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Treatment of Hydrocarbons by Microorganisms in Petroleum Refining

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Abstract

Due to the toxicity and fire resistance of aromatic components in the absence of oxygen, petroleum pollution of soils and sediments is a global concern. Floating oxygen can injected into the anaerobic region of a contaminated environment to promote ineffective and expensive biodegradation Alternatives include more soluble electron acceptors like nitrates and sulfates, but these are incompletely decomposed hydrocarbons that oxidize slowly.

Keywords: Hydrocarbons, Microorganisms, Petroleum Refining

Introduction

This section explains how chlorate invasion can be used by perchlorate-reducing bacteria as a different source of oxygen to degrade pollutants. This intermediate step in the microbial reduction of perchlorate or chlorate involves the conversion of chlorate to molecular oxygen and chloride. We isolated new microbes as part of our research on microbial perchlorate reduction. Distorted CKB that grows anaerobically by perchlorate or reduction of chlorate is made from waste sludge from a Pennsylvania paper mill. After two days of incubation, about 40% of the original 14C is recovered in this form when chlorite is added to a soil sample of the CKB strain that has been contaminated with petroleum in the absence of oxygen. After two days of incubation, about 40% of the original ^{14}C is recovered in this form when chlorite is added to a soil sample of the CKB strain that has been contaminated with petroleum in the absence of oxygen. On the third day after adding 1 mM chlorite to the sediment, 60% of the 14C will be recovered as CO_2 by the sixth day. In samples without chlorite or CKB strains, no $^{14}CO_2$ is produced.

Anaoxic soil samples that have not previously been exposed to hydrocarbons yield similar results. There is, however, a brief delay stage of 24 hours that is consistent with the microbial population's benzene adaptation. Low chlorite concentrations are used without significantly altering the stimulating effect. More than half of the degree of benzene degradation seen in 1 mM chlorite was also seen in 1 mM chlorite.

Clearly defined mixed cultures without soil also experience this stimulating effect. Naphthalene is rapidly converted to $14CO_2$ when [^{14}C] naphthalene is combined with an aerobic hydrocarbon oxide Pseudomonas JS150 strain and treated with chlorite under anaerobic conditions. If you omit either the creature or the chlorite, $14CO_2$ will not be produced unless you also add O_2 to your headspace. As a result, the presence of the CKB strain and chlorite is directly related to the rate of naphthalene degradation.

We hypothesized that the CKB strain's ability to recognize chlorites for O_2 and chloride could be the cause of the stimulation of

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hydrocarbon degradation since the CKB strain cannot degrade aromatic hydrocarbons in pure culture. The resulting O_2 is utilized by naturally occurring aerobic hydrocarbon-oxidizing bacteria, which are prevented from doing so by the soil's anoxic environment. It has been shown that doing this produces O_2 quickly and proportionately by adding chlorite to the CKB strain's anaerobic-washed whole cell suspension. If the cells are killed by heat or left unattended, O_2 production is not possible.

Our findings demonstrate that the production of extracellular O_2 from chlorite by perchlorate-reducing bacteria in anaerobic environments is possible. Hydrocarbon-oxidizing bacteria can use this O_2 to break down hydrocarbons, including the dangerous chemical benzene. Due to its toxicity and relative solubility, this environmental contaminant is particularly significant. Perchlorate-reducing bacteria are common in a wide range of environments, including pristine soil and petroleum-contaminated sediments, but little is known about them.

Our findings are within the limits established by the World Health Organization (200 mg/liter) and the US Environmental Protection Agency (1 mg/liter) despite the fact that high concentrations of chlorite can be toxic to many microbial species. The use of chlorite influx as a bioremediation technique to promote hydrocarbon oxidation in contaminated environments presents a fresh substitute for conventional infusion techniques.