

Treatability Testing Toward Soil and Groundwater Remediation Using the Oppenheimer Formula™

A short, low-cost pre-trial that determines whether microbial treatment is suitable before remediation begins.



BioRangers

What Is a Treatability Test?

A treatability test (microbial treatment suitability test) determines, before remediation begins, whether microbial cleanup can succeed. Using soil and groundwater collected from the actual site, it confirms that the target substances and samples do not inhibit microbial growth. By using the Oppenheimer Formula™ (a microbial consortium), a multi-microbial agent whose effectiveness has been verified in advance, this determination can be made quickly and at low cost, leading to highly reliable remediation measures.

Purpose of the test Determine suitability of microbial remediation	Agent used Oppenheimer Formula™
Duration From 2 weeks between test start and report	Target Soil and groundwater contamination (oil, VOC, etc.)

Test Samples and Analytical / Measurement Parameters

The samples used are soil and groundwater collected from the actual site. Because soil is not uniform in character or particle size — ranging from cohesive to sandy soils — it is passed through a sieve of about 4 mm to equalize particle size, and uniformity is maintained by adjusting the moisture content and mixing. For oil contamination, TPH (total petroleum hydrocarbons) serves as the indicator analytical parameter, and total microbial count, pH, nitrogen (ammonium / nitrite / nitrate), phosphorus (phosphate), oil odour, and oil sheen are measured.

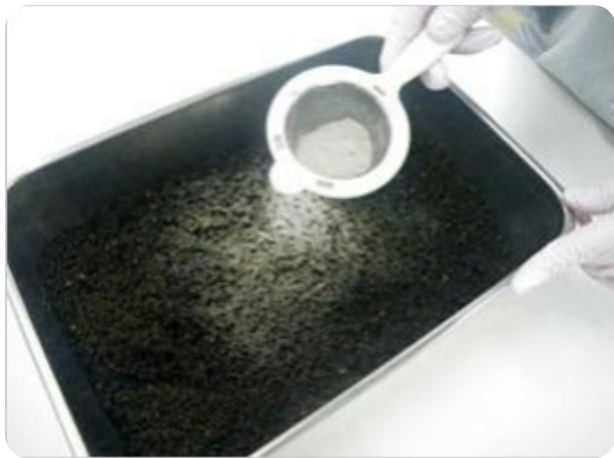
TPH is quantified mainly by the GC-FID method at a third-party analytical institution. Total microbial count is obtained by direct microscopy (Direct Count), which is free of culture-medium bias and ideal for observing the natural environment; pH, nitrogen, and phosphorus are measured with simple measurement kits such as pack tests; and oil odour and oil sheen are quantified in accordance with the guidelines for oil contamination countermeasures (oil sheen by the petri-dish method).

Case Study ① Class-A Heavy-Oil-Contaminated Soil

Site-collected soil was passed through a 4 mm sieve, and 1 kg was portioned into a stainless tray to secure a pre-treatment sample. To the remainder, prescribed amounts of nutrient, an essential-element aqueous solution, and the multi-microbial agent were added; the mixture was stirred once daily and cured at room temperature. Samples were taken every two weeks to track the changes in TPH (GC-FID method) and total microbial count.



Test operation: sieving the soil sample



Test operation: adding the multi-microbial agents

TPH fraction (mg/kg-dry)	Initial value	Day 14	Day 42
C6~C12	<48	<48	<47
C12~C28	520	290	140
C28~C44	3,100	1,300	520
C6~C44 (total)	3,700	1,700	650
Total microbial count (cells/g-wet)	6.99E+07	2.20E+08	3.77E+08

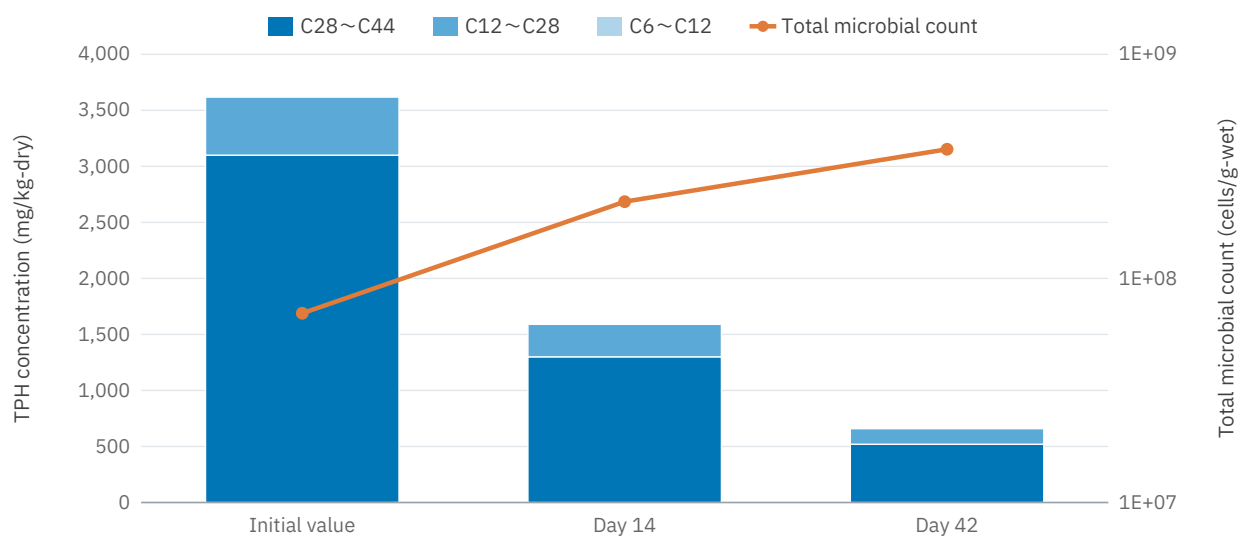


Fig. 1: Changes in TPH fractions and total microbial count (Class-A heavy-oil-contaminated soil)

Conclusion: TPH decreased from an initial value of 3,700 mg/kg to 650 mg/kg by Day 42. The total microbial count increased from 6.99E+07 to 3.77E+08 cells/g-wet, with no growth inhibition observed. The soil in question is therefore judged to be amenable to remediation with the multi-microbial agent.

Case Study ② Lubricating-Oil-Contaminated Groundwater

Site-collected groundwater was portioned at 100 mL each into four 500 mL Erlenmeyer flasks to secure a pre-treatment sample. To the remaining two flasks, prescribed amounts of nutrient, an essential-element aqueous solution, and the multi-microbial agent were added, and the flasks were cultured on a shaker. After one week, post-treatment samples were collected and TPH and total microbial count were compared.



TPH fraction (mg/L)	Initial value	Day 7
C6 ~ C12	<4.1	<4.1
C12 ~ C28	123	24
C28 ~ C44	841	100
C6 ~ C44 (total)	964	124

TPH fraction (mg/L)	Initial value	Day 7
Total microbial count (cells/ml)	6.81E+06	1.17E+08

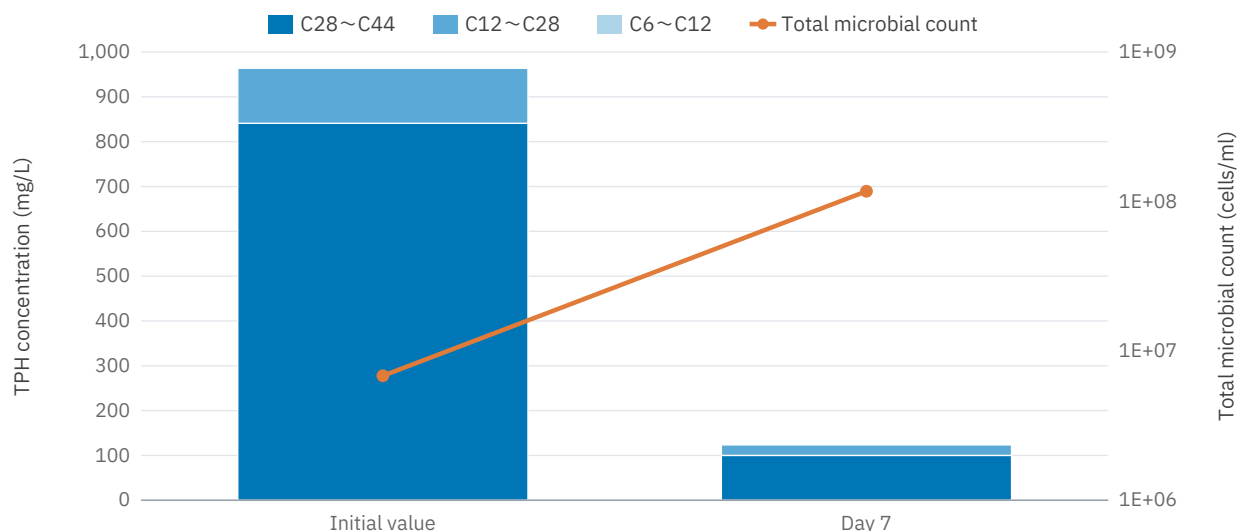


Fig. 2: Changes in TPH fractions and total microbial count (lubricating-oil-contaminated groundwater)

Conclusion: TPH decreased from an initial value of 964 mg/L to 124 mg/L by Day 7. The total microbial count increased from 6.81E+06 to 1.17E+08 cells/ml, with no growth inhibition observed. This groundwater is likewise judged to be amenable to remediation with the multi-microbial agent.

• Evaluation

Evaluation Method and Significance

TPH is evaluated by the decrease in its total and in each fraction, and total microbial count by its increase or decrease. pH is confirmed to be in the neutral range; nitrogen and phosphorus are assessed for whether the amount required relative to TPH is sufficient; and oil odour and oil sheen are quantified to qualitatively evaluate the presence or absence of the target substances. If a decrease in the target substances and an increase in the total microbial count can be confirmed, the sample can be judged amenable to remediation with the multi-microbial agent.

Confirming effectiveness in advance leads to the implementation of highly reliable remediation measures and, for reference, also serves as an indicator for tracking progress during remediation. In addition to the standard test, we offer custom treatability tests with adjusted test periods, analytical parameters, frequencies, and the like. Because the verification period is short and the cost is low, we recommend it when you are considering the remediation of soil and groundwater contamination.