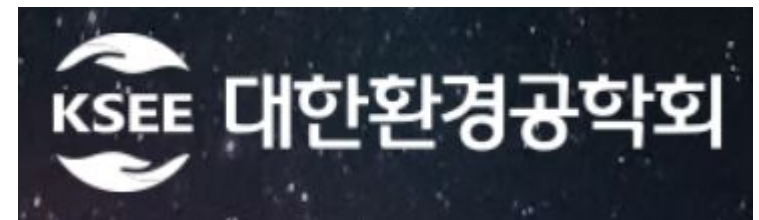# EFFECTS OF FISH WASTE ADDITION ON ANAEROBIC CO-DIGESTION OF SLUDGE WITH FOOD WASTE

PRESENTED BY SUJIN CHOI
ACADEMIC ADVISOR PROF. SEOKHWAN HWANG
BIOENGINEERS FOR ENVIRONMENTAL SCIENCE AND TECHNOLOGY LAB. (B.E.S.T)
POHANG UNIVERSITY OF SCIENCE AND TECHNOLOGY (POSTECH)

Division of Environmental Science & Engineering, POSTECH

Problem statement, Objective and Hypothesis

- Problem Statement

- Why fish waste? >> In South Korea, total production of fish was about 2.3 million tons in 2019 and domestic consumption of fishery products was 65.9 kg/person/year!!

- Is fish waste a promising substrate for AD? >> Yes! It contains high proteins and lipids

- What's the problem? >> Fish waste degradation intermediates, including LCFAs and ammonia, lead to the system instability

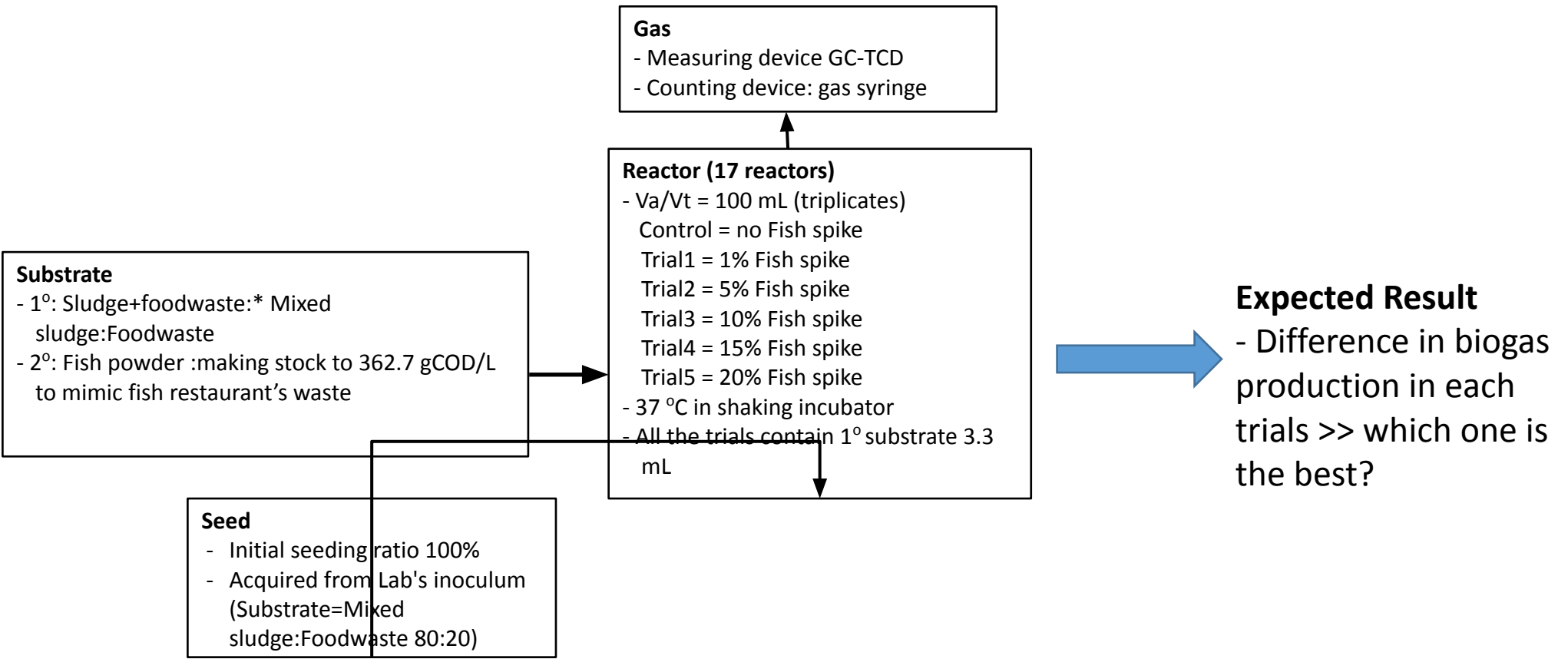- Can we add fish waste (unexpected substrate) to the stable AD digesters?

- Objective

- To find the optimal concentration (v/v) of fish waste that can be co-digested with Food waste and Sludge mixture

- Hypothesis

- Addition of fish waste will improve the methane production

Fish Spike Pretest Operation
Flowchart

Gas
- Measuring device GC-TCD
- Counting device: gas syringe

Reactor (17 reactors)
- Va/Vt = 100 mL (triplicates)
  Control = no Fish spike
  Trial1 = 1% Fish spike
  Trial2 = 5% Fish spike
  Trial3 = 10% Fish spike
  Trial4 = 15% Fish spike
  Trial5 = 20% Fish spike
- 37 °C in shaking incubator
- All the trials contain 1° substrate 3.3 mL

Substrate
- 1°: Sludge+foodwaste:* Mixed
  sludge:Foodwaste
- 2°: Fish powder :making stock to 362.7 gCOD/L
  to mimic fish restaurant's waste

Seed
- Initial seeding ratio 100%
- Acquired from Lab's inoculum
  (Substrate=Mixed
  sludge:Foodwaste 80:20)

Expected Result
- Difference in biogas production in each trials >> which one is the best?

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Results of Fish Spike Pretest (Batch mode)

## Results: pH and cumulative biogas amount

▪ pH

- 1% and 5% fish waste showed similar pH to the control (abt pH 7.5)

- 10% fish waste showed pH dropped to 6.8, then recovered after 5 days to abt pH 7.5

- 15% fish waste showed pH dropped to 6.5, then recovered after 11 days to abt pH 7.5

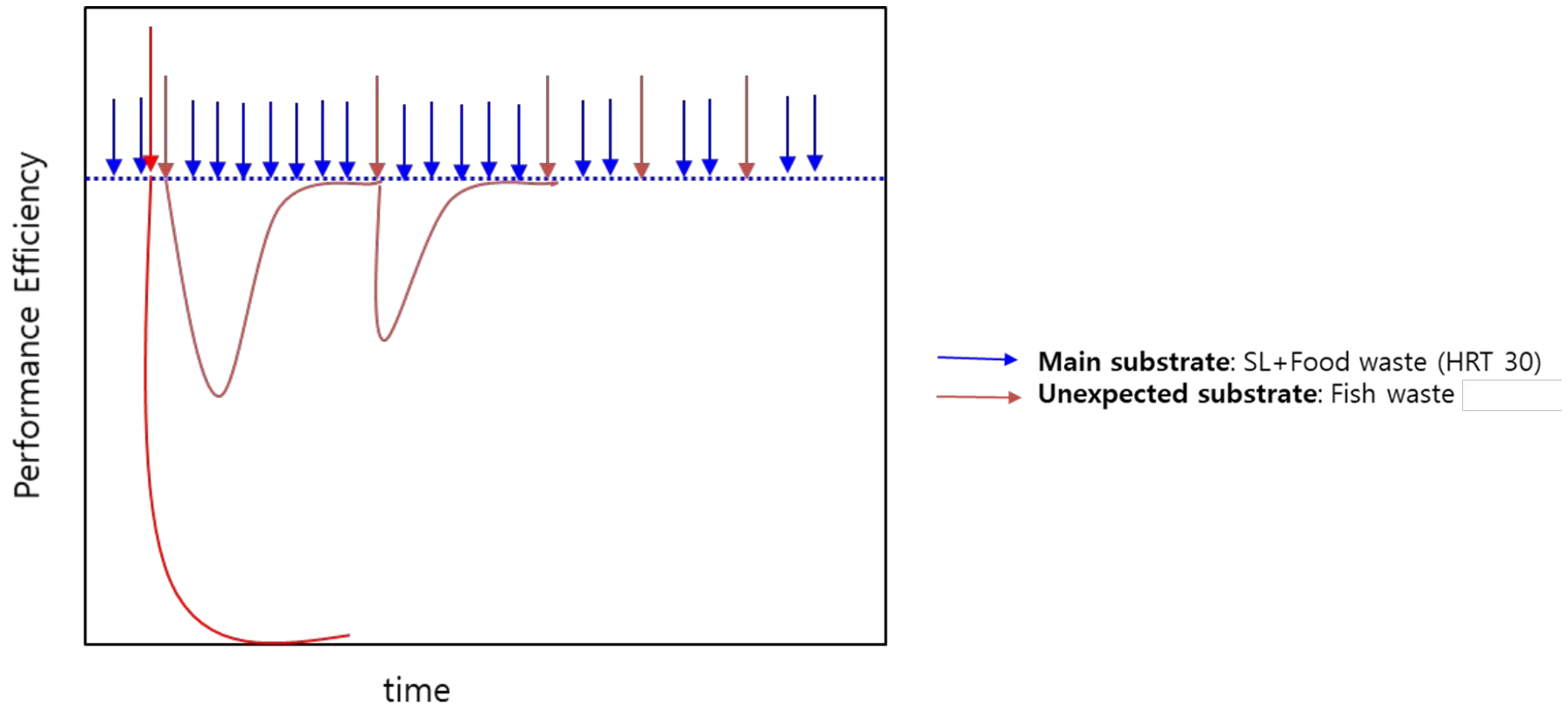- No pH recovery found in 20% fish waste (pH 6.4)

▪ Cumulative methane production

- 5% fish waste showed the highest cumulative methane production (31% increased)

- Methane production reduced 36.6, 55.7 and 94.4% when 10, 15, and 20% v/v of fish waste were added
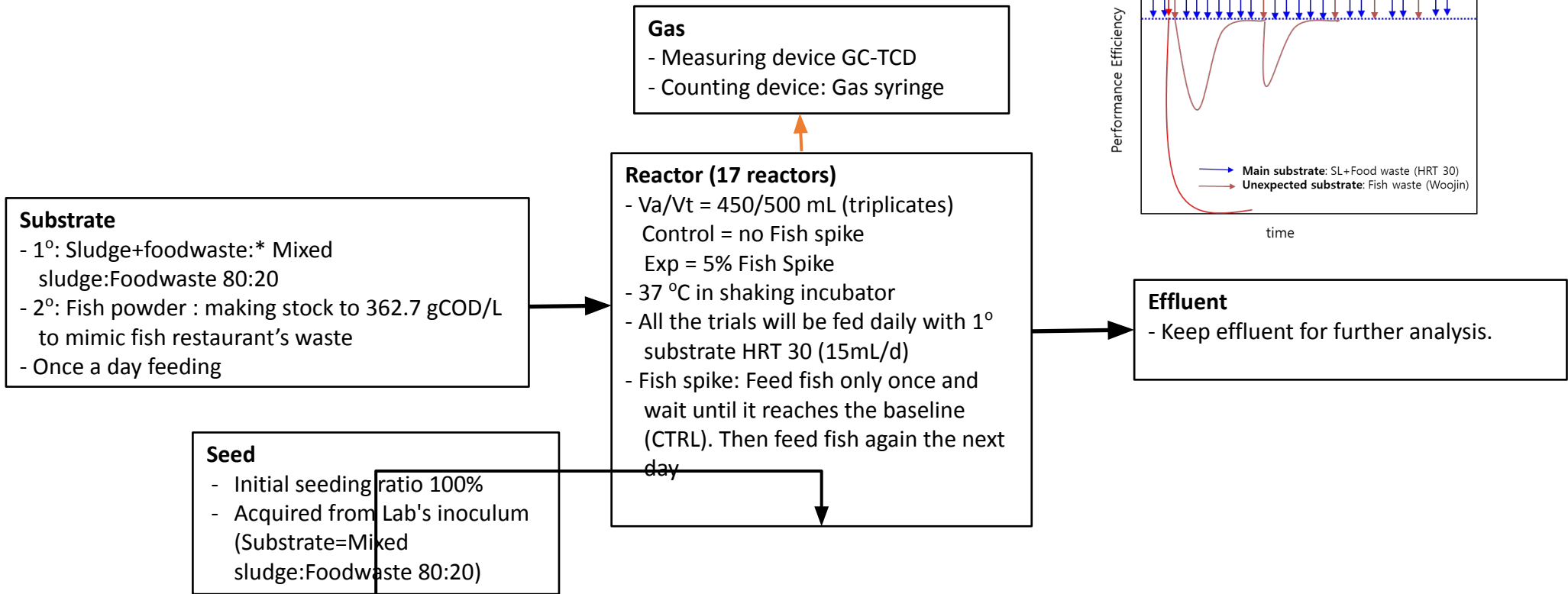
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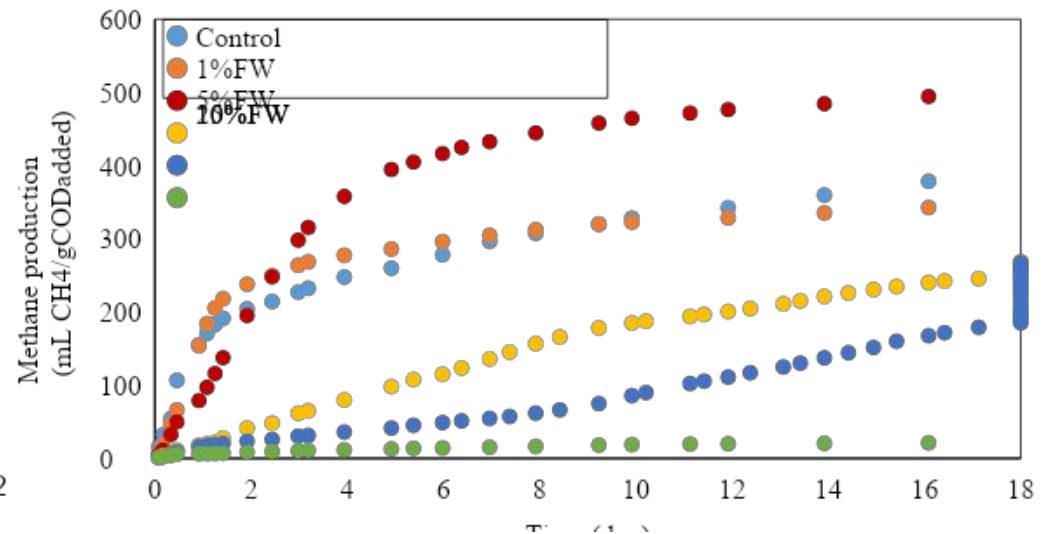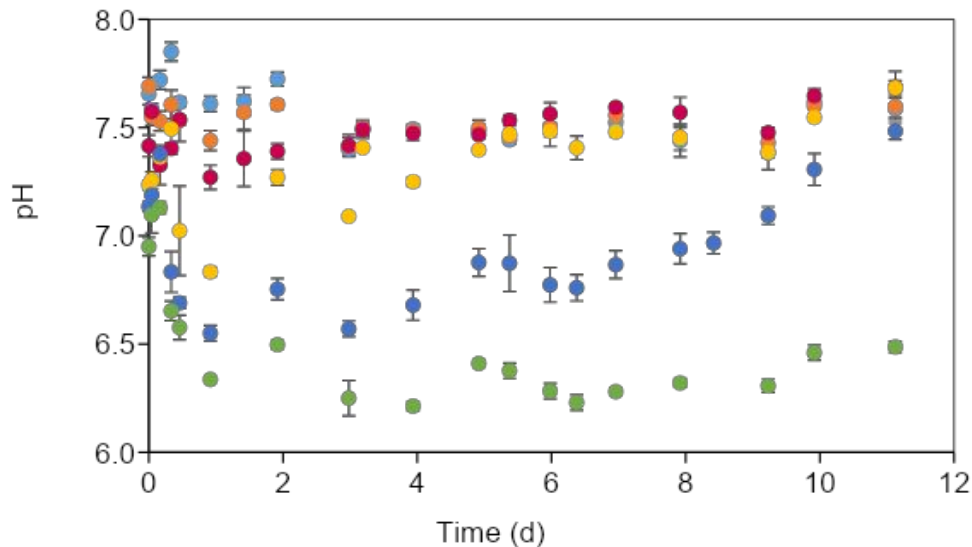
Questions need to be answered

1. Can we feed fish waste spike to the stable digester in semi-continuous operation (while still keeping feeding with its substrate) without causing any inhibition to the system?

2. Will the sequential feeding of fish waste spike improve the performance of the operation?

Main substrate: SL+Food waste (HRT 30)
Unexpected substrate: Fish waste

Fish Spike Plan (semi-continuous mode)

Fish Spike Operation Flowchart

Gas
- Measuring device GC-TCD
- Counting device: Gas syringe

Substrate
- $1°$: Sludge+foodwaste:* Mixed sludge:Foodwaste 80:20
- $2°$: Fish powder : making stock to 362.7 gCOD/L to mimic fish restaurant's waste
- Once a day feeding

Reactor (17 reactors)
- Va/Vt = 450/500 mL (triplicates)
  Control = no Fish spike
  Exp = 5% Fish Spike
- 37 $°C$ in shaking incubator
- All the trials will be fed daily with $1°$ substrate HRT 30 (15mL/d)
- Fish spike: Feed fish only once and wait until it reaches the baseline (CTRL). Then feed fish again the next day

Effluent
- Keep effluent for further analysis.

Seed
- Initial seeding ratio 100%
- Acquired from Lab's inoculum (Substrate=Mixed sludge:Foodwaste 80:20)

Recovery period

Performance Efficiency

Main substrate: SL+Food waste (HRT 30)
Unexpected substrate: Fish waste (Woojin)

time

Independent Variables
- Fish spike feeding amount

(no fish waste VS 5% Fish waste spike)

Dependent Variables
- pH
- Biogas production
- Recovery pattern

Criteria for fish spike injection
- pH > 7.6

- TVFA < 1g/L, HPr:HAc ratio <1.4
- Biogas production ±5% compared with CTRL

Results: Fish Spike Experiment

- pH

- 5% fish waste showed similar pH to the control (about pH 7.6) during first 2 injection

- However, pH in 5% Fish waste spike was increasing as the fish waste injection continued
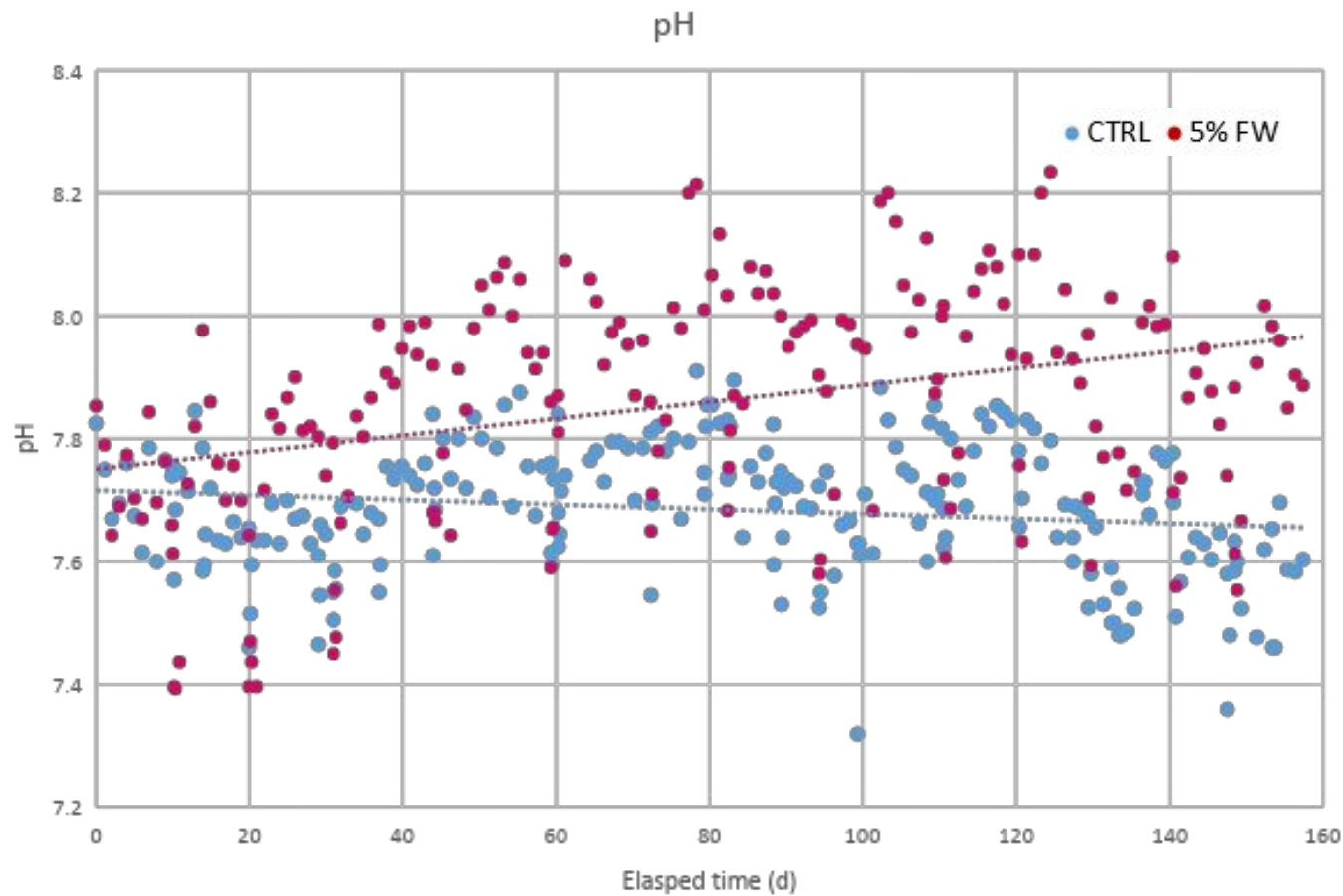
Results: Fish Spike Experiment

- Daily methane production

- Adding 5% fish waste spike improved the methane production

Methane Production (mL/mL/d)

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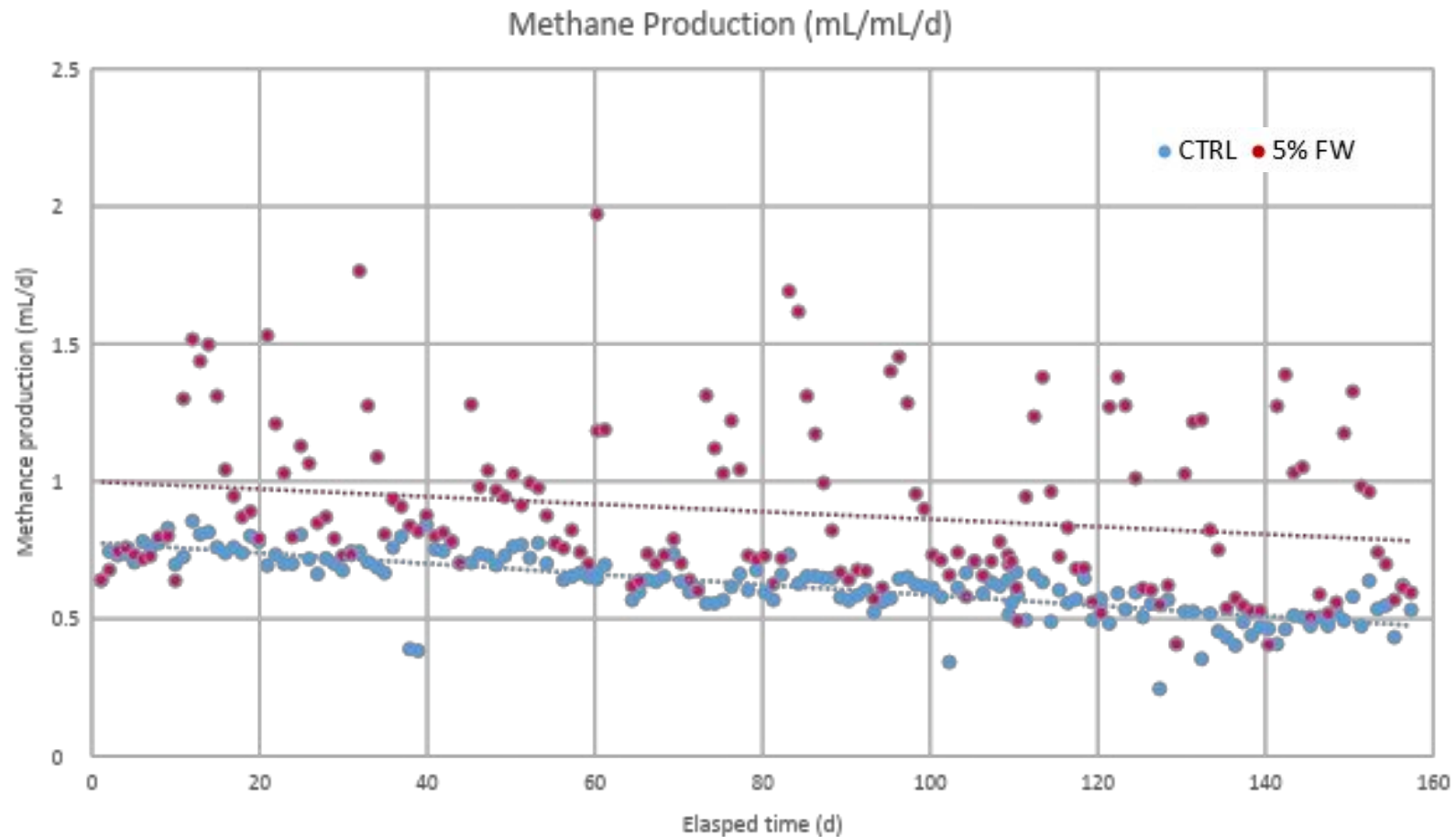
Major findings

- 5% fish waste spike improved methane production both in batch mode and semi-continuous mode

- Fish spike can be occasionally introduced to the existing AD system without causing system failure

Further study

- To find the key microbes involved in a sudden change of substrate (fish spike) and recovery period

- To investigate the relationship between microbial shifts and changes in process performance

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