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EBNet Environmental Biotechnology

UKRI Biotechnology and Biological Sciences Research Council

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Simultaneous Bioremediation of Nutrient Pollution and Carbon Fixation Through a Novel, Integrated Anammox and Acetogens-Based Bio-Electrochemical System

Challenge

The carbon and nitrogen cycles are two of the Earth's most important biogeochemical cycles due to their integral roles on the Earth's living systems. Although both cycles are seriously damaged by harmful anthropogenic activities, the later cycle received less attention from the scientific community in terms of its proper management and recovery from the damages caused.

Improper management of the nitrogen cycle is also associated with the accumulation of fixed nitrogen compounds, i.e., nutrients in the environment, causing severe environmental pollution problems, including eutrophication, acid rain, red tides, and rapid destruction of the ozone layer.

This PoC award was used develop a novel, proof-of-concept, bio-electrochemical system (BES) for simultaneous management of both nitrogen and carbon cycles by removing excess nutrients and CO_2 from the environment.

Outcomes

The project employed both microbial anaerobic ammonium oxidation (anammox) by ANAMMOX bacteria and carbon dioxide (CO_2) reduction by acetogen-enriched microbial consortia in an integrated, one pot BES to produce nitrogen gas and organic acids simultaneously by supplying electricity.

The electroactive microorganisms in the integrated BES oxidised nutrients such as NH_4 into inert nitrogen gas and reduced CO_2 into high-value organic acids, including acetate, propionate and butyrate; thereby contributing to the bioremediation of both nutrient and carbon pollutions simultaneously.

Further optimisation and scale-up of the novel, integrated, one pot BES reactor can not only help manage the nitrogen and carbon cycles but also be used to develop cost-effective and energy-efficient wastewater treatment processes.

Such a novel system can therefore be used to solve both environmental sustainability problems and decarbonisation challenge of the UK's chemical
industry sector.

Dr Ahsan Islam has research interests in:

- ***Biochemical/bioprocess engineering***
- ***Metabolic engineering***
- ***Systems biology and synthetic biology***
- ***Computational biology and bioinformatics***
- ***Comparative and functional genomics***
- ***Environmental microbiology***