Oil Pollution? Bioversal, the Green Solution!

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Bioversal
in association with nature
Advanced Bio-Technology Applications
www.bioversal.com

Oil Spills released in soil, groundwater and natural water resources are a global problem, which mainly occur during routine activities all along the oil production, transport, storage, processing and distribution life cycle chain. Crude oil released in this way represents an environmental issue of great concern because spills threaten animals, plant life and other marine resources. Natural Biodegradation processes occur when micro organisms like bacteria feed on oil.

OIL SPILLS: SOURCES & MAGNITUDE

According to a 2002 report from the National Academy of Sciences, approximately 210 million gal (790 million l) of oil spills into the oceans each year. Sources include the wells from which oil is extracted and the ships used to transport it, as well as natural oil seepage from geologic formations below the seafloor, as for example in Coal Oil Point along the California Coast,where an estimated 2,000–3,000 gal (7,570–11,350 l) of crude oil is released naturally from the ocean floor every day. While accidental tanker and off-shore oil spills receive the most publicity, they only account for approximately 25% of the crude oil released into the oceans each year by human activity with the remainder largely due to routine oil tanker ship maintenance operations such as loading, discharging, and emptying ballast tanks. According to a 2002 study performed by the National Research Council, a total of 29 million gal (110 million l) of petroleum are released into North American ocean waters each year as a result of human activities or carelessness. However, only a small fraction of that environmental pollution is due to pipeline ruptures or oil tanker spills. Approximately 85% of those spills involve land-based runoffs from cars and trucks, fuel dumping by commercial airplane pilots, and emissions from small boats and crafts.

Bioversal HC®: Mode of Action	Effect	Time scale of Action:
As a Mild Bio-Surfactant:		
Emulsifying and Fragmenting Oil Particles Detaching Oil Particles from Surfaces; Making them Available to Bacteria	Cleaning	Short-term (Minutes)
As a Bacterial Growth Enhancer:		
Attracting Oil-Degrading Bacteria; Stimulating Bacterial Growth	Stimulating	Middle-term (Hours)
As a Product of Bioremediation:		
Enhancing Biodegradation of Hydrocarbons in Oil; Autobiodegradation Low Oxygen Depletion	Bioremediation	Long-term (Days to Weeks)

Bioversal's Mode of Action

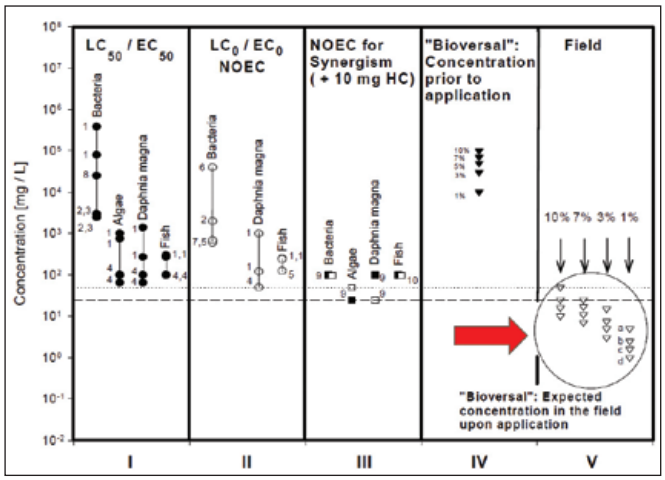
OIL SPILLS: A GLOBAL PROBLEM

The Deepwater Horizon oil Spill in the Gulf of Mexico has only focused our attention to an old problem. Oil spills have occured all over the world. The Cutter Information Corporation tracks oil spills involving at least 10,000 gal (34 tonnes). It reports that spills of that magnitude have occurred in the waters of 112 countries since 1960. Oil spills are also known to happen more often in some parts of the world. Major oil spills from tankers have occurred in the Gulf of Mexico (267 spills); the northeastern United States (140 spills); the Mediterranean Sea (127 spills); the Persian Gulf (108 spills); the North Sea (75 spills); Japan (60 spills); the Baltic Sea (52 spills); the United Kingdom and English Channel (49 spills); Malaysia and Singapore (39 spills); the west coast of France and north and west coasts of Spain (33 spills); and Korea (32 spills).

NATURAL MECHANISMS OF OIL BIODEGRADATION

A diversity of naturally occurring Microorganisms in water and soil have the capacity to transform biologically and degrade spilled Hydrocarbons. This biodegradation process relies mainly on aerobic (oxygen related) mechanisms, where a consortium of bacterias uses oxygen to split and transform hydrocarbons in more harmless byproducts. The end result of such sophisticated biochemical reactions can be CO_2 and Water. Environmental conditions and parameters like temperature, pH, oxygen supply, nutrients (Nitrogen, Phosphate), Bioavailability (solubility of Hydrocarbons in water), toxicity levels in water though control

the biodegradation performance and velocity. During this process a series of Microorganisms produce and release Biosurfactants or Biotensids (Rhamnolipids etc.), detergent like biochemical substances which attack in water non soluble oil to form micelles or emulsions. This process makes oil bio-available to a consortium of bacterias. These microorganisms populate microscopic oil drops encapsulated with biosurfactants in the water column. Using docking mechanisms and via their membrane bacterias use the oxygen available in water to metabolize Hydrocarbons in different consecutive steps to CO_2 and H_2O. Sufficient food encourages cell division and the bacterial population grows to accelerate biodegradation of oil. In polluted water oxygen supply is guaranteed by the dissolved oxygen in the water column.



Ecotoxicity Data for Bioversal HC Solutions Undiluted and Upon Dilution as Applied in the field (Prof. Dr. R. Dallinger 2002) Bioversal has been tested repeatedly for its toxicity and Ecotoxicity. It exhibits a remarkably low Toxicity towards Bacteria, Algae, Invertebrates, Fish and Mammals.

Synthetic surfactants are generally used in oil related facilities like Off-Shore platforms to handle a series of important activities.

- Fire extinguishing AFFF foams
- Cleaning and Emulsifying
- Dispersants for accidental Oil Spill treatment

These synthetic detergents or surfactants though, are not biocompatible with the natural biodegradation process of spilled oil , although some of the new generation products present good biodegradable characteristics. Most of these surfactants once mixed with oil and spilled overboard damage this selected biodiversity of oil eating bacterias with the result to inhibit the biodegradation process. Although these products present high performance in dealing with their specific application problematic they do not possess an integrated environmental approach which includes or considers bioremediation effectiveness mechanisms. They are not Biocompatible.

BIOVERSAL'S ADVANCED BIOTECHNOLOGY APLICATIONS

Bioversal has developed in the last 10 years Advanced High Performance Biosurfactants of vegetal origin which enhance the natural self cleaning potential in polluted sites after application. Biodegradation is rapidly activated and natural degradation of spilled Hydrocarbons in water and soil is dramatically accelerated. These eco-friendly and highly biocompatible products offer high performance applications in the field of Fire and Explosion Protection (Bioversal QF), Water and Soil Treatment (Bioversal HC), Industrial Cleaning (Bioversal MANTEQ) and Bioremediation (Bioversal HC Soilteq & Aquateq) with integrated activation of environmental restoration capacities during and after oil spills.

BIOVERSAL'S BIOCOMPATIBLE SURFACTANTS: WHAT DO THEY CONTAIN?

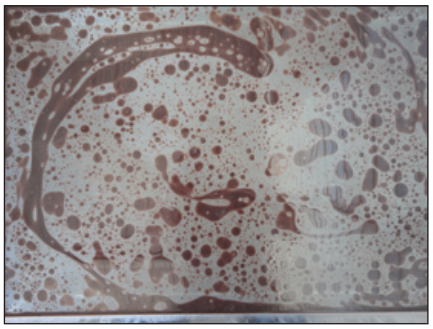
Bioversal's products differ substantially in their biochemical composition from synthetic petrol derived surfactants. They are composed of mild Surfactants of Biological Origin e.g. from Vegetable Sources with long-chained anionic isooctyl Esters and non-ionogenic alkyl-polyglycosides. Natural Buffer Substances and Natural Bioactivators are functioning as Bacterial Attractants and facilitate the docking process and cell membrane contact of microorganisms on encapsulated oil drops. Selective and unique Bacterial Substrates improve the Nitrogen-Carbon ratio (e.g. on a Protein Basis) to assure initial nutrient supply for an enhanced biodegradation process of Oil.

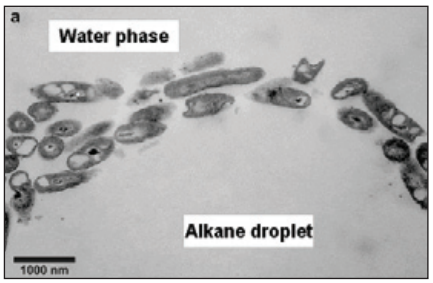
This sophisticated composition of Bioversal products guarantees similar characteristics and mechanisms like naturally produced biosurfactants by oil degrading bacterias. In the same time Bioversal's Biosurfactants are low toxic with 100 times less toxic than conventional synthetic surfactants and highly biodegradable (100% within 4-7 days).

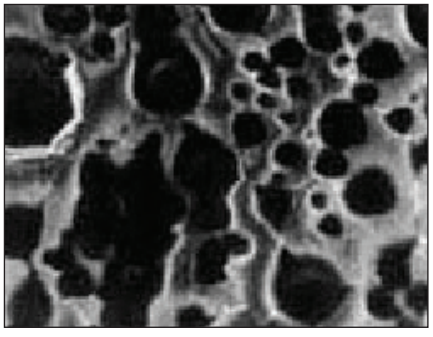
BIOVERSAL'S BIOCOMPATIBLE SURFACTANTS: HOW DO THEY WORK?

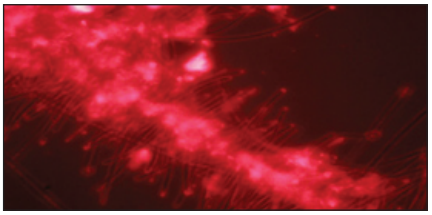
Bioversal's products contain as mentioned above 3 main functional components:

1. mild / weak Surfactants









Attraction of hydrocarbon degrading bacteria on a Bioversal fluorescence-labeled model activator. Bioversal's Bioactivator labeled with Texas Red binds specifically to the glycoside structures of the bacteria and enriches these at the model surface.

2. bacterial substrates on protein basis
3. bioactivator

The mild/weak surfactants guarantee a weak tensidic action to assure sufficient fragmentation and weak emulsification of Oil Particles to make oil available to bacterias. The formation of stable micelles makes oil particles float on the water surface to assure unlimited oxygen supply from the atmosphere, optimum temperatures and light. Emulsification in the water column is held at a minimum in order to avoid oxygen depletion of the water column.

The bacterial substrates deliver enough nitrogen, important constituents for bacterial growth and cell division.

What makes Bioversal unique world wide though is the presence of a Bioactivator of vegetal origin. Its main function is to be a target for Bacterial Cell Wall Receptors, like a sophisticated docking device which attracts bacterias and enhances its adhesion on coated oil particles.

As a result of these combined mechanisms (1,2,3) Bioversal stimulates and enhances bacterial growth on a natural way and accelerates biodegradation of hydrocarbons without having any negative ecological impact making Nature Your Ally.

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