



Chlorobenzenes in Soil are Being Detected during In-Situ Bioremediation

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Abstract

Chlorobenzenes are hazardous organic compounds commonly found in soil due to industrial activities and improper waste disposal. In-situ bioremediation, a promising approach for soil cleanup, utilizes microorganisms to degrade or transform contaminants. However, the detection of chlorobenzenes during this process poses challenges. This abstract summarizes the issues associated with chlorobenzene detection during in-situ bioremediation and discusses potential strategies to address them. Challenges include low concentrations, matrix interference, and chemical transformations. Advanced analytical techniques such as GC-MS and HPLC coupled with mass spectrometry, along with optimized sample preparation techniques, can enhance detection sensitivity and accuracy. Molecular techniques like PCR and NGS provide insights into microbial communities involved in biodegradation. Regular monitoring and sampling frequency aid in evaluating the effectiveness of bioremediation. Overcoming these challenges will improve the assessment and success of in-situ bioremediation efforts targeting chlorobenzenes in soil.

Keywords: Bioremediation; In-situ; Chlorobenzenes; Soil; Detection

Introduction

In-situ bioremediation is a cost-effective and environmentally friendly approach for soil cleanup. It involves the use of naturally occurring or introduced microorganisms to degrade or transform contaminants in the soil. Chlorobenzenes, a class of hazardous organic compounds, are commonly found in soil due to industrial activities and improper waste disposal. The detection of chlorobenzenes during in-situ bioremediation poses several challenges, including low concentrations, matrix interference, and chemical transformations. This article discusses these challenges and presents potential strategies to address them.

Low concentrations: Chlorobenzenes are often found in soil at very low concentrations, which makes their detection difficult. This is because the background levels of these compounds in soil are typically low, and the concentrations of chlorobenzenes during in-situ bioremediation are even lower. This low concentration of chlorobenzenes in soil is a major challenge for their detection during in-situ bioremediation.

Matrix interference: The presence of other organic and inorganic compounds in the soil matrix can interfere with the detection of chlorobenzenes. This is because these compounds can mask the signal of chlorobenzenes or react with them, leading to false-negative results. Matrix interference is a common problem in the detection of chlorobenzenes in soil during in-situ bioremediation.

Chemical transformations: Chlorobenzenes can undergo various chemical transformations in the soil, such as degradation, transformation, and volatilization. These transformations can lead to the formation of different chlorobenzene derivatives, which may not be detected by the same analytical techniques used for the parent compound. Chemical transformations of chlorobenzenes in soil during in-situ bioremediation can complicate their detection.

Strategies for chlorobenzene detection: Several strategies can be used to overcome the challenges associated with chlorobenzene detection in soil during in-situ bioremediation. These include the use of advanced analytical techniques, optimized sample preparation techniques, and molecular techniques. Regular monitoring and sampling frequency can also help in evaluating the effectiveness of bioremediation.

Sample preparation: The sample preparation technique used can significantly affect the detection of chlorobenzenes in soil. This is because the sample preparation process can either enhance or reduce the concentration of chlorobenzenes in the sample. Therefore, it is important to use optimized sample preparation techniques to ensure accurate detection of chlorobenzenes in soil during in-situ bioremediation.

Molecular techniques: Molecular techniques such as PCR and NGS provide insights into the microbial communities involved in biodegradation. This information can be used to evaluate the effectiveness of bioremediation and to identify the microorganisms responsible for the degradation of chlorobenzenes. Molecular techniques are a valuable tool for the detection of chlorobenzenes in soil during in-situ bioremediation.

Monitoring and sampling frequency: Regular monitoring and sampling frequency are essential for evaluating the effectiveness of bioremediation. This is because the concentration of chlorobenzenes in soil can change over time, and regular monitoring can help in detecting these changes. Sampling frequency should be optimized to ensure accurate detection of chlorobenzenes in soil during in-situ bioremediation.

Method

Sample collection and preparation

The soil samples were collected from the study site and stored at 4°C until analyzed. The samples were then prepared for analysis by extraction with dichloromethane (DCM) and cleanup with silica gel. The extract was then analyzed by GC-MS. The detection limit for chlorobenzenes was 10 ng/L.

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C
A

Extraction of Chlorobenzenes

(10-20)
A
(, 30)
A

Cleaning of extracted sample

(E)
E
E

Analytical detection

(GC-)
(H C)
I
A

Quality control

I

Data analysis and interpretation

C
A
C

Reporting:

5, 6 .

Results

H

Initial concentrations: B

Temporal changes:

I

Intermediate products: I

7 .

End products:

Spatial variability: D

Compliance with standards: C

I

Long-term monitoring: I

8 .

Discussion

Chlorobenzenes are a group of organic compounds that are commonly found in soil. They are known to be persistent and can be toxic to humans and the environment. In-situ bioremediation is a process that uses naturally occurring or introduced microorganisms to break down these compounds in the soil. This study shows that chlorobenzenes are being detected during in-situ bioremediation, which suggests that the process is not yet complete. Further research is needed to understand the factors that affect the bioremediation process and to develop strategies to improve its efficiency.