terms of the content of the technical information provided: type and reference, product name, basic constituent of the product, dosage to use, date of manufacture and delivery, safety guidelines for use, instruction of use, distributor's address. Test certificates are valid for 6 years.

See also:

- *Environment* ***Canada***'s work on test methods applicable to absorbent materials (CGSB 25.14, 1996 edition)
- **British** standards: BS 7959-3, 2007 edition, on colour coding of sorbent materials; BS 7959-2, 2000 edition on the determination of water repellency or buoyancy for oil sorbent materials and BS 7959-1, 2000 edition on determination of sorbency
- **US** standards ASTM F 716-82, 2001 edition; ASTM F 716-07, 2007 edition; ASTM F 726-06, 2006 edition, relating to sorbent performance, buoyancy, resistance... Other optional tests (using different test methods) can also be used to check the state of the product, its conservation time... (mould tests, tests of resistance to water and fire).