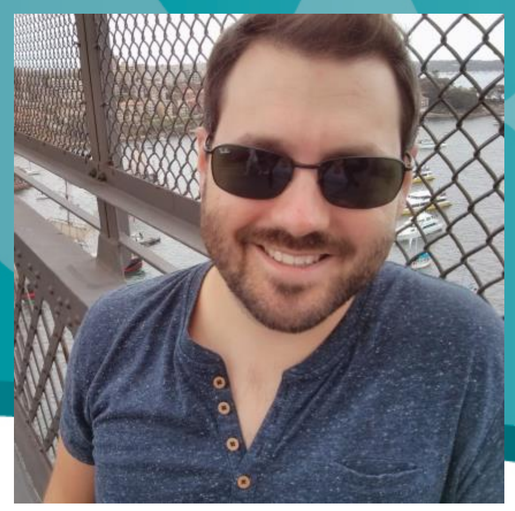
CRC for Water Sensitive Cities

Sludge Fermentation

On-Site Production of VFAs for PPB Nutrient Recovery



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Program C: Future Technologies

Project C2.1: Resource Recovery from Wastewater

Introduction

Purple phototrophic bacteria (PPB) are able to efficiently remove nitrogen and phosphorus from wastewater to discharge limits. However, standard domestic wastewater COD:N:P ratios of 300:50:10 are unbalanced in COD, limiting PPB growth and N and P uptake efficiency. COD must be added to the feed stream to an optimal ratio of 100:8:1.2 in order to make up this deficiency (Fig 1).

Fermentation of PPB sludge produces soluble organics that can be recycle to the main process for achieving optimal COD/N/P ratio. However, ammonia production must be managed to ensure that the COD:N ratio is increased to enable full uptake of N and P. In this study, we aim to optimise sludge fermentation for maximum fermentation product generation with minimal ammonia production.

PPB Growth in Carbon-limited System

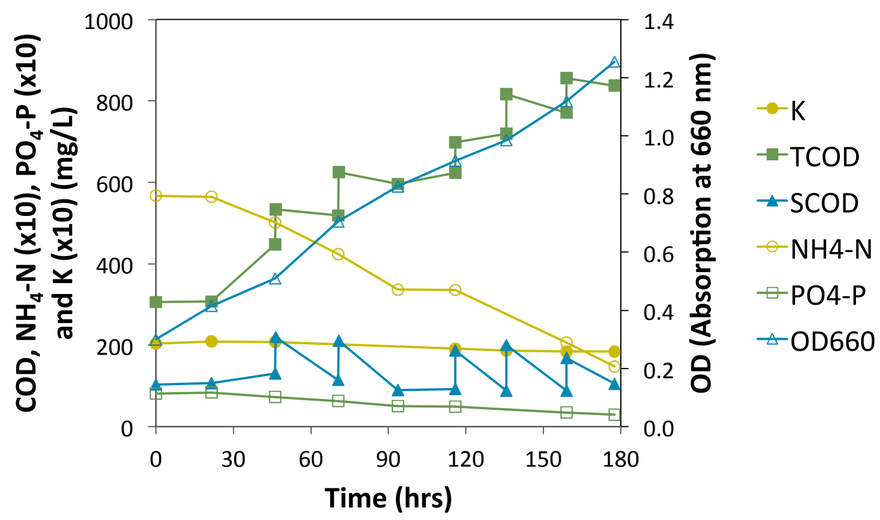

Figure 1: PPB biomass (OD_{660}) increases with spiked acetate (SCOD) while consuming ammonia (NH_4-N) in batch system.

Culture Enrichment Gas Production

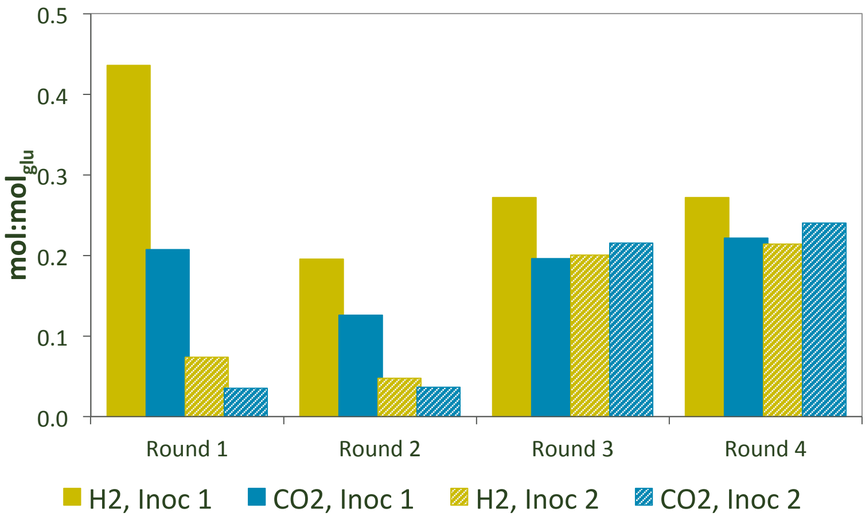

Figure 2: Molar yields of H_2 and CO_2 through culture enrichment.

Method

- Enrichment: Thermophilic sludge (*Inoculum 1*) & anaerobic granular sludge (*Inoculum 2*) + 4 substrate spikes.
- Experimental conditions: 1% VS substrate, 2.5% VS inoculum. 5 d. 30, 37, 55°C (*Inoculum 1*) & 30°C (*Inoculum 2*)
- Substrate: PPB biomass, waste activated sludge (WAS), Algae biomass, + Control (glucose)
- Analytical: VFA, alcohols, NH4-N, biogas.

Preliminary Results

- ✓ **Successful enrichment** after 4 spikes: ↑CO2 and ≈H2 yields (Fig 2)
- ✓ **Initial screening**: First 2 d fermentation dominates. Methanogenesis prevails onwards (Fig 3)
- ✓ Full analysis of enrichment, screening and fermentation experiments is **currently ongoing**

Screening Round Gas Production

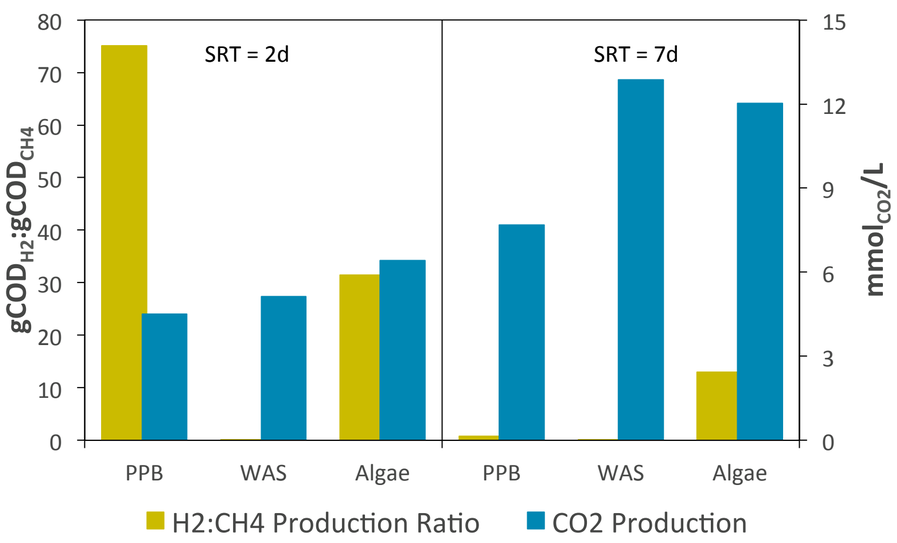

Figure 3: Ratio of H_2 to CH_4 production and total production of CO_2 from initial screening experiment at different digestion times.

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