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Probiotic SOLUTIONS®

Biological Remediation of Diesel Fuel

Introduction

An environmental consulting firm in Arizona successfully bioremediated approximately 100 cubic yards of diesel contaminated soil utilizing Probiotic Solutions® products. The soil was generated from the removal of two underground storage tanks (UST's). A 4,000 gallon unleaded gasoline UST and a 10,000 gallon diesel fuel UST were excavated and removed.

Upon removal of the UST's, a soil investigation was conducted. Several soil samples were collected from the UST excavation areas. The samples were analyzed for total petroleum hydrocarbons (TPH) in accordance with Environmental Protection Agency (EPA) method 418.1 and for aromatic hydrocarbons (BTEX) in accordance with EPA method 8020. Modified EPA method 8015 was used to analyze for gasoline and diesel.

Most analytical results obtained from the soil sample analyses indicated TPH concentrations and aromatic hydrocarbon (BTEX) concentrations below analytical detection limits. However, one composite sample collected from the excavated soil near the fill end of the UST indicated a TPH concentration of 607 parts per million and a total xylenes concentration of 50 parts per billion (ppb). Initial TPH levels were tested by Columbia Analytical Services of Kelso, Washington.

Based upon the results of the investigation, it was determined that TPH contamination was encountered in the UST excavation. The contamination was believed to be caused by overfilling of the tanks or surface spillage, and not a leaking underground storage tank. The extent of the contamination appeared to be limited to a volume of approximately 90 cubic yards (51 tons) of soil. The 90 cubic yards of soil were excavated and transferred to a treatment site. The soil was stored on black 6-mil "visqueen" plastic at the treatment site. The plastic barrier was bermed under and around the edges with clean, clay soil materials. The plastic rested directly on an asphalt parking lot.

Sample Verification of Contaminant

Initial TPH levels reported concentrations of 607 ppm and 504 ppm for diesel, and 14 ppm for gasoline. The main contaminant was therefore interpreted as diesel fuel. Permits were obtained from the Oregon Department of Environmental Quality (DEQ) to begin aeration procedures. The soil was aerated mechanically using a rototiller on a weekly basis for approximately 6 months. A quarterly sampling of the treated soils, analyzed according to EPA method 418.1 for total recoverable petroleum hydrocarbon (TRPH), reported concentrations ranging from 155 to 327 ppm. EPA method 8015 modified reported TPH concentrations ranging from 93 to 221 ppm. There were no detectable gasoline TPH concentrations or BTEX concentrations identified.

Based on field observations and analytical test results, treatment of the excavated soil was found to be less effective in remediating the diesel contaminants in the soil than originally expected. A second remediation method was introduced. Biological remediation was tested to determine if the use of biological constituents (nutrients, soil conditioners, etc.) could promote the biological degradation of petroleum hydrocarbons in the soils stored at the facility in Oregon. A biotreatability procedure was developed and performed to determine the extent of any TPH reduction resulting from indigenous microbial activity.

Biotreatability Study

Soil samples were taken from the treatment site and sent to a laboratory in Arizona. The soil was emptied into a large stainless steel tray. The soil was thoroughly mixed (to create a homogenous mixture) using a steel hand trowel. The soil was then divided equally into four smaller stainless steel trays. Each soil sample received a complex organic material obtained from Probiotic Solutions® in Gilbert, Arizona. The product name was MICATROL®. MICATROL® is designed to protect the biological systems living in the soil from any harmful constituents that may be present. This agent also aids in providing microorganisms with sufficient energy to promote petroleum reduction in soils. MICATROL® complexes petroleum contaminants with proteins, Micro Carbon Technology™, and carbohydrates, enabling the petroleum hydrocarbon products to be accessible for microbial degradation. The chains of the actual hydrocarbons are

reduced in length. Shorter chains are more easily degraded than longer, more complex petroleum products. The soil samples also received nutrients and organic complexes via Probiotic Solutions® products NUTRIPLEX® and BIO ENERGIZER®. These nutrients included nitrogen, phosphorous, micronutrients, and a soil conditioner. Three of the soils were treated with varying degrees of the complexing agents. A fourth sample received no treatment except for water and aeration.

Once the samples were prepared, the soil was tested weekly during a four week period for TPH concentrations, pH, moisture, odor, organic matter, temperature, and microbial population counts. All of the soil samples were aerated once every three days using a steel hand trowel. The samples also received water every third day to provide adequate moisture levels for microbial activity. The treated samples received injections of the previously described products every seventh day for the first 21 days of the study. Upon completion of the study, all three samples reported TPH decreases to below detectable limits. The control sample which did not receive any of the treatment products did not decrease in TPH concentrations. Biological activity increased in all samples with the exception of the control sample. The results of the biotreatability study were favorable in supporting the use of the bioremediation procedure for the soils stored at the Oregon facility.

Bioremediation

Procedures

The soil treatment area was prepared previous to the biotreatability study, so there was no need to reconstruct a land treatment unit. Treatment procedures for bioremediation included application of the contaminated soil with several complexing agents and nutrient products provided by Probiotic Solutions® of Arizona. The products consisted of BIO ENERGIZER®, MICATROL® and NUTRIPLEX®. These products, along with mechanical soil tilling and moisture, encourage existing indigenous soil organisms to utilize the TPH/TRPH as an energy or food source.

The products delivered by Probiotic Solutions® were sprayed onto the surface of the soil using a backpack sprayer unit. Upon completion of the application of the products, the soil was tilled weekly using a standard garden rototiller. The complexing agents and nutrient products were allowed to leach into the soil by watering with a garden sprayer. Following the watering process, the soil pile was covered with a 6-mil "visqueen" plastic cover, to prevent flooding of the bermed area which may have resulted from rainfall.

Analytical Chemistry Verification

After seven weeks of biotreatment, verification soil samples were collected from the soil holding area. The verification samples were prepared by collecting equal volumes from each of twenty-four grid points superimposed on the soil pile. Soil samples from every fourth grid location were sampled and delivered to a certified lab in Arizona for chemical analysis.

All soil samples were collected, transported, and analyzed in accordance with EPA document SW-846, "Test Methods for Evaluating Solid Wastes", 3rd Edition, and "Methods for Chemical Analysis of Water and Waste Water." The composite soil samples collected during the excavation were analyzed for diesel fuel by Columbia Analytical Services of Kelso, Washington in accordance with EPA Method 8015 modified. In addition, all soil samples were analyzed for TRPH in accordance with EPA Method 418.1 modified.

The analytical chemistry test results of verification soil samples collected from the soil treatment pile indicated TRPH concentrations ranging from 13 to 51 ppm. These concentrations are below the Oregon Department of Environmental Quality cleanup guidelines of 100 ppm for diesel contaminated soils.

Summary and Conclusions

A 4,000-gallon unleaded gasoline UST and a 10,000-gallon diesel UST were removed from the Oregon facility. The excavated soil was stockpiled on-site and sampled for TRPH. Analytical chemistry test results indicated a TRPH concentration of 607 ppm. Approximately 90 cubic yards of contaminated soil was transported to an offsite facility for remediation by aeration methods. After six months of aeration, the soil had not been remediated to acceptable levels. After the 6-month aeration treatment, a bioremediation treatment project was started to expedite the contaminated soil remediation process. Analytical chemistry test results of verification soil samples collected one month after beginning the bioremediation of the contaminated soils using BIO ENERGIZER®, MICATROL® and NUTRIPLEX® indicated TRPH concentrations below the Oregon DEQ cleanup standards. Three months later the project was completed with final on-site disposal of the soil.

Based on field observations, and analytical chemistry test results, it was concluded that bioremediation of the excavated contaminated soils was successful in lowering TRPH concentrations below Oregon DEQ cleanup standards.

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