

Evaluation of Nature's Broom Plus for Remediation of Used Motor Oil and Hydraulic Fluid

Summary:

In a nine week study, a bio-based oil absorbent, Nature's Broom Plus, was evaluated for its ability to stimulate the degradation of petroleum products in used motor oil and hydraulic fluid. There were three treatments: 1) controls containing only Nature's Broom Plus and de-ionized water, 2) Nature's Broom Plus contaminated with ~ 20,000 ppm of Havoline motor oil and de-ionized water and 3) Nature's Broom Plus contaminated with ~ 10,000 ppm of used hydraulic fluid and de-ionized water. Total petroleum hydrocarbon (TPH) analysis showed that there was a 75% degradation of the motor oil and 67% degradation of the hydraulic fluid after 9 weeks. Bacteria counts showed an exponential increase in all samples throughout the nine week test period

Procedure/Methodology

Nature's Broom Plus was provided by a company located in Hollandale, Mississippi. One hundred grams of Nature's Broom was measured into each of the nine brown glass dishes used for the test. Three of the six dishes were an absorbent -only controls and the other six dishes were absorbent plus motor oil per dish or hydraulic fluid. Sixty grams of deionized water was added to all dishes to yield 60% moisture content. The 60% moisture content is optimum for bacterial growth in a matrix of this nature (Borazjani, 1997). As soon as the dishes were mixed, a 20 gram sample was taken from each dish for day 0 testing. Each dish was weighed and subsequently recorded to determine future moisture loss in the dishes. The moisture loss was adjusted to 60% with deionized water every three days. A 20 gram sample was pulled from each dish every three weeks during a nine week study. Samples were tested for bacteria counts and TPH

TPH concentrations were measured by using the modified Standard Method 5520-F (Clesceri, 1989). Ten mL of methylene chloride were added to a vial containing one gram of Nature's Broom. The mixture was vortexed for one minute and sonicated for 10 minutes. One mL of extract was pipetted into a test tube containing nine mL of methylene chloride and one gram of silica gel to remove fatty acids. The mixture was vortexed for one minute. The solution was filtered through 10 grams of activated sodium sulfate into a pre-weighed flask containing boiling chips. The filter and sodium sulfate was rinsed with 20 mL of methylene chloride to remove residual petroleum hydrocarbons. Flasks containing the solution were placed into a boiling water bath to evaporate the methylene chloride. The flasks were allowed to cool and subsequently reweighed. The difference in the initial weight and the final weight of the flasks was attributed to TPH (Borazjani, 1997; ATSDR, 1999)

In order to estimate bacteria populations, nutrient agar and nutrient agar amended with petroleum were used. One gram of each sample was added to autoclaved water tubes for dilution. Each sample was diluted and plated on two nutrient agar plates and two TPH agar plates. The plates were incubated at 28°C for approximately 48 hours to allow the bacteria present in the sample to multiply. Bacteria counts were performed on the samples on day 0, week 3, week 6, and week 9.

Results

TPH levels in the motor oil samples decreased by 75% over the nine week test period, while hydraulic fluid decreased by 67% as shown in Figure 1. The starting concentration of motor oil was greater than the starting concentration of hydraulic fluid. Bacteria counts yielded exponential growth throughout the nine week test. Levels for bacteria acclimated to TPH also grew exponentially in all sample sets throughout the nine week test as shown in Figure 2. The exponential growth of the bacteria acclimated to TPH present in Nature's Broom Plus was the main source of degradation for the petroleum hydrocarbon.

Figure 1. Concentration of Motor Oil and hydraulic fluid at Day 0 and Week 9.

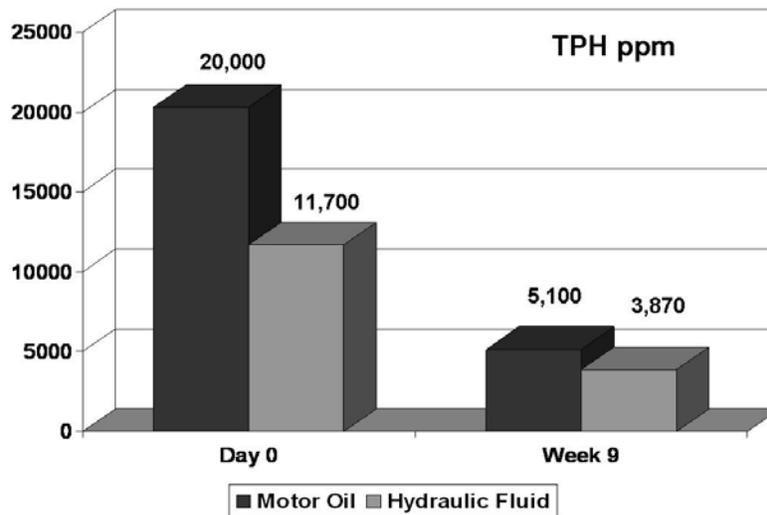
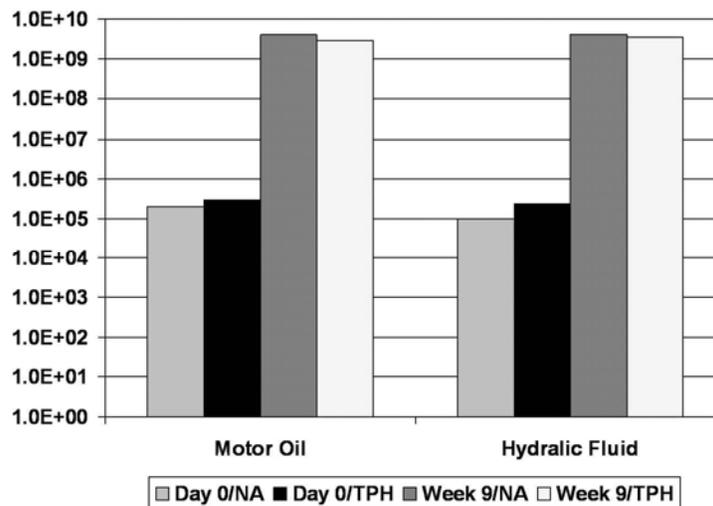


Figure 2. Bacteria counts on Nutrient Agar and Nutrient Agar amended with TPH for Controls and Motor Oil Samples at Day 0 and Week 9 of study.



Nature's Broom showed ability to degrade motor oil and hydraulic fluid over a reasonable three month time period and appears to be a suitable product for use on highway oil spills. It contains a high level of bacteria which is essential in the breakdown of petroleum hydrocarbons. The bacteria use the starches stored in the wood fibers as a starter food source and begin multiplying when moisture content and temperature allow. Enzymes produced by the bacteria will break down the petroleum hydrocarbons into non-toxic compounds. This suggests that Nature's Broom Plus contains the bacteria necessary for breakdown of petroleum hydrocarbons and a starter food source for the bacteria as well. Adsorption ability coupled with its degradation capability, ensure that Nature's Broom Plus has the ability to encapsulate and degrade certain petroleum products, such as motor oil, after disposal.

References

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