

# **Comparison of Bioremediation Strategies for Treatment of Oil Sludge Contaminated Soil**



**By**

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# **Comparison of Bioremediation Strategies for Treatment of Oil Sludge Contaminated Soil**



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## **Abstract**

Petro chemical hydrocarbons are considered to be the most significant environmental pollutants and are need to be improved. In the present study the biodegradation of petroleum hydrocarbons was achieved under shake flask conditions using an efficient bacterial consortium that was isolated and identified in Environmental Sciences laboratory of Bahria University Islamabad Campus. The consortium was tested for bio surfactant production before being employed for the process of bio degradation. Bio remediation techniques (natural attenuation, bio stimulation and bio augmentation) were assessed with 6% oily sludge concentration in open microcosms over the period of 6 weeks. The percentage removal and petro chemical degradation was evaluated using UV-visible spectrophotometer and Fourier Transform infrared Spectroscopy. Addition of heterotrophic bacteria and nutrients in different concentrations demonstrated higher degradation rate of total petroleum hydrocarbons (TPH) than those of natural attenuation treatments. The bacterial consortium achieved 79.06% degradation of petroleum hydrocarbon in Natural attenuation, 80.62% in bio stimulation and 80.93% in bio augmentation. FTIR spectra of hydrocarbons before and after biodegradation experiments also revealed significant changes in the characteristic peaks, making certain bonds.

## **Dedication**

Dedicated to ALLAH Almighty who made us and we are for HIM. Prophet (S.A.W.W) who showed us the righteous way and to our beloved parents whose love and Prayers have been the source of constant strength and encouragement for me.

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## ABBREVIATIONS

<b>TPH</b>	Total Petroleum Hydrocarbons
<b>FTIR</b>	Fourier Transformed Infrared Spectroscopy
<b>PAHs</b>	Polycyclic Aromatic Hydrocarbons
<b>PAHs</b>	Polycyclic Fragrant Hydrocarbons
<b>US</b>	United States
<b>EPA</b>	Environmental Protection Agency
<b>VOCS</b>	Volatile Organic Hydrocarbons
<b>SVOCS</b>	Semi Volatile Organic Hydrocarbons
<b>CNS</b>	Carbon Nitrogen Sulphur
<b>PCBS</b>	Polychlorinated Biphenyls
<b>pH</b>	Power of Hydrogen ion concentration
<b>GEM</b>	Genetically Engineered Microorganisms
<b>ATP</b>	Adenosine Triphosphate
<b>AOC</b>	Attock Oil Company Limited
<b>ARL</b>	Attock Refinery Limited
<b>NA</b>	Natural Attenuation
<b>BA</b>	Bio-Augmentation
<b>BS</b>	Bio-Stimulation
<b>MSM</b>	Minerals Salt Medium
<b>CFU</b>	Colony Forming Units
<b>UV/VIS</b>	Ultra Violet-Visible
<b>NIR</b>	Near Infrared
<b>UEO</b>	Used Engine Oil
<b>DO</b>	Diesel Oil
<b>Fig</b>	Figure
<b>K<sub>h2</sub>PO<sub>4</sub></b>	Di hydrogen Potassium Phosphate
<b>K<sub>2</sub>hPO<sub>4</sub></b>	Dipotassium Hydrogen Phosphate
<b>MgSO<sub>4</sub>.7H<sub>2</sub>O</b>	Magnesium Sulphate
<b>ZnSO<sub>4</sub>.7H<sub>2</sub>O</b>	Zinc Sulphate
<b>FeSO<sub>4</sub>.7H<sub>2</sub>O</b>	Ferrous Sulphate
<b>MnSO<sub>4</sub>.7H<sub>2</sub>O</b>	Manganese Sulphate
<b>NH<sub>4</sub>NO<sub>3</sub></b>	Ammonium Nitrate

<b>CuSo<sub>4</sub>.7H<sub>2</sub>O</b>	Copper Sulphate
<b>H<sub>2</sub>O</b>	Water
<b>Spp</b>	Specie
<b>CO<sub>2</sub></b>	Carbon dioxide
<b>mL</b>	milliliter
<b>cm<sup>-1</sup></b>	Per Centimeter
<b>°C</b>	Degree Celsius
<b>rpm</b>	Revolution Per Minute
<b>O</b>	Oxygen
<b>CNP</b>	Carbon Nitrogen Phosphorus
<b>L</b>	Liter
<b>nm</b>	Nano Meter
<b>CHNS</b>	Carbon Hydrogen Nitrogen Sulphur
<b>v/v</b>	Volume by Volume
<b>w/w</b>	weight by weight