EBNet BIV2020 Summary Sheet – Winning applications

BIV2020001

Prof James Chong, University of York / Dr Adam Ostrowski, Carbogenics Ltd

Determination of microbial communities of laboratory Anaerobic Digestion tanks and impact of the CreChar® additive on the microbial community dynamics

Proposal Summary

Anaerobic Digestion (AD) is a biotechnological process in which various types of organic waste can be converted into biogas, a valuable and renewable alternative to fossil gas. AD is driven by a consortium of microorganisms, bacteria and archaea alike, performing sequential biochemical functions of degradation of biopolymers, generation of substrates for methanogenesis and finally methanogenesis. The stability of AD relies on synchronization of these processes; however, the commercial AD plant operators frequently experience process inhibition and failure. Carbogenics Ltd have developed a novel carbon additive CreChar® intended to increase the stability and processivity of AD plants. CreChar® is expected to facilitate microbial interactions, biofilm development and increase in the abundance of the essential microbial taxa. Carbogenics recently acquired a MinION sequencer from Oxford Nanopore Technologies and obtained large quantity of genomics data from various experimental reactors. However, there is very little information available on the microorganisms commonly found in AD and the MinION technology is very young and currently not supported by user-friendly analysis software. At Carbogenics, we managed to process approx. 30% of the obtained data but we lack the expertise required to unlock all the information in the datasets. We would like to partner with the group of Prof James Chong, University of York, who are leaders in the development the tools for metagenomics of AD. The Chong Group are the frontrunners in the analysis of the data output by the nanoporebased sequencers and are a natural choice for a partner to understand the information in the data obtained by Carbogenics.

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BIV2020002

Dr Yadira Bajón Fernández, Cranfield University/ Kimberley Dobney, Turn and Flow

Understanding anaerobic biodegradability of organic menstrual care products: technical feasibility and sector receptivity

Proposal Summary

Turn is a product service system (PSS) to recycle organic menstrual care products and to stop them being sent to landfill, being incinerated or being flushed. This is a complex and stigmatised topic hence Turn will also be raising public awareness on the impact of traditional menstrual care products (on the planet and the body) and encouraging the use of organic products as an alternative.

This proposal brings together engineers and social scientists to prove the feasibility of value recovery from organic menstrual care products. The focus is on elucidating technical viability by investigating products biodegradability and potential for biogas formation in anaerobic digesters (AD); as well as

informing sector receptivity towards this new feedstock by conducting semistructured interviews with key AD practitioners. The Environment Agency will be included in the interviews in order to comprehensively understand the regulatory limitations for accepting used organic menstrual care products in existing AD sites. This proposal will start a collaboration between Turn and Cranfield University. Project outcomes will elucidate the viability of using anaerobic digestion as the core technology for Turn's proposed PSS and inform future pilot continuous AD trials. The generated dataset will constitute the basis for Turn and Flow to discuss implementation of the PSS with local councils, since the system could divert up to 200,000 tones of menstrual waste from landfill each year in the UK, with concomitant benefits in renewable energy generation and digestate production.

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BIV2020004

Dr Yongqiang Liu, University of Southampton / Adam White, Plantwork Systems Ltd.

Meeting the nutrient neutrality challenge using newly developed biological technology

Proposal Summary

To protect our water bodies from eutrophication, regulations on nutrient discharge limits are being tightened. This has significant impact on the water industry as well as the environment as most existing nutrient removal technologies are expensive to install and require significant amounts of energy and chemicals to remove nutrients. This results in pollution levels being reduced in the receiving water bodies, but being increased in the air and soil due to the technology having a larger carbon footprint and producing more chemical enriched sludge for disposal. There is thus a major requirement in the wastewater treatment market for a more sustainable nutrient removal technology which uses less energy and no chemicals. Plantwork Systems Ltd (PWS) has designed, built and operated a prototype biological nutrient removal plant branded as NUTREM®. The plant was developed in the first instance to target removal of Total Phosphorus (TP), achieving a total effluent phosphorus concentration well below 0.5 mg/L. The technology was demonstrated to have the best performance among several phosphorus removal technologies assessed by UKWIR. It was also observed to remove Total Nitrogen (TN), although to a lesser degree. In order to meet the challenge for both TN and TP removal using the NUTREM® system, and without the addition of chemicals, PWS will work in partnership with the University of Southampton (UoS) to optimize the process to achieve very low levels of both nutrients in the final treated effluent i.e. less than 5 mg/L of TN and less than 0.5 mg/L of TP using the full-scale operating treatment facility at Petersfield STW in Hampshire. A successful outcome will provide the market with a more sustainable nutrient removal technology with a particular advantage for onsite nutrient removal on new developments. The optimisation, demonstration and validation of the enhanced process at the full-scale facility will lead to rapid technology adoption and roll-out, which can quickly meet the Nutrient Neutrality challenge facing the South of England. This will in turn unblock a significant number of new developments which are currently stalled as a direct result of this issue.

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BIV202005

Prof. Sonia Heaven, University of Southampton / Laura Conroy, United Utilities / Prof. Charles Banks CJC Labs Ltd.

Scale-up trials for design of gas injection retrofitting to wastewater sludge anaerobic digesters

Proposal Summary

Wastewater treatment is the world's largest environmental biotechnology industry, and arguably the one that makes the greatest contribution to the protection of public health and the environment. Around 50% of the cost of operating conventional municipal wastewater treatment plants is in the management of wastewater biosolids, commonly known as sewage sludge. This material is itself a potentially valuable resource because of its nutrient and energy content. Anaerobic digestion (AD) is in widespread use to process sewage sludges, making them suitable in many cases for land application, and also generating biogas as a renewable energy source. Both aspects thus contribute to a more circular economy as well as to environmental protection. Biogas production can meet some of the energy requirements of the treatment process, and provide a revenue stream that helps to offset the costs of treatment. Improving the performance and cost-effectiveness of the digestion process is thus a key area in moving industry towards more sustainable wastewater management solutions. This project focuses on in-situ biomethanisation, an emerging technology that offers partial biogas-to-biomethane upgrading while also increasing biomethane yield. The proposed work brings together engineering and microbial aspects, and is an important step towards scale-up and technology transfer that will assist the water industry in evaluating how to retrofit existing digesters as a means of improving their economic and environmental performance. It will thus open up further opportunities for application of AD as an environmental protection technology, and make available existing digestion infrastructure to meet challenging new sustainability targets both locally and globally.