ANAEROBIC MICROBIAL DEGRADATION OF SURFACTANTS

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Surfactants which are used today constitute a diverse group of chemicals designed for cleaning and solubilization purposes. These are the main ingredients of household and industrial detergents and are also used in personal care products and in pesticide formulations. After use, surfactants can be found together with pollutants in waste water that is treated in waste water treatment plants (WWTP) or are discharged directly into the aquatic environment. The removal of surfactants from wastewater is a microbial process, which has several advantages when compared to the nonbiological techniques. Surfactants biodegradation in the presence of oxygen is feasible and subject of many studies. However, environments where molecular oxygen is present at very low concentrations or is even absent are common in Nature. Anoxic environments are found in anaerobic digesters, septic tanks, organically enriched sediments, flooded soils and landfills. Surfactants can be used as energy and carbon source by bacteria where nitrate is present as an electron acceptor, if oxygen is limiting or not available. Through the denitrification process, the undesired accumulation of nitrate, in the WWTP or in the environment, is avoided by its reduction to N_2. The surfactant is used as carbon source, being oxidized to CO_2 and H_2O (Figure 1).

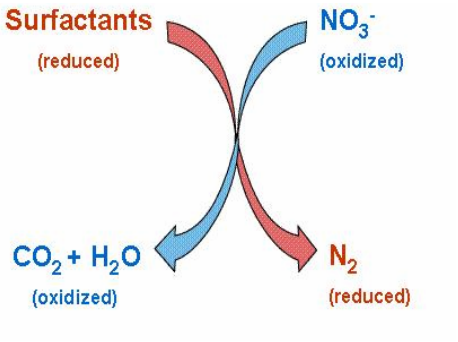

Figure 1. Surfactants oxidation coupled to nitrate reduction.

In many studies, the anionic surfactants group of aliphatic alkylsulfates is commonly represented by sodium dodecyl sulfate (SDS) (Figure 2). SDS is found in commercial products used for personal hygiene and cosmetics. This compound has been proved to be biodegradable under aerobic conditions and an aerobic metabolic pathway of alkylsulfates degradation has been proposed. However, few reports of SDS biodegradation in denitrifying conditions are available. The study of the microorganisms which are able to perform surfactants oxidation coupled to nitrate reduction is of great importance, by investigating alternative metabolic pathways for the degradation of these pollutants. The obtained knowledge can be applied in biotechnology processes for the degradation of surfactants or for the bioremediation of contaminated sites, where anaerobic conditions are present.

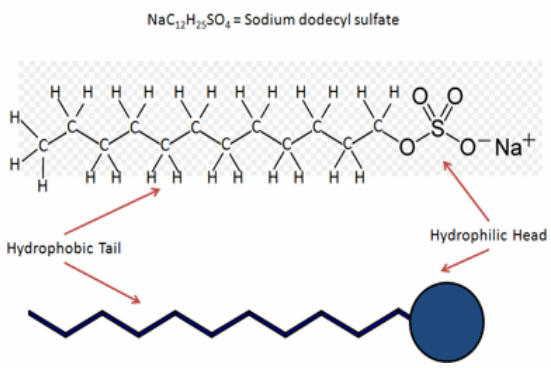

Figure 2. Molecular structure sodium dodecyl sulfate (SDS)

This main objective this project is to study microorganisms which are able to couple the degradation of surfactants, such as SDS, to the reduction of nitrate. For this purpose, cultivation (Figure 3) and isolation techniques are used, in order to obtain pure cultures. The identification is performed using molecular biology techniques. Physiological and biochemical aspects of the isolates will be studied. Biodegradation experiments have been performed and some pure cultures were already obtained. Anaerobic enzyme assays and analysis of surfactants, nitrate and other compounds will also be performed with these isolates.

Figure 3. Batch cultures of SDS degrading microorganisms, under anoxic conditions.