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Two Oil Sands Tailings Ponds Native Microbes Iso-Alkane Breakdowns by Methanogenic Organisms

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Abstract

Alkanes, which are frequently present in crude oils and petroleum products, are among the least chemically reactive organic compounds. Despite being inert, alkanes have been the only sources of carbon and energy for bacteria in aerobic settings for more than a century. On the other hand, the anaerobic microbial metabolism of alkanes has only recently been firmly demonstrated, with a focus largely on n-alkanes. There are currently few reports of anaerobic biodegradation of iso- and cycloalkanes due to their relative resistance compared to n-alkanes.

***Keywords:** Cycloalkanes; Microbes; Methanogenic; Biodegradation; Chemically reactive*

Description

Biodegradation of iso- and cycloalkanes occurs after a few days of incubation under aerobic conditions; however it takes much longer under anaerobic ones. However, because iso- and cycloalkanes are significant oil components that can have an impact on the environment, research into the biodegradability of these compounds in anaerobic environments is essential. A significant land feature of surface mined oil sands operations in Northern Alberta, Canada, tailings ponds are a source of Greenhouse Gas (GHG) emissions, primarily methane (CH_4). The oil sands processing effluents, which also include water, sand, silt, clay, and unextracted bitumen, are deposited in enormous oil sands tailings ponds where methanogens flourishes. Unrecovered extraction solvents, of which alkanes are a significant component, make up a small fraction of these effluents.

Different operators use various naphtha distillates, a mixture of mostly C_5-C_{10} aliphatics plus monoaromatics, as used by Canadian Natural Resources Limited (CNRL), to paraffinic (almost entirely aliphatic C_5 and C_6 hydrocarbons), as used by Canadian Natural Upgrading Limited (CNUL; formerly known as Shell Albian Sands Inc). In Mature Fine Tailings (MFT) retrieved from the Syncrude Canada Limited tailings pond known as Mildred Settling Lake Basin, previous research found that n-alkanes were an important substrate for the indigenous methanogenic microbial community, whereas other important components like iso- and cycloalkanes were only degraded after extensive laboratory incubation.

Additionally, we found that MFT microorganisms preferred to degrade n-alkanes found in their own tailings solvent over those found in the solvents of other tailings ponds. The objective of this work was to determine whether this pattern of preference persisted in these two tailings ponds, which differ in age, residual solvent, and other variables, for resistant "secondary substrates" such iso-alkanes. Based on information on the composition of the solvents employed in two blends of iso-alkanes were made. We assessed the volume and trends of CH_4 production.

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In sealed microcosms with each MFT incubated with its cognate solvent and the other 'exotic' solvent, biodegradation of individual iso-alkanes within the mixtures and changes in the microbial communities exposed to the isoalkane mixtures were used as indications of biodegradation capacity. Since all extraction solvents used by surface-mined oil sands operators contain iso-alkanes, evaluating their biodegradation by MFT from different tailings ponds can shed light on the anaerobic isoalkane biodegradation processes.