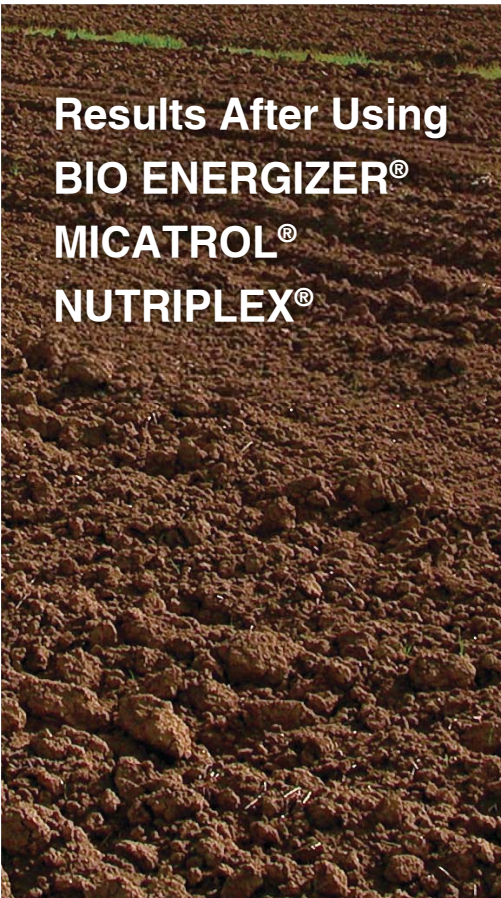




## Biological Remediation of Crude Oil Contaminated Soil

Results After Using  
**BIO ENERGIZER®**  
**MICATROL®**  
**NUTRIPLEX®**



### Introduction

A remediation company in Arizona was selected to complete a Remedial Action Plan for soils contaminated with crude oil located in an oil production field in Texas. The crude oil contaminated soil was generated from storage tank bottom materials which had been removed from several oil recovery storage tank batteries located within the oil field storage facility. The soils were store on-site for approximately five years (with periodic addition of materials to the storage pile). Bioremediation probiotic technology was chosen using Probiotic Solutions® products (BIO ENERGIZER®, MICATROL® and NUTRIPLEX®) for the pilot study clean-up and mitigation of the petroleum contaminated soil materials.

### Sample Verification

During the preparation of the tank-bottom materials treatment, a composite sample was obtained and sent to a certified laboratory for analytical verification. The investigation revealed total petroleum hydrocarbon (TPH) levels at 75,000 parts per million (ppm). The composite sample also reported barium levels at 1,750 ppm, cadmium at 0.4 ppm, chromium at 7.5 ppm, mercury at 0.1 ppm, and lead levels at 49.9 ppm. BTEX and MTBE were not tested. All Environmental Protection Agency (EPA) analyses were conducted by a certified lab in Arizona. Samples were obtained in accordance with EPA documents SW- 846 "Test Methods for Evaluating Solid Waste" and "Methods of Chemical Analysis for Water and Wastewater. Initial investigations were reported using EPA methods 418.1 modified for total recoverable petroleum hydrocarbons (TRPH). Metals were reported using an EPA method for EP tox metals by total digestion analysis. The soils were heavily contaminated with highly saturated crude oil. The soil in the storage area exhibited cement like characteristics on the direct surface of the materials, but below this one inch hard crust was a soil that displayed a wet cement like soil. The material was highly liquefied and had no solid texture.

### Bioremediation Procedures

Treatment of the soil began on July 27. The soil pile was spread out over an area approximately 200 feet in length, and 30 to 75 feet in width. The depth of the soil was approximately 12 to 18 inches. All areas surrounding the pile were protected by an earthen berm. A large bulldozer was utilized to spread the materials over the land treatment unit (LTU) area. The soil being spread was highly saturated with oil materials as described above. The tank bottom materials were not easily spread because of the liquefied state they were in. The material exhibited the characteristics of wet cement when being spread.

To initiate the solidifying and detoxification of the tank bottom materials, MICATROL® was applied to the soil. This product is comprised of specific organic elements and compounds which are successful in tying up and buffering harmful contaminants which may hinder the biological remediation of petroleum products. The product was applied via a high pressure delivery system. The products were mixed in a 500-gallon holding tank and then pumped through a high pressure motor into and out of a delivery hose. The probiotic products were applied over the entire area, ensuring complete and adequate coverage of the contaminated material being treated. Upon completion of the treatment, the materials were mixed mechanically the following day.

The soil materials received several watering treatments to ensure that the soil retained enough moisture and water for microbial activity. The soil was also periodically mixed using a tractor mounted mixing device. The soil received a second treatment of probiotic products on August 8. No non-indigenous organisms were applied, but complexed nutrients were applied to the materials. The nutrients were supplied via the product NUTRIPLEX® and were applied along with BIO ENERGIZER® which is a probiotic complex of organic acids, buffers, nutrients and energy systems which enhance natural biological systems. A third product MICATROL® was also used. MICATROL® is a probiotic product engineered to pull petroleum compounds from the matrices of soil particles. The soil was tilled and mixed periodically by mechanical methods after the soil was treated. Water was also added periodically to ensure proper moisture content.

The tank bottom materials changed color from a dark-gray or black color to a brown or light brown color. The soil materials had taken on a completely different texture after the treatments using the Probiotic Solutions® products. The petroleum odors emanating off of the materials had decreased substantially because of volatilization and/ or the tying-up action of the volatile compounds by the probiotic complexes applied to the soil. The crumble structure of the materials had also improved as the TPH saturation of the soils had been decreased by the indigenous organisms which had biodegraded the petroleum products.

## Conclusion

The contaminated material was inoculated only twice during a one month period. The soil was inoculated by surface application to guarantee that the probiotic products and water were applied efficiently to the soil materials. The nutrients (NUTRIPLEX®) and other probiotic complexes (BIO ENERGIZER® & MICATROL®) were pre-mixed in a 500 gallon tank and were then applied under high pressure into and onto the soil. The mixture was added to the soil in an effort to release the saturated oil complexes, detoxify the materials for microbial proliferation, and to supply adequate nutrients to the soil for microbial assimilation. The saturated soils were effectively treated and the soil became more manageable and workable as the project progressed. The probiotic complexes which were utilized seemed to have the best effect on the soil. Probiotic complexes actually rearrange the structure of petroleum hydrocarbons and will detoxify harmful environments that have been affected by petroleum contaminants. This was readily noticeable and very beneficial in the treatment procedures. The petroleum contamination became more available for microbial degradation once freed from the saturated tank bottom materials.



Approximately six weeks later a second sampling of the material was conducted to verify current TPH reduction levels. The sampling reported TPH levels at below 10,000 ppm. The reduction from 75,000 ppm to below 10,000 ppm in a thirty day period is remarkable and very substantial. The reduction reported verified that the bioremediation processes are effective in reducing high petroleum hydrocarbon contamination, even in highly saturated tank bottom materials. The Probiotic Solutions® products (BIO ENERGIZER®, MICATROL® and NUTRIPLEX®) and application procedures are beneficial and responsible for the reduction of the TPH concentrations. It is also evident that the aeration procedures were also beneficial in establishing the proper environment for microbial proliferation, resulting in substantial contaminant degradation.

**No non-indigenous soil microorganisms were utilized.** The indigenous organisms were utilized because of the established microbial populations that had developed over the five year period of time that the tank bottom materials had been stored on site. The soil contained in the LTU received approximately 3,000 gallons of water per inoculation. The water was utilized as a carrier for Probiotic Solutions® products. The soil was mixed and surface irrigated periodically to ensure proper soil moisture availability approximately 30% moisture content. The soil pile was aerated mechanically with a tractor and mechanical mixing device. The aeration process coupled with Probiotic Solutions® products provided sufficient oxygen and necessary nutrients for the microbiological ecosystem in the soil to effectively reduce the TPH concentrations.

Our Probiotic Solutions® Products  
Are Highly Efficient and Effective Due to Our Unique Delivery System



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