SDB SYSTEM

Soil decontamination by bacteria

TIBIO Suisse Romande
Chemin de Bérée 4C
1010 Lausanne, CH

OUR
COMPANY & BUSINESS SECTORS

TIBIO is part of the Frattale Group holding company based in Lucerne, Switzerland.

TIBIO's products and services are designed for **environmental professionals**.

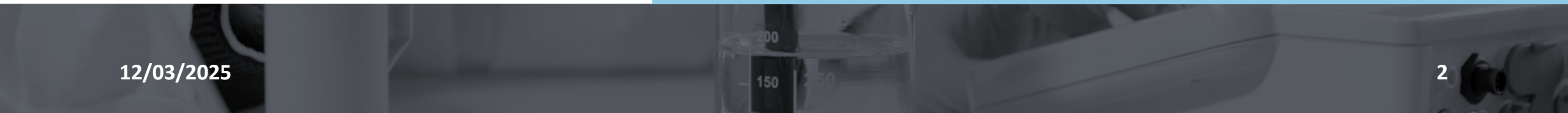
Commercial activities

Environmental biotechnology: biotechnological applications for the treatment and management of pollutants and for the management of public health problems

Chemicals: development of solutions for treating pollutants (absorbent polymers)

Green chemistry & Microbiology: chemical reactions using enzymes and micro-organisms

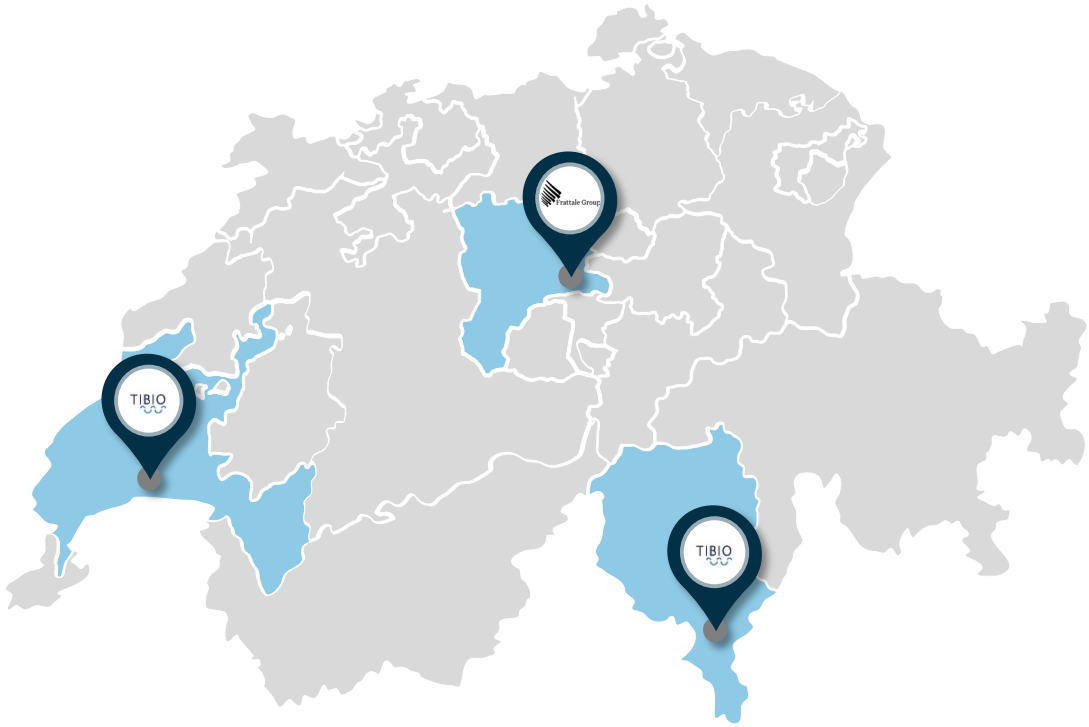
Scientific support & Due Diligence: support for environmental professionals



LA
COMPANY MISSION

SUSTAINABILITY

We are firmly convinced of the need to move towards industrial applications that maintain and enhance quality of life while **minimizing** or even neutralizing **environmental impacts**.



OVER 15 YEARS OF INTERNATIONAL EXPERIENCE

SDB SYSTEM
SOIL DECONTAMINATION BY BACTERIA

ISSUES & REGULATORY CONTEXT

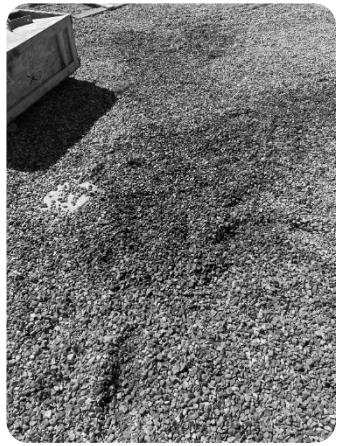
In Switzerland, the policy of rehabilitating and treating polluted sites dates back to the 1990s. The cantons and the Confederation (DDPS, FOCA, FOT) set about drawing up their cadastres of polluted sites. The authorities define how soil pollution is to be removed **on a case-by-case basis**, taking into account **available techniques**.

In the event of contamination, the soil must be **treated and/or monitored in** accordance with the Ordinance on the Remediation of Polluted Sites (OSites).

SDB SYSTEM
SOIL DECONTAMINATION BY BACTERIA

Obligation to **treat pollution**

It very often leads to the excavation and replacement of polluted soil. This solution is very costly and requires site closure and complex civil engineering works, particularly in urban areas, difficult-to-access zones and protected areas.



Pollution monitoring obligation

This is a costly operation that requires constant dialogue with local authorities and can prevent sites from being rebuilt.

The application of **sustainable** land **treatment and reclamation solutions** is increasingly encouraged by the authorities, and the **SDB SYSTEM** bioremediation solution is one of them.

SOLUTION

Apply to **permeable surfaces (plants, fill, soil)** and **low-permeability** surfaces **(rock, cement, metals)** contaminated by **hydrocarbons and their derivatives**.

A **100% organic solution** that complies **with current requirements**.

Avoids **costly** civil engineering work.

A SWISS TECHNOLOGY DEVELOPED BY

SDB SYSTEM
(NON-EXHAUSTIVE) LIST OF POLLUTANTS - SOIL

POLLUTANTS COMPATIBLE WITH THE STANDARD SDB SYSTEM SOLUTION

- Light and heavy aliphatic hydrocarbons, type **C5-C10** and **C10-C40**
- **BTEX**, **ETBE**, **MTBE** and **halogenated compounds**
- Polyaromatic compounds, **PAH** type
- Chlorinated compounds, **PCB** type
- **Siloxanes** and **synthetic oils**

TIBIO is constantly developing new solutions for the treatment of complex pollution:

- By selecting new strains of bacteria and enzymes,
- By combining its biological solutions with those of trusted partners (phytoremediation, mycoremediation, etc.).

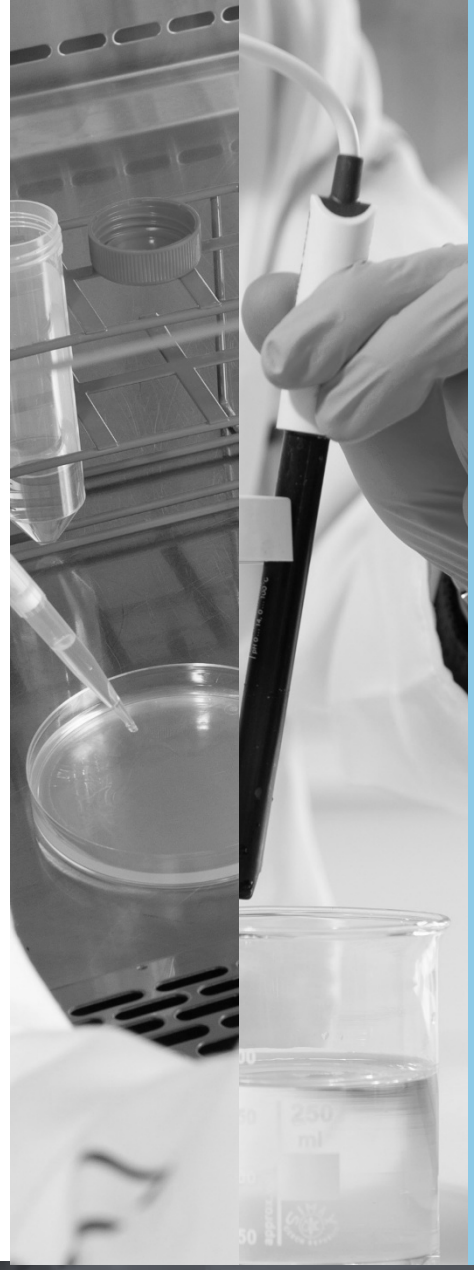
Example: Ongoing pilot project on dioxin degradation with the Canton of Vaud - Switzerland.

BENEFITS

COMPETITIVE

HIGHLIGHTS

- **Biodegradation of transformer oils**: a market first
- Solution based on a **patented approach** with highly selected bacteria
- **Turnkey solution** that can be implemented in the toughest environments
- **Safe** for people and the environment: no toxic or hazardous substances
- Minimally invasive intervention in the ground for effective operation over several months
- **Increase in land value** after treatment
- Possibility **of rebuilding without having to excavate the soil** and shut down site operations
- **Environmentally-friendly** processing in compliance with environmental standards



SAFE

The decontamination process is based on a **natural**, **environmentally-friendly** process.

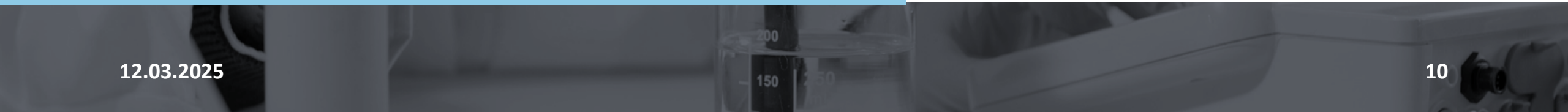
No toxic chemicals are used and no environmental pollutants are produced.

The bacteria used belong to risk group 1.
In accordance with Directive 2000/54/EC of September 18, 2000 and other applicable regulations, their use poses no risk to man or the environment.

Same risk group as yogurt

TWO APPROACHES:

- SURFACE TREATMENT
- IN-DEPTH TREATMENT



Surface pollution (< 50 cm) - Intervention methodology

1. Surface soil samples taken by **auger** by an independent environmental consultancy and sent to an ISO 17025 accredited laboratory for **analysis**.

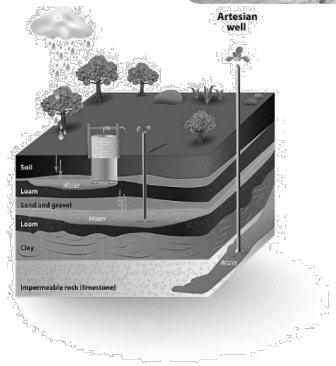
2. Characterization of contamination and **preliminary hydrogeological study** (location and concentration of contamination) provided by partner engineering firm.

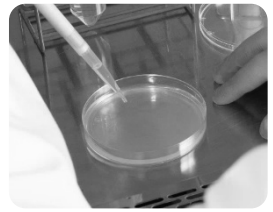
3. Development of a **response plan** and **production of** selected **bacteria** and nutrients according to the nature of the contamination identified; bacteria are in liquid and/or solid form.

4. **On-site application** by a service team, **no heavy machinery required**.
Average intervention capacity: 1000 m^2 of surface can be treated in 1 day by two technicians

5. Regular **sampling** and analysis **campaigns** to measure contaminant removal from the soil.

6. End of project when analyses show that contamination is below the legal thresholds in force. Treatment time varies according to the nature of the contamination, generally between **6 and 18 months**.





APPLICATION OF BACTERIA

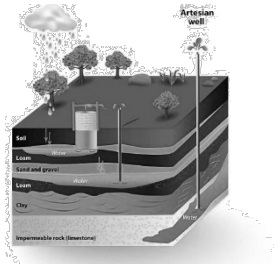
SURFACE POLLUTION (< 50 cm)

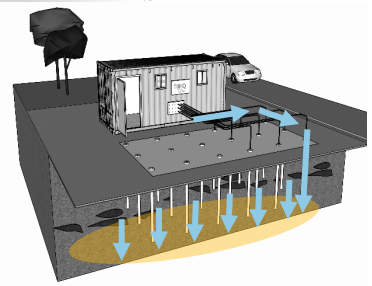
Liquid bacteria and nutrient spraying

Dispersion of **solid** bacteria and fertilizer

Deep pollution (> 50 cm) - Intervention methodology

1. Surface soil sampling by **core sampling**, carried out by an independent environmental consultancy and sent to an ISO 17025 accredited laboratory for **analysis.**
2. Characterization of contamination and **preliminary hydrogeological study** (location and concentration of contamination) provided by partner engineering firm.
3. Preparation of the **intervention plan** and **production of the** selected **bacteria** and nutrients according to the nature of the contamination identified; the bacteria are in liquid and/or solid form. Preparation of the SDB System injection system.
4. On-site **installation** of the **SDB injection system**, including installation of injection wells, positioning of injection pump and cubitainers for storage of liquid bacteria.
5. Regular **sampling** and analysis **campaigns** to measure contaminant removal from the soil.
6. End of project when analyses show that contamination is below the legal thresholds in force. Treatment time varies according to the nature of the contamination, generally between **9 and 24 months**.



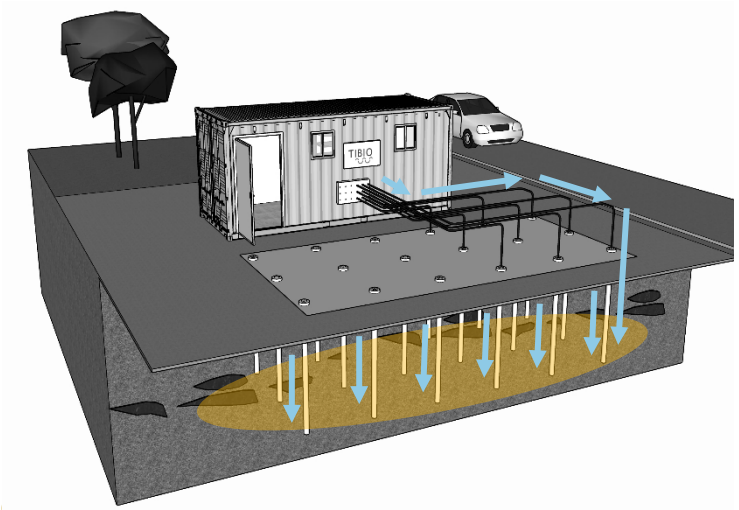


APPLICATION OF BACTERIA

DEEP POLLUTION (> 50 CM)

Set-up of an SDB system in operation.

Standard mesh: Nearly one injection point per 5 $m^{2.}$

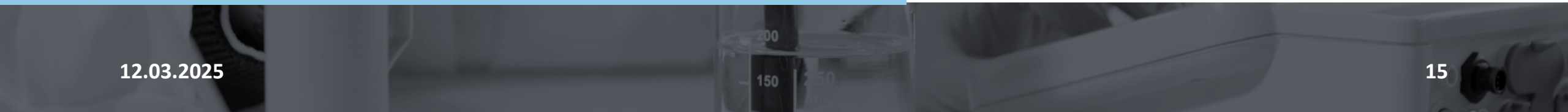


Yell

Compact, modular injection units pre-assembled in shipping containers

TWO CONFIGURATIONS :

- IN-SITU PROCESSING
- EX-SITU TREATMENT



APPLICATION

IN-SITU AND EX-SITU

In-situ

- Disused or operating industrial site
- Site to be rehabilitated as part of land transactions
- Industrial wasteland

Ex-situ

- Excavated soil reclamation platform
- Landfill and disused or operating sites

BATHROOM BIOREMEDIATION

SOME REFERENCES

12.03.2025

SURFACE BIOREMEDIATION - IN SITU

CASE STUDY

Hydrocarbon leak of synthetic dielectric oil type following rupture of a high-voltage cable head during maintenance work on an electrical transformer. Operation in the Canton of Valais, in the Swiss Alps, altitude 600 m.

Pollutants: Dielectric oil - Hydrocarbons C10-C40
Soil type: Gravel and minerals, low organic content

Surface area - Volume: 750 m^2 - 75 m^3
Depth: 0 - 10 cm below the surface

Initial concentration: 100 mg/kg MS
Remediation target: < 0.5 mg/kg MS (< LOQ)
Final concentration: < 0.5 mg/kg MS (< LOQ)
% reduction: > 99.5

Treatment duration: 3 months

EXAMPLE 2

SURFACE BIOREMEDIATION - IN SITU

CASE STUDY

Spillage of synthetic dielectric oil following an accident on an electrical transformer and accidental spills. Intervention in Seine et Marne (77), France.

Pollutants: Dielectric oil - Hydrocarbons C10-C40

Soil type: Gravel and minerals, low organic content

Surface area - Volume: 1000 m^2 - 200 m^3

Depth: 0 - 20 cm below the surface

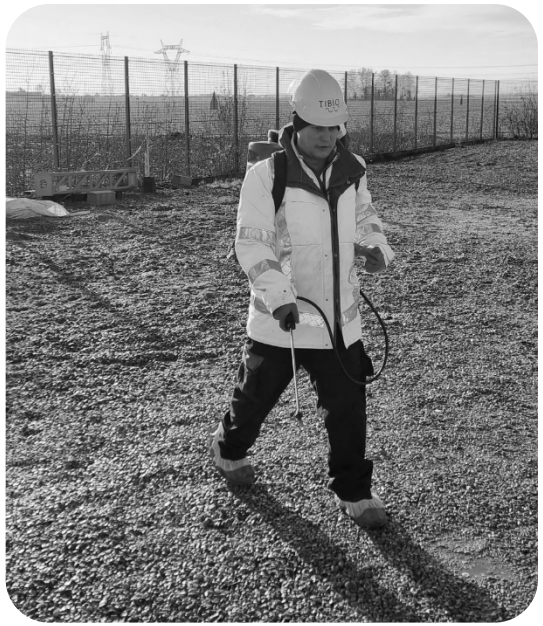
Initial concentration: Up to 5400 mg/kg MS

Remediation target: < 500 mg/kg MS

Final concentration: 272 mg/kg MS

% reduction: 95

Treatment duration: 8 months



EXAMPLE 3

SURFACE BIOREMEDIATION - IN SITU

CASE STUDY

Land contamination on private plots following decades of nearby industrial activity. Bioremediation enables minimally invasive biological treatment on difficult-to-access plots. Intervention in the Canton of Valais, in the Swiss Alps, altitude 520 m.

Pollutants: Hydrocarbons PAHs
Soil type: Soil with high organic content

Surface area - Volume: 300 m^2 - 60 m^3
Depth: 0 - 20 cm below the surface

Initial concentration: 11 - 15 mg/kg MS
Remediation target: < 10 mg/kg MS
Intermediate concentration: up to 7.8 mg/kg DM at T+6 months
% reduction: up to 29% at T+6 months

Treatment duration: Ongoing - Next sampling at T+12 months

DEEP INJECTION WORK

CASE STUDY

Injection of a bio-solution under the pavement to solve instability problems due to partial drying out of clay layers.
Installation of several hundred injection wells along 400 linear meters of roadside.

Soil type: sand, silt, clay

Surface area - Volume: 400 m^2 - 790 m^3
Depth: Between 1.1 m and 2 m deep

Injection volume: 20 m^3
Injection pressure: Between 2 and 4 bar

Objective: Consolidation of clay layers
Treatment duration: 12 months

SURFACE BIOREMEDIATION - IN SITU

CASE STUDY

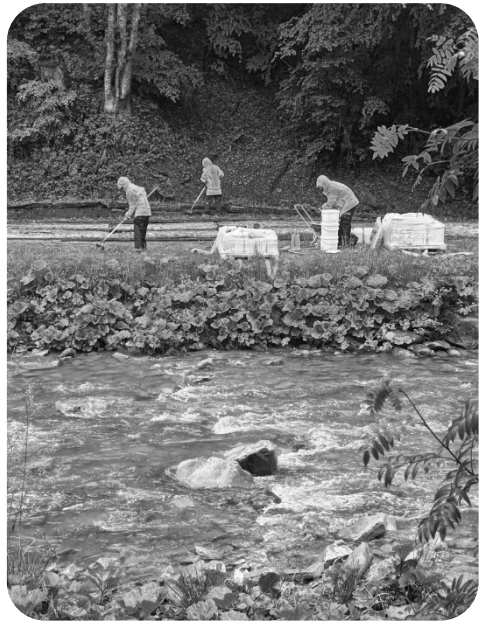
Soil contamination at a shooting range caused by the fragmentation of clay discs. Difficult-to-access areas, where it is difficult to use heavy machinery to excavate and dispose of contaminated soil. Intervention in the Canton of Fribourg, in the Swiss Alps, altitude 880 m.

Pollutants: Hydrocarbons PAHs
Soil type: Soil with high organic content

Surface - Volume: 1500 m^2 - 300 m^3
Depth: 0 - 20 cm below the surface

Initial concentration: Up to 2800 mg/kg MS
Remediation target: < 100 mg/kg MS
Intermediate concentration: up to 200 mg/kg DM at T+9 months
% reduction: 93

Treatment duration: Ongoing - Next sampling at T+12 months



EXAMPLE 6

SURFACE BIOREMEDIATION - IN SITU

CASE STUDY

Hydraulic oil leak following an incident on a site machine. Contamination on an electrical substation.

Operations in Bouches-du-Rhône (13), France.

Pollutants: Oil - Hydrocarbons C10-C40

Soil type: Concrete, bitumen and earth structures

Surface area - Volume: 250 m^2 - 50 m^3

Depth: 0 - 20 cm below the surface

Initial concentration: Up to 6400 mg/kg MS

Remediation target: < 500 mg/kg MS

Final concentration: - mg/kg MS

% reduction: -

Treatment duration: Ongoing - Follow-up planned at T+6 months

EXAMPLE 7

EX SITU BIOREMEDIATION & WATER TREATMENT

CASE STUDY

Hydrocarbon leak of the dielectric oil type following damage to an underground electrical link. Contamination of surface soil and downstream water, sensitive environment. Surface soil spread to a depth of around 20 cm. Operation in the Canton of Valais, in the Swiss Alps, altitude 1050 m.

Pollutants: Dielectric oil - Hydrocarbons C10-C40
Type of contamination: Surface organic soil, downstream water body

Surface area - Volume: > 200 m^2 - > 40 m^3
Depth: 0 - 2 m, heterogeneous distribution

Initial concentration: Up to 153.9 mg/kg MS
Remediation target: < 50 mg/kg MS
Final concentration: - mg/kg MS
% reduction : -

Treatment duration: Ongoing - Follow-up planned at T+6 months

WATER ULTRAFILTRATION UNIT

EXAMPLE 8

SURFACE BIOREMEDIATION - IN SITU

CASE STUDY

Hydrocarbon leak of the dielectric oil type following damage to an underground link close to a watercourse.
The leak was caused by excavation operations carried out by a construction company.
Preventive treatment by bioremediation. Work carried out in Moselle (57), France.

Pollutants: Dielectric oil - Hydrocarbons C10-C40
Soil type: Soil, sand

Surface - Volume: < 25 m^2 - < 5 m^3
Depth: 0 - 20 cm

Initial concentration: 135 mg/kg MS
Remediation target: Achieved (< 500 mg/kg MS)
Final concentration: 28 mg/kg MS
% reduction: 79

Treatment duration: 4 months

EXAMPLE 9

SURFACE BIOREMEDIATION - IN SITU

CASE STUDY

Contamination of several private plots following an accidental fuel oil spill caused by flooding of the nearby river. Operation in the Canton of Valais, Swiss Alps, altitude 1550 m.

Pollutants: Fuel oil - Hydrocarbons C10-C40
Soil type: Soil

Surface area - Volume: 906 m^2 - 291 m^3
Depth: 0 - 40 cm, heterogeneous distribution

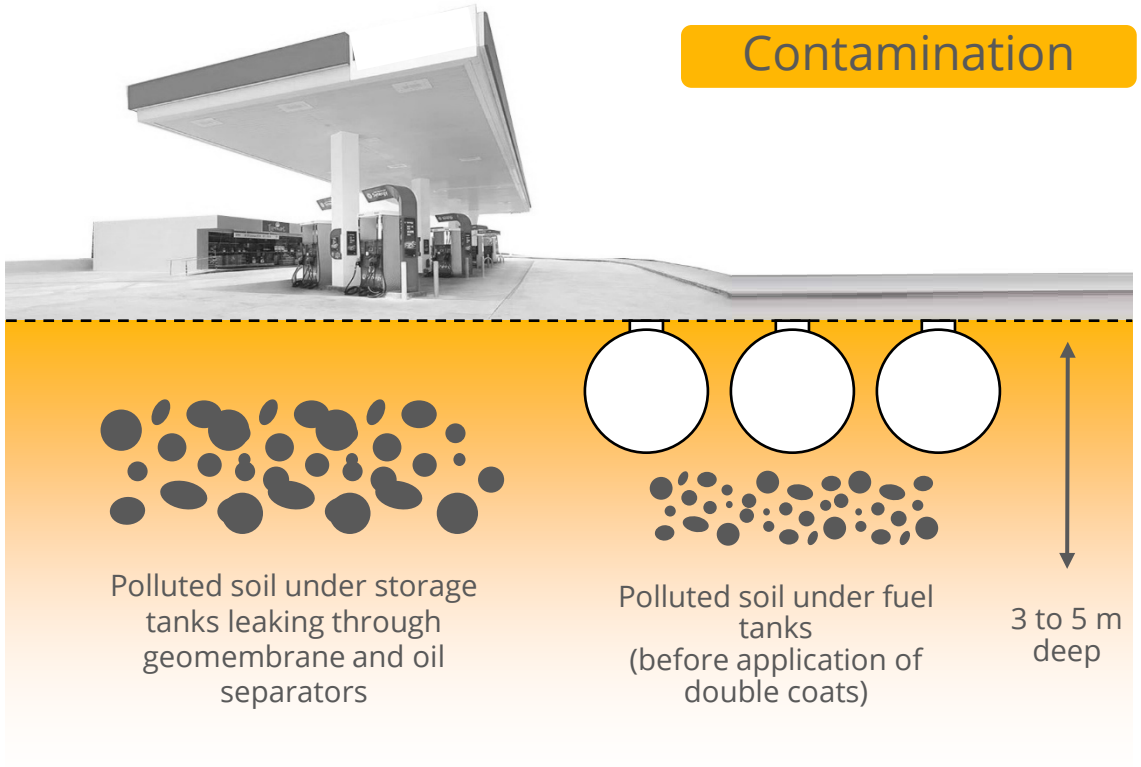
Initial concentration: Up to 1300 mg/kg MS
Remediation target: (< 50 mg/kg MS)
Final concentration: - mg/kg MS
% reduction: 79

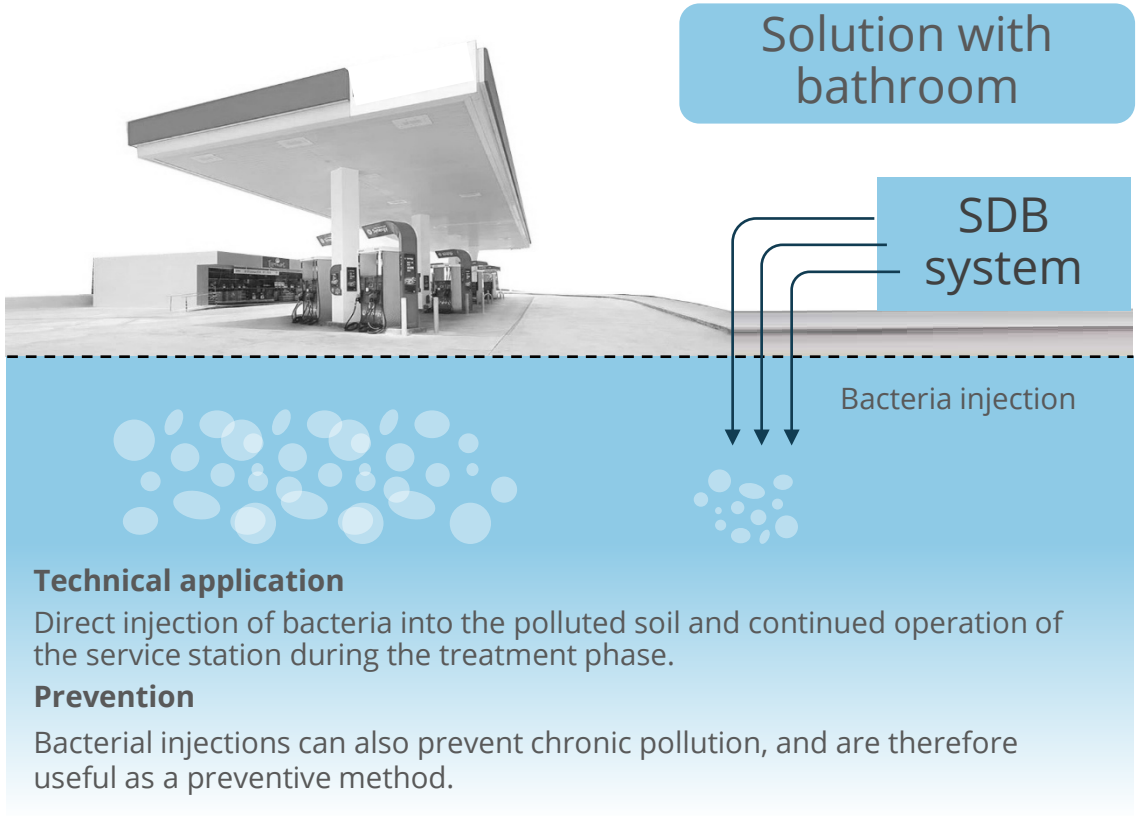
Treatment duration: Ongoing - Follow-up planned at T+6 months

DEEP BIOREMEDIATION

CASE STUDY

Hydrocarbon contamination problem under underground fuel tanks at a service station





Technical application

Direct injection of bacteria into the polluted soil and continued operation of the service station during the treatment phase.

Prevention

Bacterial injections can also prevent chronic pollution, and are therefore useful as a preventive method.

TIBIO

THANK YOU

www.tibio.ch