

# Analytical Techniques for Tracking the Bioremediation of Hydrocarbons in Sludge and Soil Polluted By Petroleum

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## Abstract

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**Keywords:** Bioremediation; Hydrocarbons; Soil contamination; Sludge contamination

## Introduction

Petroleum hydrocarbons are major environmental pollutants, causing soil and sludge contamination through accidental spills, industrial activities, and improper disposal practices [1]. The persistence of hydrocarbons in the environment poses risks to ecosystem health and human well-being, necessitating effective remediation strategies. Bioremediation, which harnesses the metabolic capabilities of microorganisms to degrade hydrocarbons into harmless by-products, has gained attention due to its cost-effectiveness and sustainability compared to traditional remediation methods like excavation and incineration [2]. Monitoring the efficiency and progress of bioremediation processes is crucial for assessing remediation success and environmental safety. Various analytical techniques are employed for this purpose; Gas chromatography (GC) and high-performance liquid chromatography (HPLC) are widely used to quantify hydrocarbon concentrations in contaminated samples [3]. These techniques offer high sensitivity and specificity, enabling accurate monitoring of pollutant degradation over time. GC-intl

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of microbial activity and the origin of carbon sources. Isotope ratio mass spectrometry (IRMS) and compound-specific isotope analysis (CSIA) are powerful tools for assessing the biodegradation of petroleum hydrocarbons and distinguishing between biotic and abiotic degradation processes [12-14].

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