Pratik Desai et al., J Fundam Renewable Energy Appl 2017, 7:9(Suppl)
DOI: 10.4172/2090-4541-C1-044

Solving the ammonia –carbon dioxide cycle – sustainable biomass utilization linked to a circular economy approach

Pratik Desai[1,2] and **William B J Zimmerman**[1]
[1]University of Sheffield, UK
[2]Perlemax Ltd., UK

Microbubbles are bubbles sized between 1µm and 1000µm and offer tremendous advantages with respect to transport phenomena due to their high surface area to volume ratio. Accelerated biogas production rate via periodic CO_2 microbubble injection was demonstrated with over 100%- 120% increase in the rate of biogas yield for an untreated wet food waste in an anaerobic digestion process. Recently, Desai demonstrated a new unit operation –microbubble stripping – in order to separate ammonia from an ammonia rich wastewater stream 300 times faster than an industrial stripping column with a mass transfer coefficient 3000-15000 times faster than a stripper. The removal rate was as high as nearly 100% from the wastewater. This process, when combined with the accelerated biogas production introduces the third novelty of generating precipitated salts of ammonium carbamate and ammonium carbonate by reacting the CO_2 and NH_3 in water which can be selectively tuned - another feature not observed in literature - and is performed at room temperature and pressure. This reaction is exothermic and using heat from the exothermicity of this process to conserve the heat for the anaerobic digester is part of process integration. The theory proposed for the increase in biogas production rate is that the CO_2 bubbles provide a pH shock to the system. The biogas generated from the anaerobic digestion is then sweetened from the sustainably sourced ammonia from ammonia rich waste water (which reduces liabilities for liquids like centrate and leachate for waste management companies or increase capital efficiencies for digestate by reducing ammonia inhibition and increasing solids loading). This results in enhanced methane as a product from the digester, which coupled with a smaller CAPEX from the increased biogas yield rate and reduced OPEX due to the heat conservation reduces digester payback from 8y to 2y.

Figure1: *The NH_3- CO_2 cycle for anaerobic digestion processes by Desai and Zimmerman*

Biography

Pratik Desai is a 1st Class-Honours Chemical engineer (MEng in Chemical engineering with Fuel Technology) and PhD in Chemical Engineering at the University of Sheffield. He is the R&I Director at Perlemax and has extensive experience in microbubble generation, visualisation, fluid dynamics, interfacial dynamics and phenomena, non-equilibrium thermodynamics, fluidic and reaction catalysis. He is co-inventor of the Desai-Zimmerman Fluidic Oscillator, the Microbubble Mediated Ammonia Recovery process- 'Waste Factory', self-actuated wastewater aeration product (TOAD), nanobubble generation and associated applications in several sectors including biomedical and medical applications. He is the inventor of an energy- efficient micro/nanodroplet generation.He has led and developed several projects for aquaculture, aquaponics, hydroponics, novel contacting systems, bioreactors, chemical reactors with regenerating interfaces. Projects he is leading include bagged microbial reactors & fermenters, anaerobic digestion, biodiesel generation and worked on CO_2 capture and utilisation using MEA and Ionic Liquids and desorb them using a novel microbubble unit operation (Desai-Zimmerman contactor).

p.desai@sheffield.ac.uk