Low Temperature Anaerobic Digestion (LTAD) of Industrial Wastewater

PhD research October 2015 - September 2018

Social Impact

Rising fuel costs along with incentives favouring renewable energy market are pushing the global water market and wastewater technologies towards anaerobic digestion. Financial gains from reduced plant footprint and sludge transport also offer important economic drivers. Efficient growth of methanogens is key to AD functionality, for which mesophilic (30-35°C) or thermophilic (48-55°C) temperatures and pH 6.8-7.2 are optimal. The bottleneck in versatility of AD implementation is in its ineffectiveness at lower temperatures. As a huge chunk of biosphere is permanently under 5°C, development of LTAD would benefit communities and industrial wastewater treatment in temperate regions.

Technological Challenges

Dairy wastewaters are complex substrates consisting of high amounts of proteins and fats along with carbohydrates. Dairy industry produces products such as milk, cheese, ice cream and whey, wherein the organic loading and effluent wastewater characteristics are highly variable. Also, dairy industry has global presence and high volumes of wastewater is generated at ambient temperatures. Low temperature anaerobic degradation of dairy wastewater hence brings forth possibility of wastewater treatment coupled to energy efficient operation. However, the key microbes involved in anaerobic digestion are methanogens, which are sensitive to reduced pH, environmental fluctuations and oxygen presence and have lower specific growth rates at low temperatures. Inoculum acclimatization and reactor optimization are necessary to solve these challenges and play a key role for LTAD success.

The broad objective of this study is to implement development of anaerobic digestion processes for wastewaters at low temperatures (<20ºC) while achieving efficient methane production as well as high effluent quality. This work specifically focuses on anaerobic degradation of long chain fatty acids (LCFA) present in dairy wastewater and studying LCFA inhibition on methanogens. LTAD reactor optimization at elevated LCFA concentrations will also be considered. The inoculum effects and microbial community structure studies will help in gaining comprehension at a microbiological level.

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