Enhanced Ex Situ Bioremediation of Hydrocarbons Using Natural Absorbents

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A common problem on most large sites – the “soil treatment area”
Heat-treated peat exposes pores and increases surface area for adsorption and absorption of hydrocarbons (left side). The heat-treated peat with oil encapsulated within the pores (right side).
Role of absorbents in enhancing biodegradation – high concentration.

Extracted Oil from 40 g Soil (g)

Amount degraded in the presence of absorbent in 18 days (17.8%)
Role of absorbents in enhancing biodegradation – low concentration.

Amount degraded in the presence of absorbent in 18 days (17.9%)
Hydrocarbon degrading bacteria remaining within the pores of the heat-treated peat after the metabolism of encapsulated hydrocarbon.
Additional loss of hydrocarbon attributed to amendments added to the contaminated soil

![Graph showing hydrocarbon loss and mass per sample](image-url)
Cumulative oxygen use determined by a respirometer in the first two days

![Graph showing cumulative oxygen use over time for different samples A, B, C, and D. The x-axis represents time in minutes, and the y-axis represents oxygen use in cumulative microliters. Each sample shows a decreasing trend with time.](image-url)
Cumulative carbon dioxide production determined by a respirometer in the first two days
Most probable number counts of hexadecane degraders stimulated by the environment found in microcosms (A) and (B).
• Microcosm (B) resulted in a 30% greater loss in hydrocarbon.

• Microcosm (B) augmented degradation compared to other amendments by approximately 10%.

• Peat absorbents stimulated biodegradation and increased the number of biodegradative organisms by approximately 12,000 fold.
NEXT STEPS
Field Test Cases

- A. Contaminated soil (2 buckets)
- B. Contaminated Soil (2 buckets) + Peat Absorbent (51 - 13 L bags)
- C. Contaminated Soil (2 buckets) + Peat Absorbent with Amendments (12.5 - 44 L bags)
- D. Contaminated Soil (2 buckets) + Inorganic Nutrients (50kg 20:10:10)
- E. Contaminated Soil (2 buckets) + Natural Fertilizer (5.3 - 25kg bags Dana Modern Poultry, Barka, Oman)
- F. Contaminated Soil (2 buckets) + Peat Absorbent (51 - 13 L bags) + Natural Fertilizer (5.3 - 25kg bags Dana Modern Poultry, Barka, Oman)
- G. Contaminated Soil (2 buckets) + Peat Absorbent with Amendments (12.5 - 44 L bags) + Natural Fertilizer (5.3 - 25kg bags Dana Modern Poultry, Barka, Oman)
Residual gasoline range hydrocarbons after five months of treatment
Moisture, temperature, and CFU’s for contaminated soil alone
Moisture, temperature, and CFU’s for contaminated soil with peat absorbent

Temperature (°C) and Moisture (%)

Hydrocarbon degraders (CFU/g)

B Temp
B Moist
B CFU
LEARNINGS

• Field test (B) resulted in the lowest residual hydrocarbon concentration.

• Peat absorbent helped maintain moisture content as temperature increased.

• Peat absorbents stimulated biodegradation and the growth of biodegradative organisms (>1400 X’s).