Advanced BioCatalytics Corporation

Multifunctional Protein-Surfactant Surface Washing Agent

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OSPR/Chevron Oil Spill Response Technology Workshop
Alameda, California. February 24, 2015

Definition by the US EPA

"Surface washing agent is any product that removes oil from solid surfaces … such as beaches and rocks, through a detergency mechanism, and does not involve dispersing or solubilizing the oil into the water column."

Accell Clean® SWA
Certifications

- Listed in the U.S. EPA NCP product schedule as Surface Washing Agent

- Licensed by the California Dept. of Fish & Wildlife as Oil Spill Cleanup Agent /Surface Washing Agent

- Was approved by the Unified Command for Deepwater Horizon oil spill decontamination

Core Technology - PSC

- Based on Protein-Surfactant Complexes
  - combination of commonly used surfactants
  - with non-enzymatic proteins from baker's yeast
- Enhancing surfactant efficiencies
- Accelerating natural biodegradation of residual petroleum contamination
- 9 US Patents issued

Mechanical Effect

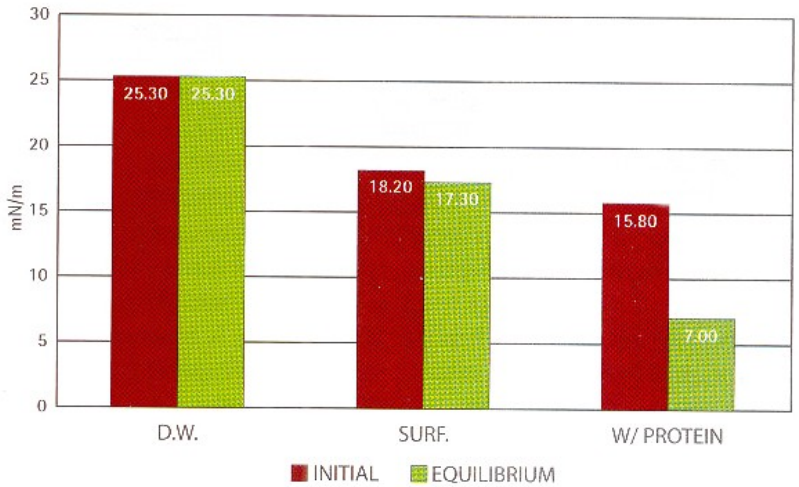
Cleaning Enhancement

Protein-Surfactant Complexes (PSC) provide significant reduction of

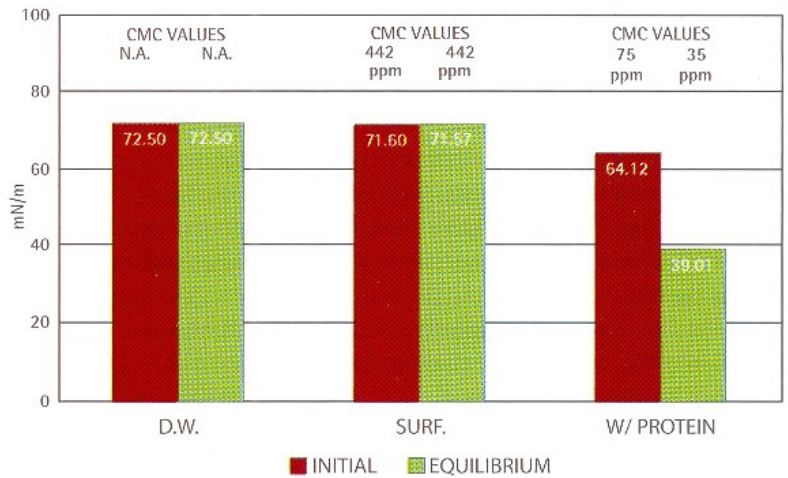
- Surface tension (ST),
- Interfacial tension (IFT),
- Critical micelle concentration (CMC).

This yields enhanced detergency and cleaning at lower concentration of the product in water, beyond achievable with surfactants alone.

Mechanical Effect - Investigation



Decrease of IFT with PSC compared to surfactant alone



Decrease of ST and CMC with PSC compared to surfactant alone

"Changing the nature of surfactants“
Ind. Biotech., Vol. 1, No. 4 (2005)

Biological Effect

Bioremediation Acceleration

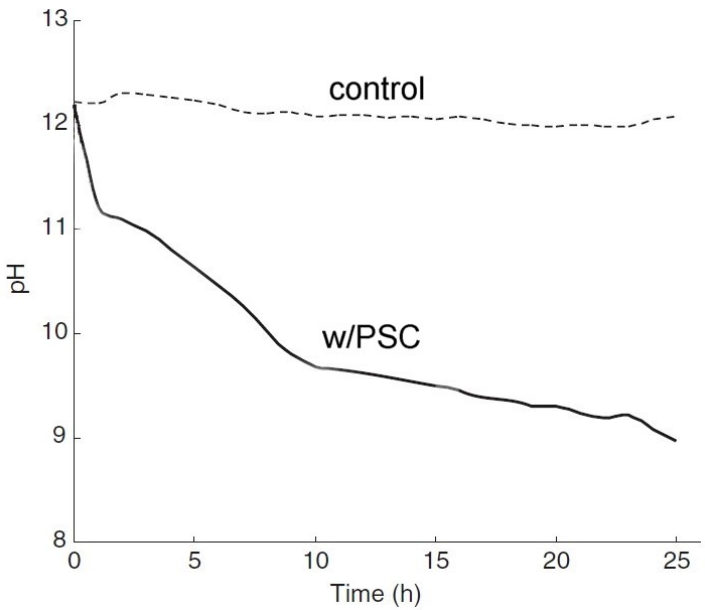
Protein-Surfactant Complexes (PSC) stimulate native oil-consuming bacteria to ingest more oil from the environment without greater growth of bacterial biomass.

This accelerates natural biodegradation of residual petroleum contamination on shoreline, plants, soil and water.

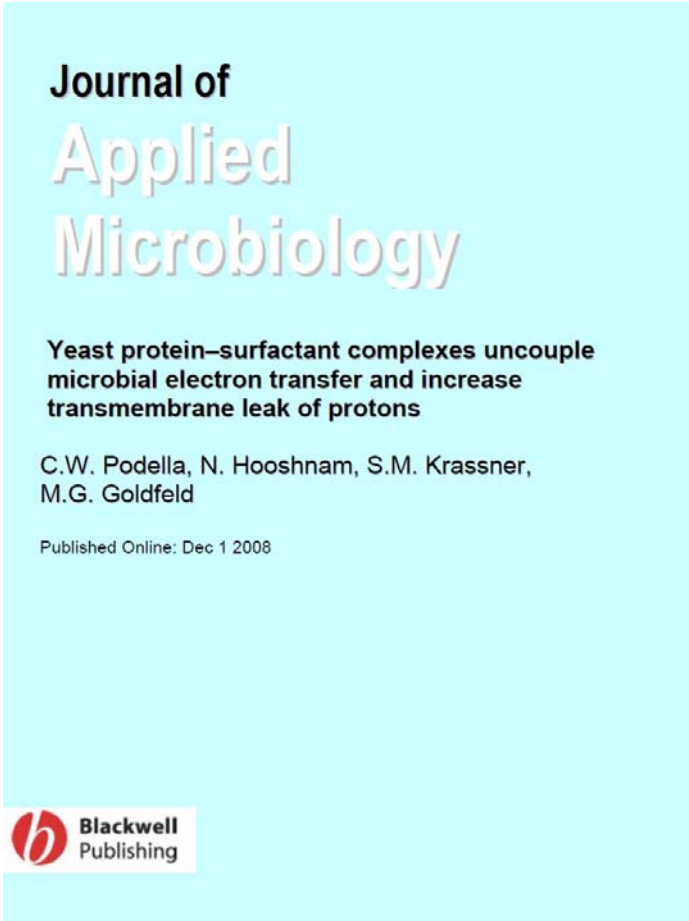
Biological Effect - Investigation

Increase of oil consumption by bacteria if PSC added

Total Organic Carbon	Control	w/PSC
Nutrient TOC (mg l^{-1})	175	353
Biomass TOC (mg l^{-1})	143	147
C in exhausted CO_2 (mg l^{-1})	50	198



Loss of alkalinity in a model cell with PSC added (causing the cell membrane to leak H^+ ions in). Alkalinity in live cells results from food oxidation and stores energy for growth and reproduction.



"Yeast protein-surfactant complexes … increase transmembrane leak of protons" J. Appl. Microbiol., Vol. 106, No. 1 (2009)

Accell Clean® SWA
Applications

- Cleaning shoreline rocks, piers, etc.
- Cleaning shoreline vegetation
- Beach sand cleaning
- Equipment decontamination onshore

Accell Clean® SWA
Advantages

- Cleans more thoroughly
- Cleans with less labor and less product
- Stimulates bioremediation of residual oil
- Safe for people and environment
  - does not contain harmful solvents
  - is pH neutral and biodegradable

Accell Clean® SWA

Equipment Decontamination Onshore

Excellent performance in 2010 Oil Spill Cleanup in Gulf of Mexico

Cleaning a pump with high-pH cleaner - required 6 men working for 2 hours, with scrubbing and wiping

Cleaning a pump with Accell Clean® - required 2 men working for 0.5 hour, just spraying and rinsing, no wiping

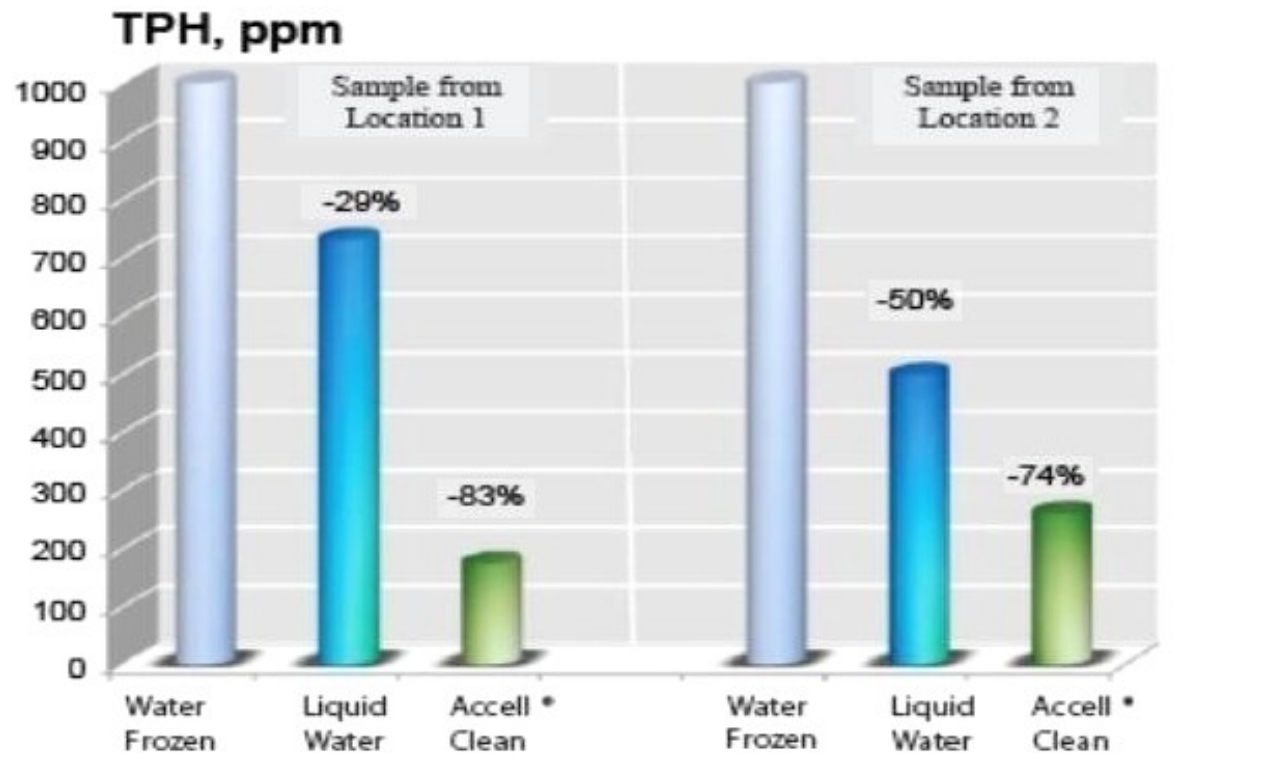
Accell Clean® SWA
Equipment Decontamination (cont.)

Underside of the pump after washing with Accell Clean®

Accell Clean® SWA

Helping Biodegradation of Residual Oil in Water

Reduction of Total Petroleum Hydrocarbon (TPH) in Ocean Water - taken near Louisiana Shore after 2010 Oil Spill in Gulf of Mexico



Incubation for 21 days. Initial level was adjusted to 1000 ppm using *n*-decane.

Accell Clean® SWA
Beach Sand Cleaning

Tested on beach in Alabama after 2010 Oil Spill in Gulf of Mexico

Mobile Sand-Cleaning Machine
by Proven Technologies
- using 1% solution of Accell Clean®

Before washing
>2% oil content

After washing
< 0.1% oil

Cleaning capacity of the machine -
50 cubic yards of sand per hour

Accell Clean® SWA
Washing Oiled Soils and Solid Waste

Washing with Accell Clean® SWA in Sand-Cleaning Machine -

- Soil Contaminated by Oil Spills from Pipelines
- Sediments from Crude-Oil Storage Tanks
- Drill Cuttings from Oil Wells

Before washing

After washing with 1% solution of Accell Clean® SWA

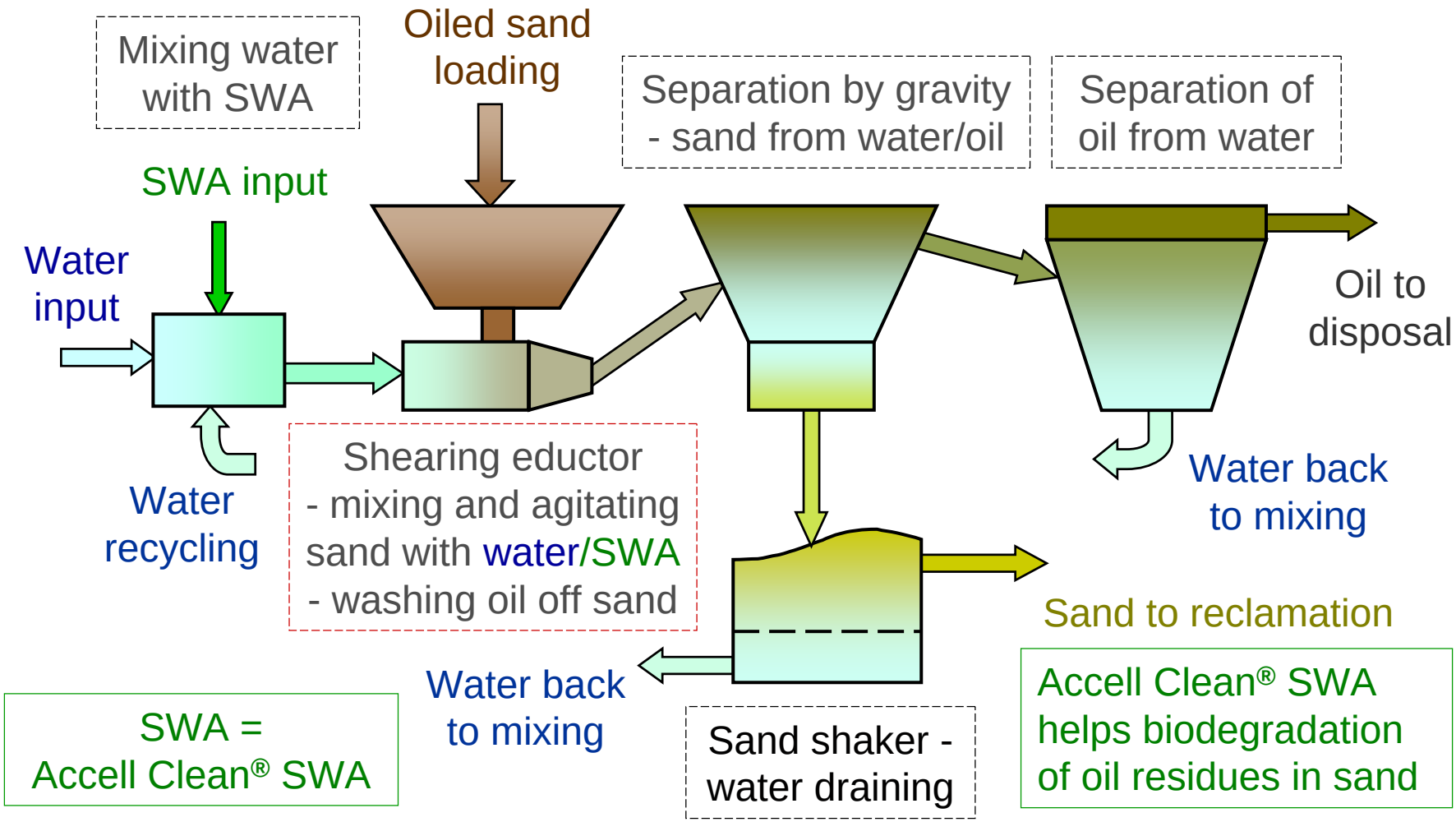
Advantage of On-Site Cleaning
of Oiled Sand or Soil

- Avoiding hauling of hazardous waste to landfill
- No need for bringing sand for replacement
- No expenses for transportation and disposal
- Avoiding contingent liabilities

Mobile sand-cleaning machine

Sand-Cleaning Machine

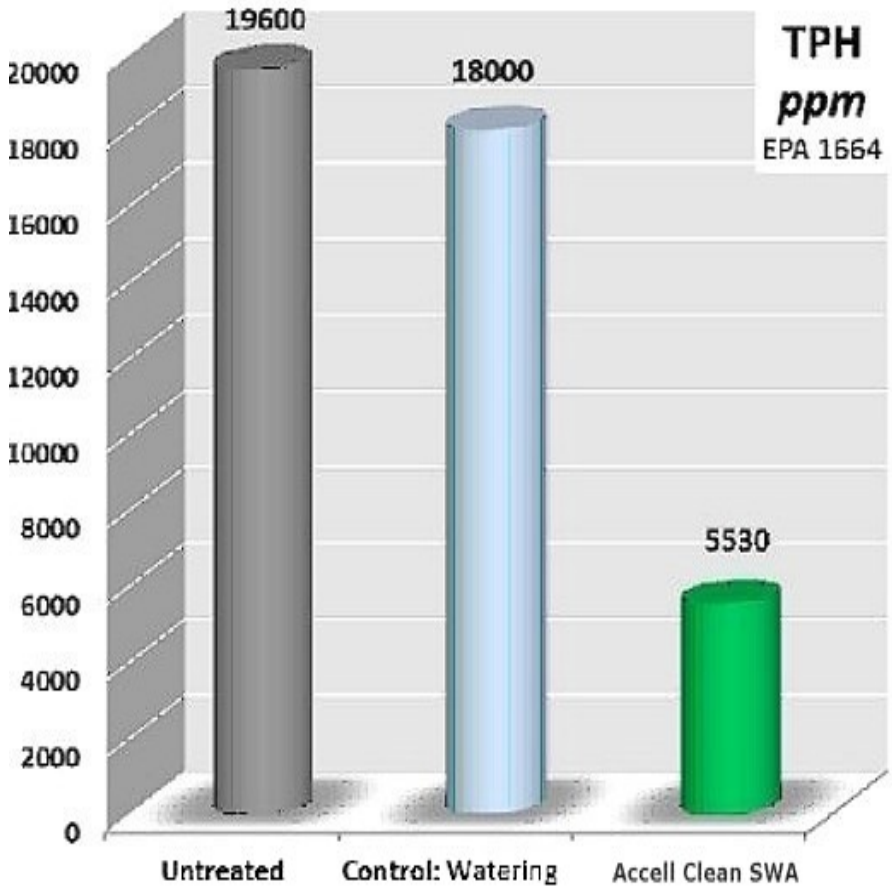
Process Diagram



Accell Clean® SWA

Helping Biodegradation of Residual Oil in Soil

Huntington Beach, CA, circa 1930



Bioremediation of oil-contaminated soil, Bolsa Chica Ecological Reserve, 2013

Accell® SBR

Specialized Product for Soil Bioremediation

Reduction of Total Petroleum Hydrocarbon (TPH) in Soil at Refinery in California