Enhancing the ADM1 Model with Microbial Communities for Enhanced Biogas Production and Control

Rohit Murali
University of Surrey

BioMass Canada

Supergen Bioenergy

Project Overview

- Project is part of my PhD as well as plays a key role in the AI4AD project which focuses in using AI tools for flexible anaerobic digestion operation under uncertainty.

- ADM1 is the most common and complex model for biogas predictions, but it overlooks the importance of microbial communities where microbial population composition and growth are crucial for optimal anaerobic digestion.

- The complexity and diversity of substrates limit understanding of these processes. The ADM1 model's failure to account for distinct microbial communities may lead to less accurate biogas production predictions.

- Developing a hybrid model which relates microbial communities to the ADM1 as well as apply machine learning approaches which may improve the accuracy of the model and help understand microbial synergies

Potential of Microbial Communities integration

Microbial Dynamics

Help identify the key microbial players in AD.

Synergistic Effects

In co-digestion the microbial community plays a crucial role in leveraging synergistic effects.

Reduced Operational Costs

More efficient feedstock utilisation, decreased energy consumption.

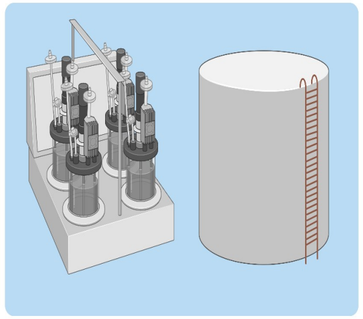
Improved Optimisation

Helps maintain optimal environmental conditions, such as pH, temperature, and retention time.

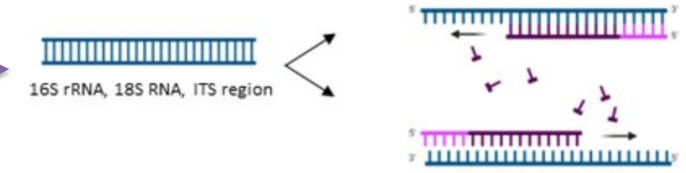
Early Fault Detection

Monitoring microbial communities and dynamics could identify process imbalances and operational issues

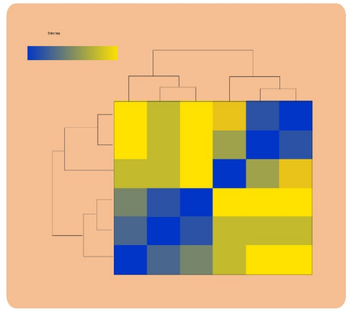
Incorporating Microbial Communities into the ADM1 Model



Lab reactor and full-scale samples

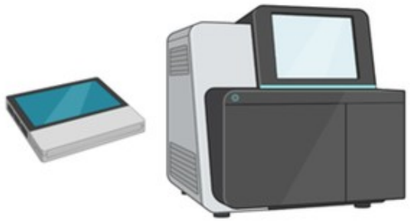


Sequencing

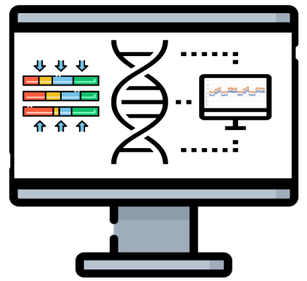


Microbial diversity and abundance analysis (bioinformatics)

DNA and RNA extraction



Molecular analysis



Genome-scale metabolic based ADM1 model

Acknowledgements

UNIVERSITY OF SURREY

People-Centred AI
UNIVERSITY OF SURREY

BioMass Canada

EPSRC
Engineering and Physical Sciences Research Council

AI FOR NETZERO

Supergen Bioenergy