

AmbiGas – Biogas production from high volume industrial effluents at ambient temperatures

Public Abstract

High volume, low strength industrial effluents represent a great potential for innovation in biogas production. In order to utilise this potential a number of challenges must be addressed.

- The high volume makes raising the temperature to typical mesophilic operating conditions unrealistic in terms of the energy input required for effluents produced at ambient or near-ambient temperatures.
- Process technologies and configurations are needed that can compensate for the reduced kinetic rates at low temperatures while operating at high flow capacities.
- The relatively low organic content leads to solubilisation of a high proportion of the methane produced into the treated effluent, and this is exacerbated at lower operating temperatures.

The overall aim of the project is thus to develop process technology, design criteria and operational strategies for biogas production from high volume, low strength industrial effluents that will allow wider uptake of this technology for both energy production and environmental protection. The proposed approach is to develop anaerobic processes capable of operation at ambient or near-ambient temperatures to minimise system energy demand, by combining psychro-tolerant consortia with innovative reactor configurations. Methane capture will be maximised using enhanced membrane-based gas recovery and upgrading systems, to reduce environmental impact and maximise net energy production.

Objectives:

The AmbiGAS project has the following objectives:

- To characterise selected under-exploited industrial effluent streams that could benefit from the use of anaerobic treatment to meet appropriate environmental standards while allowing energy production and reducing the need for energy-intensive aerobic systems.
- To develop psychrophilic and psychro-tolerant methanogenic consortia in order to exploit their special characteristics in high-rate engineered processes
- To determine the ability of these low-temperature anaerobic consortia to degrade under-exploited low-strength effluents with a range of characteristics, from highly degradable (food and beverage manufacturing) to more recalcitrant (forest industry).
- To further develop and characterise immobilised cell systems suitable for use with low-temperature acclimated methanogenic consortia in low-temperature, high-volume applications, including granular bed, biofilm and anaerobic contact processes but with the main research emphasis on membrane reactors.

- To develop effective low-energy methods for recovery of methane dissolved in low-temperature effluents using novel in situ and/or downstream membrane-based systems
- To integrate these with biogas upgrading systems for production of fuel-grade methane while avoiding process losses and environmental impacts caused by methane solubility
- To further develop Anaerobic Digestion Model 1 (ADM1) to permit effective modelling of low-temperature systems by determining the appropriate kinetic coefficients and input parameters
- To integrate the improved ADM1 kinetic model into a broad-based process optimisation tool using the Aspen Plus platform, to allow determination and optimisation of overall mass and energy balances for different industrial scenarios
- To use the integrated models to identify critical monitoring and control parameters for maximising energy yields without compromising operational stability
- To trial the developed low temperature AD systems with a number of low-strength industrial effluents (dairy, paper, brewery, ethanol production) at laboratory, pilot and technical scales in order to gather data for model validation and technology dissemination.