

Clean-Up of Sand Beach- Case Study

Utilization of the BPC technology for cleaning of an oil-contaminated beach

Introduction

The BioPetroClean (BPC) technology was successfully implemented for cleaning of a sand beach, contaminated with oil.

In August 1991, approximately 100 tons of heavy crude oil was accidentally spilled about 3 km north of Zvulun Beach between Haifa and Akko, in Israel. In order to optimize the solution, a preliminary pilot trial was performed for 25 days, followed by a full implementation clean-up, for a period of 4 months. By the end of the treatment project the BPC biological treatment led to a 88% decrease of the residual oil.

BPC's Technology

BioPetroClean's innovative biological method for treatment of contaminated water and soil is an elegant and simple way to overcome the existing challenges of currently common biological methods. The method is based on maintaining a pre-selected bacterial "cocktail" at a stable concentration, while monitoring the system with a fully automated control unit.

Pilot Results

As a preliminary step, a field trial was performed for 25 days on an oil contaminated sandy beach between Haifa and Acre, Israel. Initially, two plots of 50 m² were selected, one for the experiment and the second to serve as a control. The experimental plot was introduced to BPC's pre-selected bacterial cocktail and a special mixture of fertilizers. Throughout the process the

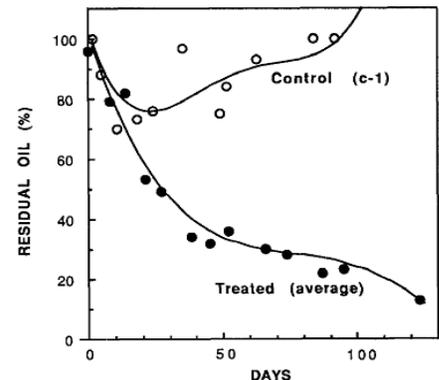
sand was watered from the adjacent sea, and tilled. The control plot was left undisturbed. The initial concentration of hydrocarbon contamination in the sand was 3.8 mg/g sand in the upper 10 cm. By the fourth day, 30% of the hydrocarbons were degraded. The biodegradation continued, reaching 50% on day 9 and 84.5% on day 25 when the treatment was completed. The control plot showed an 18% degradation by day 9 which remained relatively constant until day 25. Gas chromatographic analyses of the alkane fraction of the extracted sand, sampled on day 0 and day 25 are summarized in the table below. Extractions with CCl₄ gave similar results i.e. approximately 85% of the hydrocarbon was removed from the sand in 25 days. The C₂₀-C₃₀ fraction was most abundant at day 0 (221 mg/kg sand) and fell to 13mg/kg sand by day 25, a 94% removal. Overall there was an 86% degradation of the alkanes, similar to the data obtained by dry weight.

GC analysis of the extracted sand		
Type of extract	Extracted Hydrocarbon residual (mg/kg sand)	
	Day-0	Day-25
Total CCl ₄ extracts	3138	474
Total pentane extracts	3800	590
C ₁₄ -C ₁₈	23.7	4.7
C ₂₀ -C ₃₂	221	13
C ₃₆ -C ₄₀	132	35
C ₁₄ -C ₄₀	377	53

* The GC analyses were performed by the Israel Institute of petroleum and Energy

Full Implementation Results

Following the pilot results that indicated that the BPC technology is applicable for bioremediation of the contaminated soil, a full scale treatment was conducted. The clean-up was of 30,000 m² which were treated essentially as in the field trial. As the treatment was conducted during winter time, it is worth noting that the temperatures were around 5-10 °C throughout the process. The graph below summarizes the performance of the bioremediation process.



Graph 1: Microbial clean-up of 30,000 m² beach line north to Haifa, Israel

Based on the results presented in the above graph, the BPC bioremediation process yielded an oil degradation of 88% after 4 months.

Summary

Crude oil of approximately 100 tons was accidentally spilled in the beach line between Haifa and Acre, Israel. A preliminary field trial resulted with 84.5% oil degradation of a 50 m² sand plot, after 25 days. This trial was followed by a high scale implementation. The Utilization of BPC technology on 30,000 m² of contaminated sand beach yielded 88% degradation (even during winter time), in a 4 months period. Visual examination of the beach sand, following the treatment, in addition to the analytical data, indicate that BPC's technology is an applicable approach for sand bioremediation.

BPC Pilot Treatment of Hydrocarbon Contaminated Sand				
Day	Biologically treated plot		Non-treated plot	
	TPH (mg/g sand)	Degradation (%)	TPH (mg/g sand)	Degradation (%)
0	3.80	0	2.30	0
4	2.76	30	2.53	0
9	1.89	50	1.88	18
21	1.40	63	1.94	15.6
25	0.59	84.5	1.95	15.6