



LFS-1™

Remediation of soil and water contaminated
by hydrocarbons.

¿WHAT IS IT?

LFS-1™ is a mixture of microorganisms suspended in an aqueous solution used for bioremediation of soil and water contaminated by hydrocarbon spills and residues associated with their production. It is formulated with a group of 10 strains of bacteria of the genus *Pseudomonas* and *Acinetobacter*, all of them are highly specialized to survive under adverse conditions.

USES AND APPLICATIONS

Its main uses are (see diagram 1):

- Remediation of soil and water contaminated by oil spills

- Cleaning residues associated with the production of Oils.

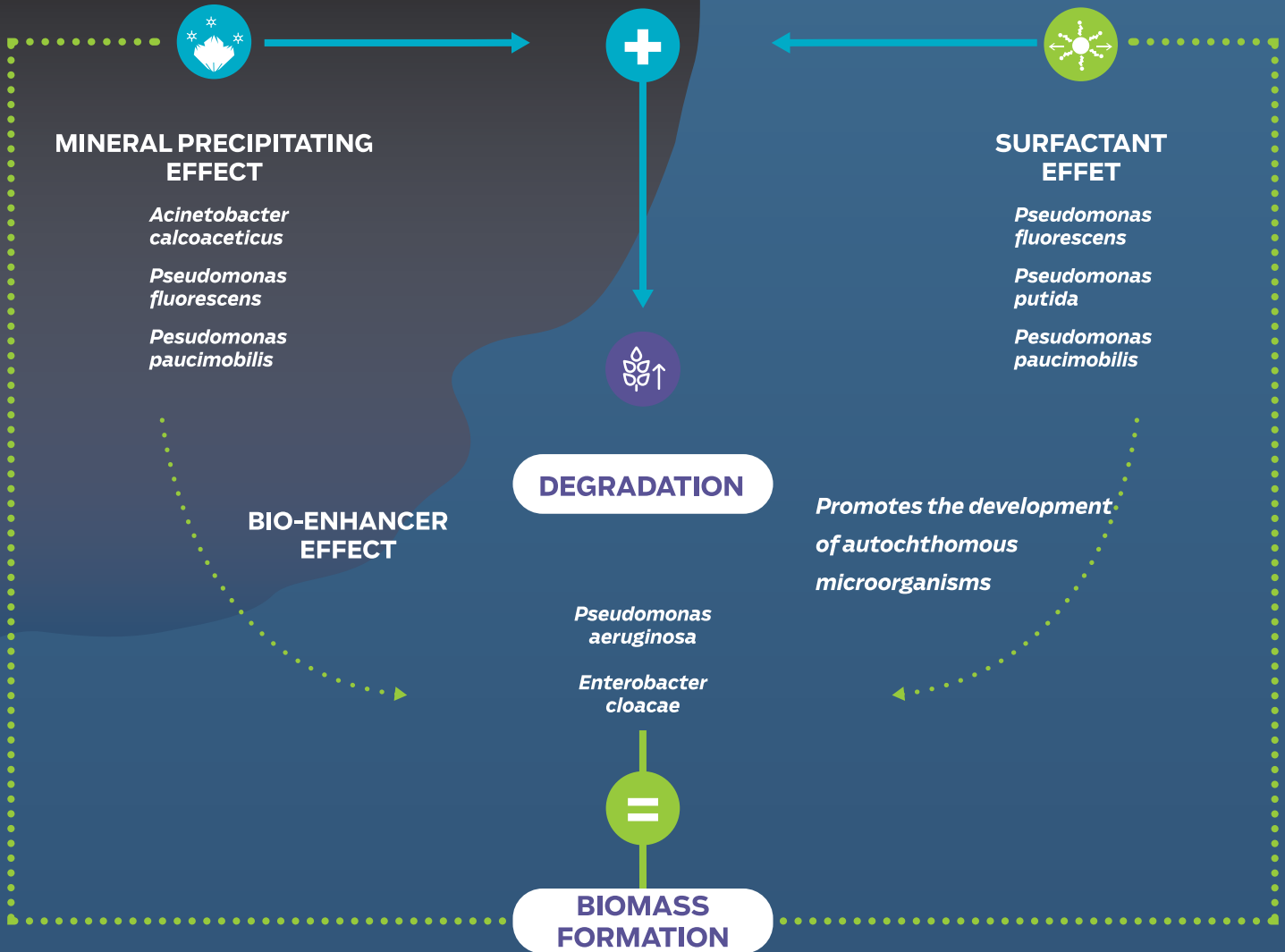
- Cleaning of sediment and oil layers

- Remediation of drilling cuttings contaminated with crude or oil-based fluids.

- Cleaning sedimentation pits.

- Remediation of oil spills in pits.

Diagram 1. Use of LFS-1™ in oil bioremediation.



HOW DOES IT WORK?

MECANISM

DEGRADATION OF HYDROCARBON CHAINS



PRECIPITATION OF DISSOLVED METALS



BIOSTIMULATION OF SOIL



DESCRIPTION

The microorganisms metabolize hydrocarbons in such a way that they degrade the hydrocarbon chains by breaking them into simpler compounds like aldehydes and alcohols. The only byproducts of the action of **LFS-1™** are small amounts of **CO₂** and fatty acid.

Dissolved heavy metals are chemically transformed to make them insoluble. The microorganisms resist the presence of metals in their environment and react to them depending on the type of metal and the degree of toxicity, generating pseudomonas that adhere small chemical groups of methyl (**CH₃**) to the chains of metals or changing their atomic charges thus causing the metal to precipitate. When they are not dissolved, they are no longer available for plants or animals that are in contact with contaminated water or soil avoiding the damage they can cause to living beings.

The population of microbes in the product are stimulated to grow to their maximum concentration through a nutrient that accompanies the application of the product and once the bioremediation is done, the microbial population gradually decreases until disappearing. The nutrients dissolve in water and contain phosphorus, potassium and nitrites. Soils treated with **LFS-1™** increase productivity and quality by optimizing nutrient availability.

WHAT ARE THE BENEFITS?

- Helps restore ecosystem balance
- **LFS-1™** degrades
- Natural solution for bioremediation, without the use of chemicals.
- The product is not dangerous, toxic or pathogenic
- Requires no special handling or permits for storage.
- Results are seen within the first 30 days

LFS-1™ DEGRADES

- Alkanes (petrol, diesel, oils, etc.)
- Chlorinated hydrocarbons (trichlorethylene, polychlorinated biphenyls etc.)
- Aromatic and polyaromatic (toluene, xylene, naphthalene, etc.)
- Ketones (methyl ethyl ketone, methyl isobutyl ketone, etc.)
- Alcohols (isopropanol, isobutanol, ethyl alcohol, etc.)
- Toxic waste (Nitrate)
- Pesticides

HOW TO APPLY:

PREPARATION:

1. Verify the levels of BTEX, TPH and TCLP prior to treatment or as required by regulatory agencies.
2. Maintain pH within range 6-9.
3. Sieve the soil or grind to obtain a uniform size. The floor should be as thin as possible.
4. Select a suitable location for bioremediation so that the ambient temperature can be maintained at or above 65 ° F (18.3 ° C). At lower temperatures the metabolic rate of bacteria.
5. Dissolve 11.5 ounces (by weight) of nutrient in one gallon of clean water. For large-scale remediation, dissolve 40 lbs of dry nutrient into approximately 55 gallons of water (preferably dechlorinated).
6. Mix **LFS-1™** with the water and nutrients solution in a 1: 1 ratio. Treatment of 1 yd3 of soil requires 1/2 gallon of LFS-1 and 1/2 gallon of nutrient solution to ensure proper soil remediation. Once the nutrient is mixed with **LFS-1™**, it should be used quickly because the bacteria will experience extremely rapid growth.
7. The moisture content should be maintained between 16-20% by periodic application of water (preferably dechlorinated). Do not apply too much water as it will slow the bioremediation process.
8. Recommendations are to review the values of BTEX, TPH and TCLP at least every 30 days.
9. We recommended to till the soil at the end of the second week in order to ensure adequate aeration.

SCALE APPLICATIONS

+ LARGE

Use ground grinders, crushers, mud grinders or an appropriate device, such as the Royer / Cooper sprayer to facilitate application when the soil is coming out of the grinding device. The soil should be placed on a plastic canvas on a berm or surrounded by a suitable container once the product is applied. Liquids should not be allowed to escape. The maximum height of the floor pile should not be greater than 18 in.

- SMALL

The soil should be placed in 2 to 3 inch layers and sprayed evenly with product. Then another 2-3 inch soil layer should be placed on top and sprayed again. This process must be repeated until all the soil is completely treated. Approximately every two layers, the floors should be slightly stirred with a garden rake.

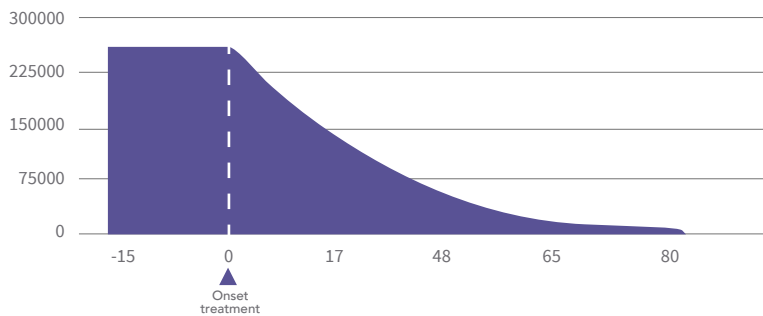
SUCCESS CASES

REMEDIATION:

[1] DRILLING CUTTING

Pure Environment Inc. As a result of drilling a gas well with oil based drilling mud by HMC, 350 yd³ of drill cuttings were contaminated with diesel. Treatment with **LFS-1™** was initiated for the remediation of these cuts on Nov 28, 1993. The cuts were remedied in a period of 3 months. The table and graph show the TPH values obtained during the regular sampling performed throughout the treatment.

	TPH PPM
Day 14	264,000
Day 0	Onset treatment
Day 17	137,000
Day 48	43,000
Day 65	14,500
Day 80	5,000



REMEDIATION:

[3] SOIL

14,000 tons of sand contaminated with grease, engine oil and hydraulic oil at an aluminum production plant in Vancouver, Washington. **LFS-1™** bio-remediated the contaminated soil in a period of 7 months, the results obtained were:

1. Reduction of TPH levels from 5,000ppm to less than 400ppm
2. Reduction of PCB levels from 175ppm to less than 10ppm



THE CLIENT SAVED OVER \$ 1.2 MILLION WITH THIS PROJECT COMPARED TO THE LANDFILL METHOD

REMEDIATION:

[2] UNDERGROUND WATER

Fuel oils contaminated the groundwater system in Harrisburg, Pennsylvania. Bioremediation of water with **LFS-1™** was carried out in a 5,000 gal bio reactor in a 12-month period. The TPH and naphthalene values before and after treatment are summarized in the following table:

	TPH mg/lit	NAPHTHALENE (mg/lit)
Pre-treatment	117	0.942
Post-treatment	0.5	Non detectable (detectable limit 0.001 mg/lit)
Permissible maximum discharge limits	3	0.005

REMEDIATION:

[4] SOIL

MOBIL 1994. Oil spill contaminated 22,000 tons of soil. The soil was remediated in-situ with **LFS-1™** and the remediation period lasted less than 4 months. **TPH levels were reduced from 250,000 ppm to less than 100 ppm.**



THE PROJECT REPRESENTED A SAVINGS OF OVER US \$ 250,000 COMPARED TO OTHER METHODS.

REFERENCES.

[1] Pure Environment Inc. Hanson Minerals Company Octubre 1993 Remediation of Drill Cuttings from the Josey # 1 Well

[2] Tethys Consultants Inc, Marzo 1995 Remediation of contaminated groundwater with combustible oils

[3] CCC Group. Vancouver Washington

Remediation 14,000 tons of soil contaminated with grease and oil

[4] MOBIL oil 1994. Remediation of 22,000 tons of soil contaminated with oil



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