Council for LAB/LAS Environmental Research

LAS ANAEROBIC BIODEGRADATION

Anaerobic biodegradation refers to biodegradation under oxygen-free (anoxic) conditions. The requirement for anaerobic biodegradation of the cleaning agents (surfactants) used in laundry and cleaning products has been a part of ecolabel programs in Europe, which attempt to identify "environmentally preferred" ingredients. As is frequently the case with biodegradation data, the available information regarding the anaerobic biodegradation of LAS is sometimes contradictory. Much of the contradiction is a result of the unrealistic requirements built into the experimental guidelines. LAS has been shown to undergo anaerobic biodegradation in certain anoxic marine sediments and bio-reactors, vessels designed to facilitate treatment of wastewater by microorganisms. However, anaerobic biodegradation is not relevant to environmental safety for substances such as LAS that rapidly and completely biodegrade under aerobic conditions, which predominate in the real world environment. Consequently, a requirement for anaerobic biodegradation is not supported by the available science.

- Anaerobic biodegradation is not relevant to environmental safety for substances such as LAS that are rapidly and completely biodegraded under aerobic conditions, which predominate in the real world environment.[(1)] Anoxic conditions are encountered in anaerobic digesters used in sewage (wastewater) treatment. The LAS remaining in the sludge (bio-solids) after anaerobic digestion does not impact the environment as the bio-solids are typically applied to agricultural lands as a soil conditioner or fertilizer, where any residual LAS undergoes rapid and complete biodegradation. For other methods of sludge disposal, such as landfilling or incineration, biodegradation is not relevant.

- LAS undergoes anaerobic biodegradation in selected marine sediments. Lara-Martin et al.[(2,3,4,5)] demonstrated that LAS biodegrades in anoxic marine sediment. Laboratory experiments performed on anoxic marine sediments spiked with 10-50 ppm of LAS showed that degradation is feasible, reaching a value of 79% in 165 days, with a half-life time of ca. 90 days. Anaerobic biodegradation was also observed with marine sediments sampled at anoxic depths in the sedimentary column. LAS concentrations in pore waters decreased sharply while biodegradation intermediates (SPC) increased. An anaerobic biodegradation pathway for LAS has also been demonstrated. The initial step in LAS anaerobic biodegradation (fumarate addition) is similar to the initial step of anaerobic biodegradation of simple compounds widely found in the environment (long-chain alkanes), structurally similar to the alkyl chain of LAS. More recently, anaerobic biodegradation of LAS has been demonstrated with marine sediments using a standard test method, the OECD 308 Guideline.

- LAS anaerobic biodegradation has also been demonstrated in 18 studies using batch and flow-through bio-reactors, vessels designed to facilitate treatment of wastewater by microorganisms.[6] Analytical methods specific for the detection of LAS were used to ensure sensitive and accurate measures of biodegradation. The biodegradation observed was primary biodegradation (removal of parent material (LAS)) but complete biodegradation (mineralization) was documented in one study using radiolabeled LAS. Anoxic conditions were confirmed by use of resazurin oxygen-indicator dye, by linking biodegradation with anaerobic processes such as denitrification and by demonstrating that the predominant microorganisms present are only compatible with anoxic conditions. A recent study[7] indicated that the biodegradation pathway in bio-reactors is the same as in marine sediments, identifying bacteria in bioreactors with the metabolic capability of executing each step of the LAS anaerobic biodegradation pathway observed in marine sediments.

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