Assessment of Volatile Fatty Acids by thermophilic anaerobic digestion of blackwater and kitchen waste

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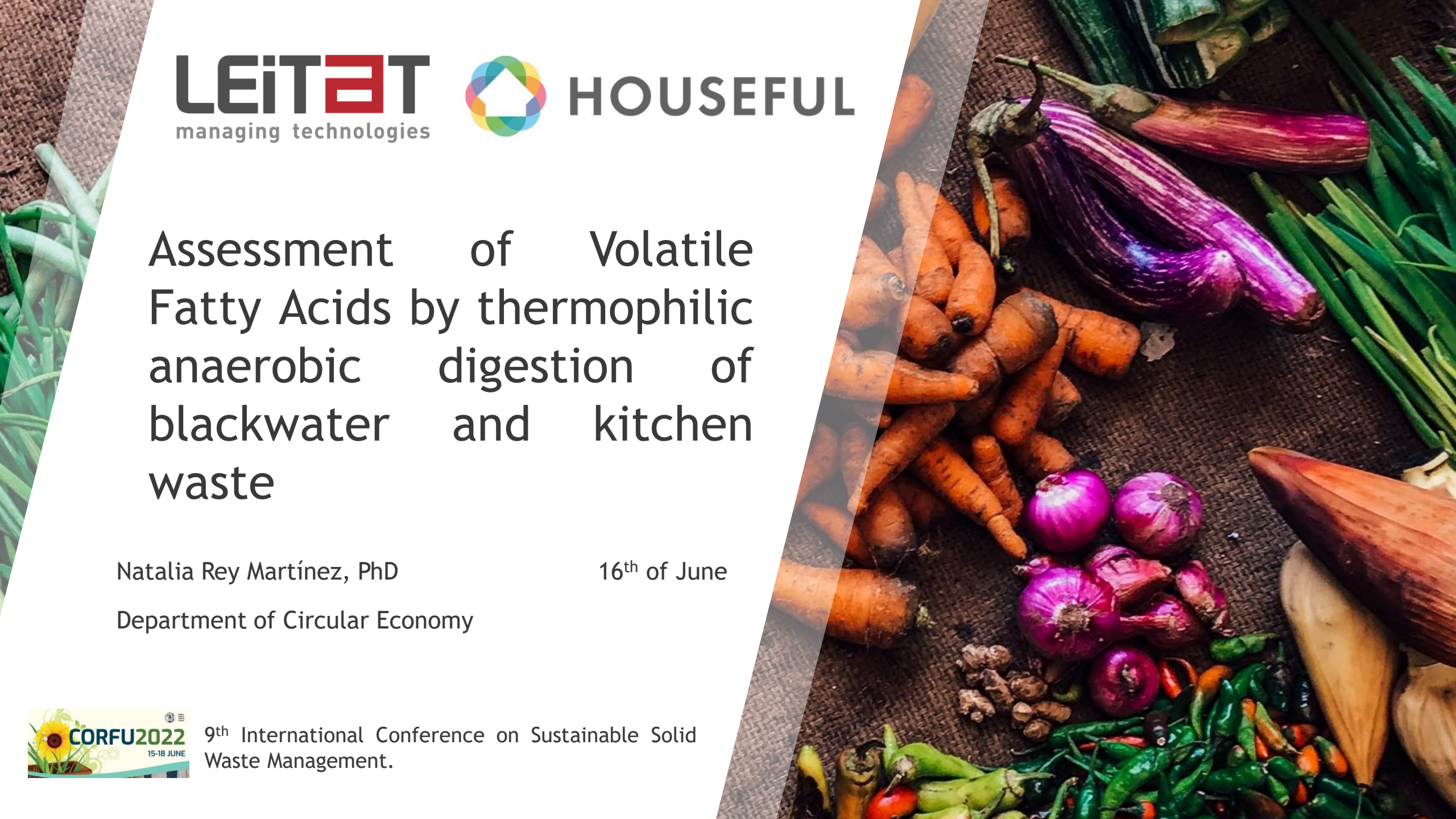
16th of June

9th International Conference on Sustainable Solid Waste Management.



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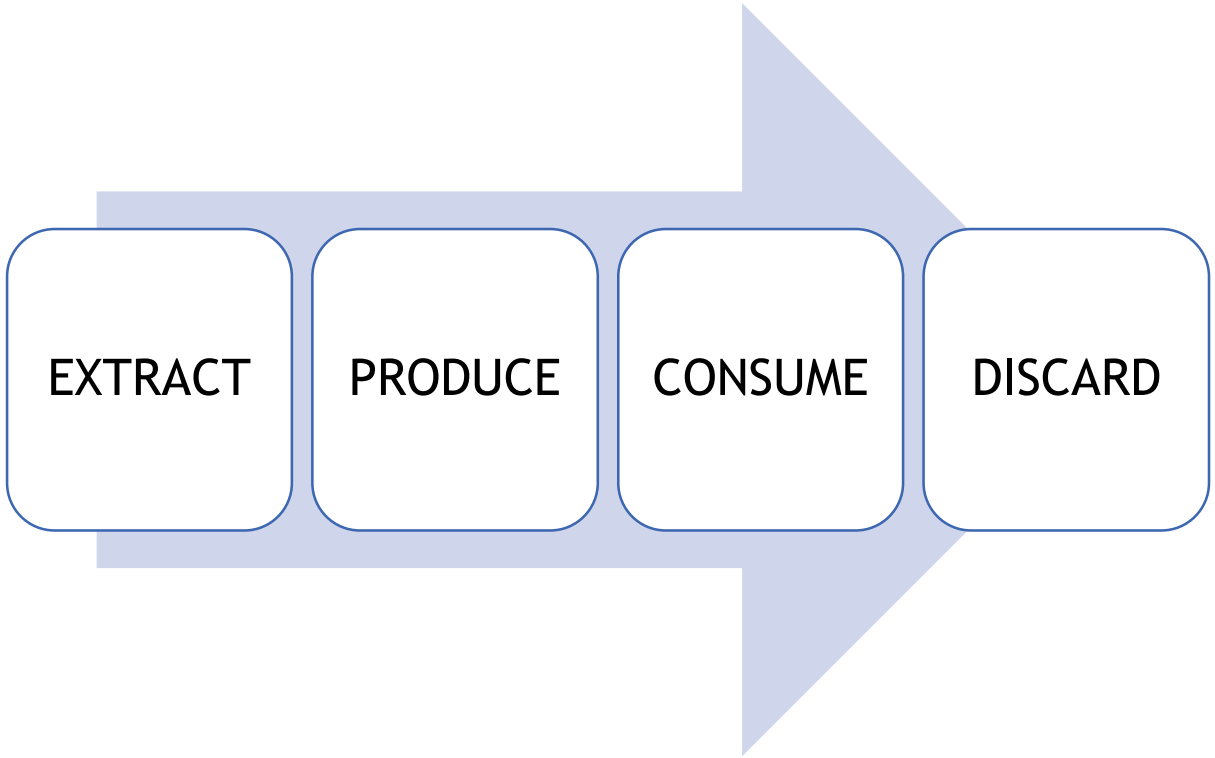
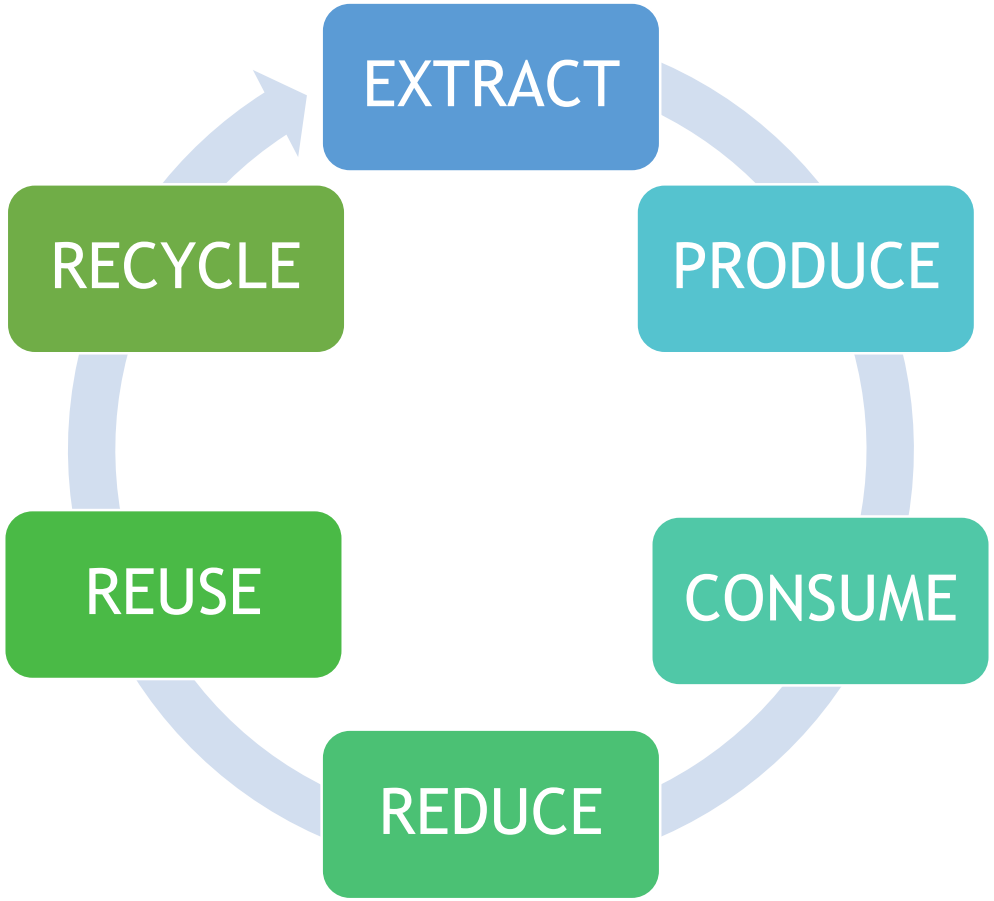
INTRODUCTION



Linear economy



Circular economy

VFA production via microbial fermentation using mixed microbial cultures is gaining interest

BIOREFINERIES

Organic streams (wastes) →  → Valuable resources

- Lignocellulosic biomass
- Food waste
- Waste activated sludge
- Dairy wastewater

Partial anaerobic digestion:
- Hydrolysis
- Acidogenesis
- Acetogenesis
- ~~Methanogenesis~~

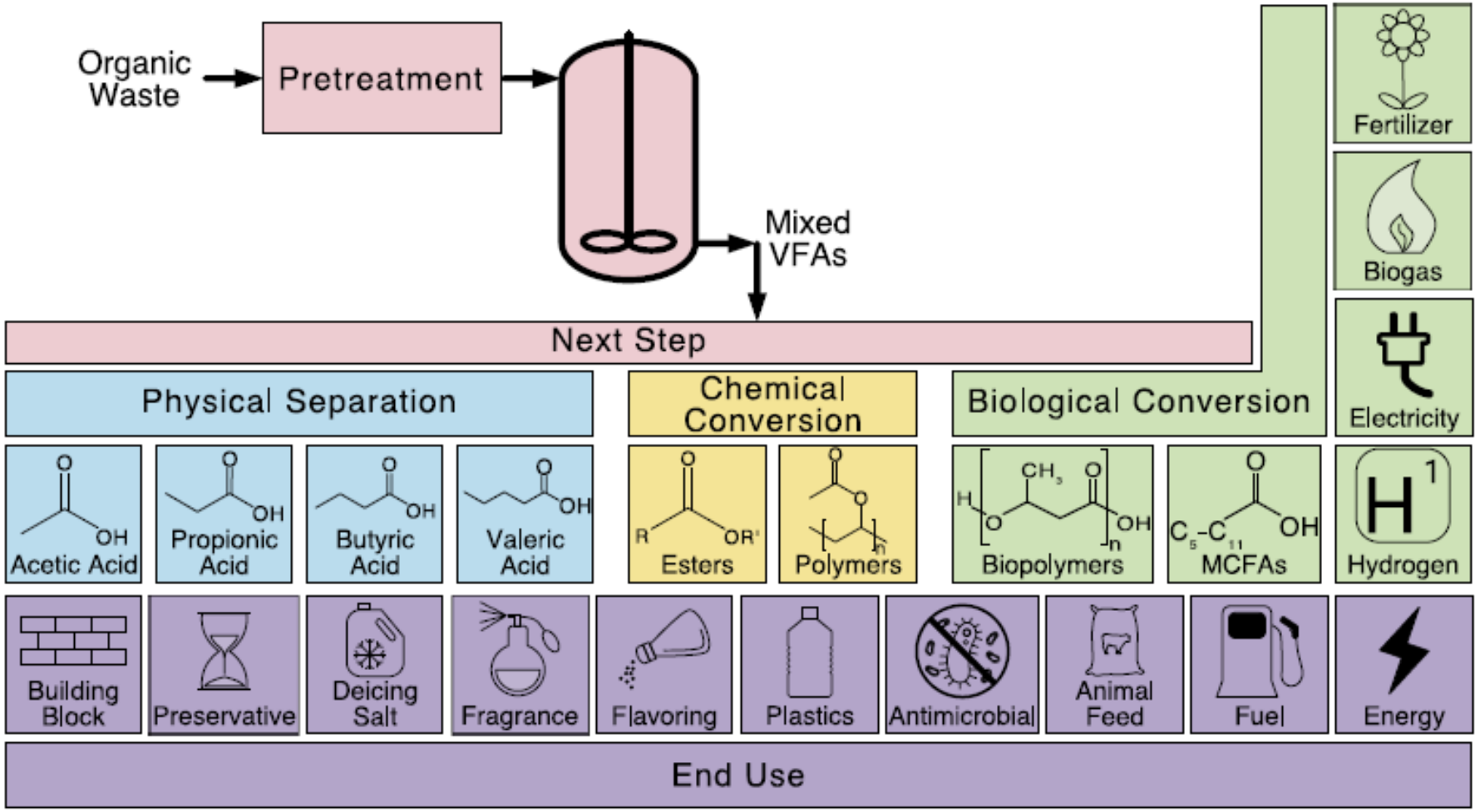
Bioenergy

Hydrogen

Platform chemicals

Mixed VFA

INTRODUCTION



Source: Ramos-Suarez, M., Zhang, Y., & Outram, V. (2021). Current perspectives on acidogenic fermentation to produce volatile fatty acids from waste. *Reviews in Environmental Science and Bio/Technology*, *20*(2), 439-478.

INTRODUCTION

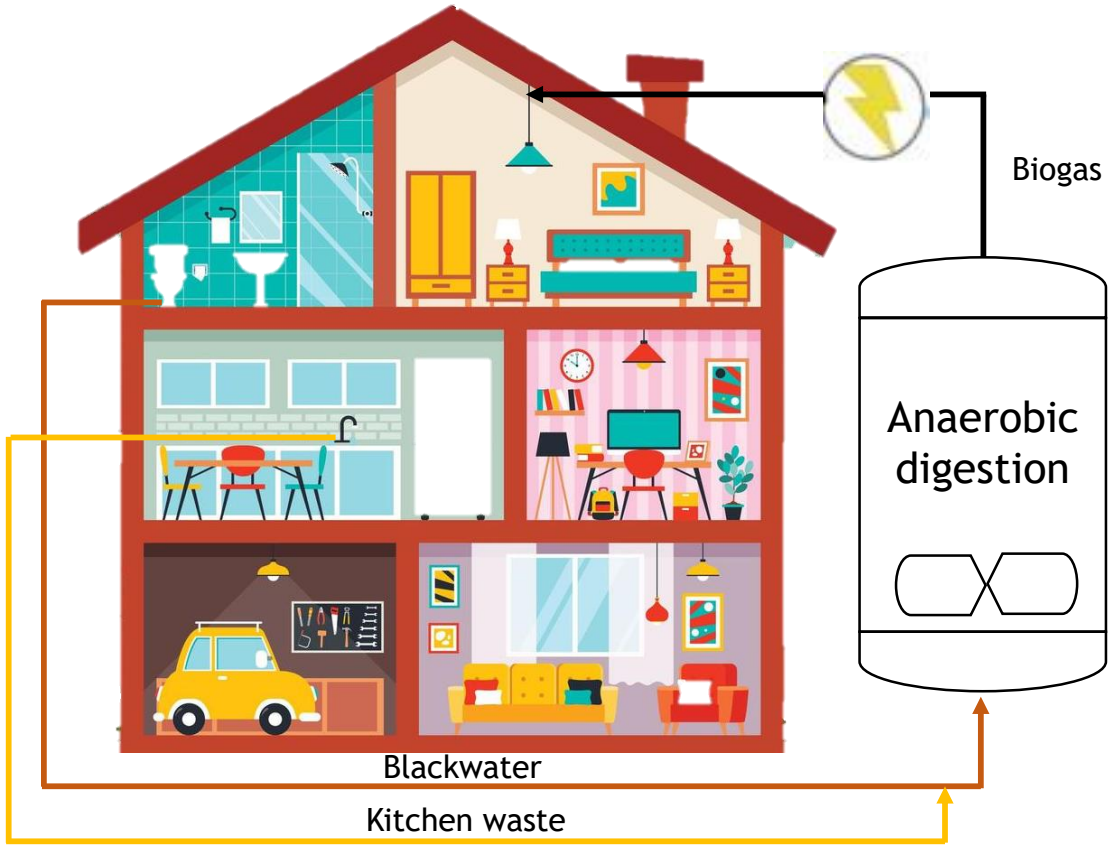
HOUSEFUL project proposes an innovative paradigm shift towards a circular economy for the housing sector. The main goal is to develop and demonstrate an **integrated systemic service** composed of 11 circular solutions. This integrated systemic service will aim at the circular management and efficient use of water, waste, energy and material resources for all stages of European building's life-cycle.

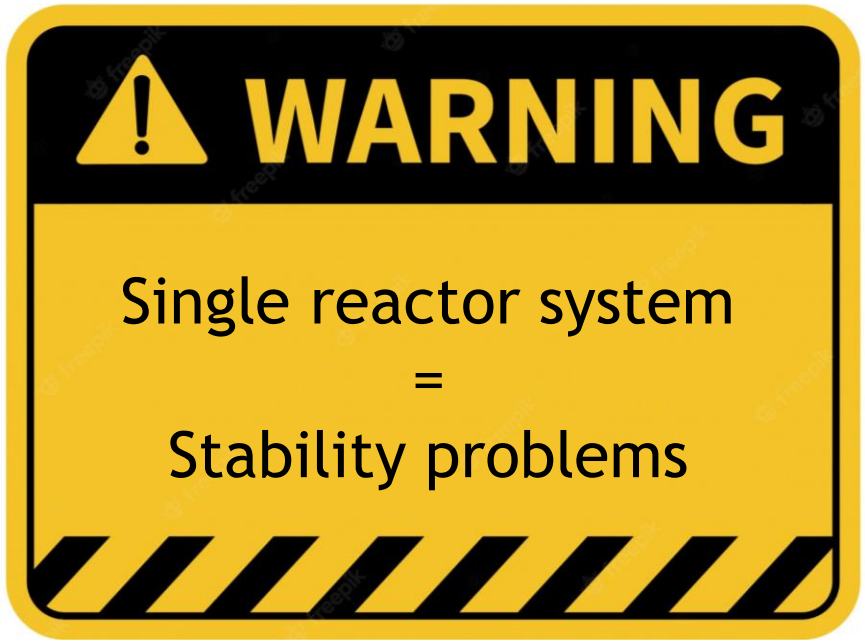
WASTE

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement N°776708. The information reflects only the author's view, and the Commission is not responsible for any use that may be made of the information it contains.

OBJECTIVE

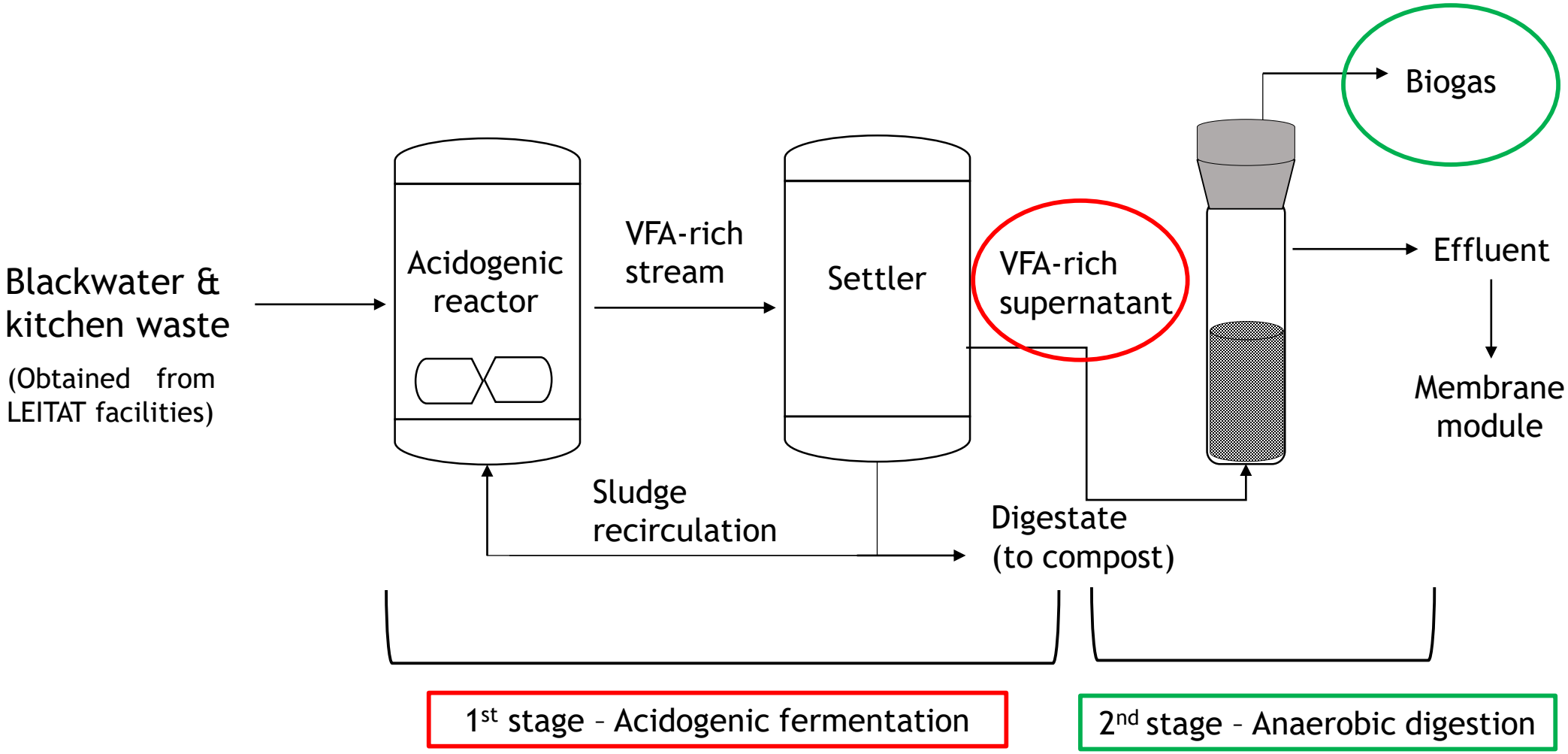
Decentralized co-digestion of blackwater and kitchen waste through wet anaerobic digestion: To balance the C/N ratio and have synergistic effects in an anaerobic system.



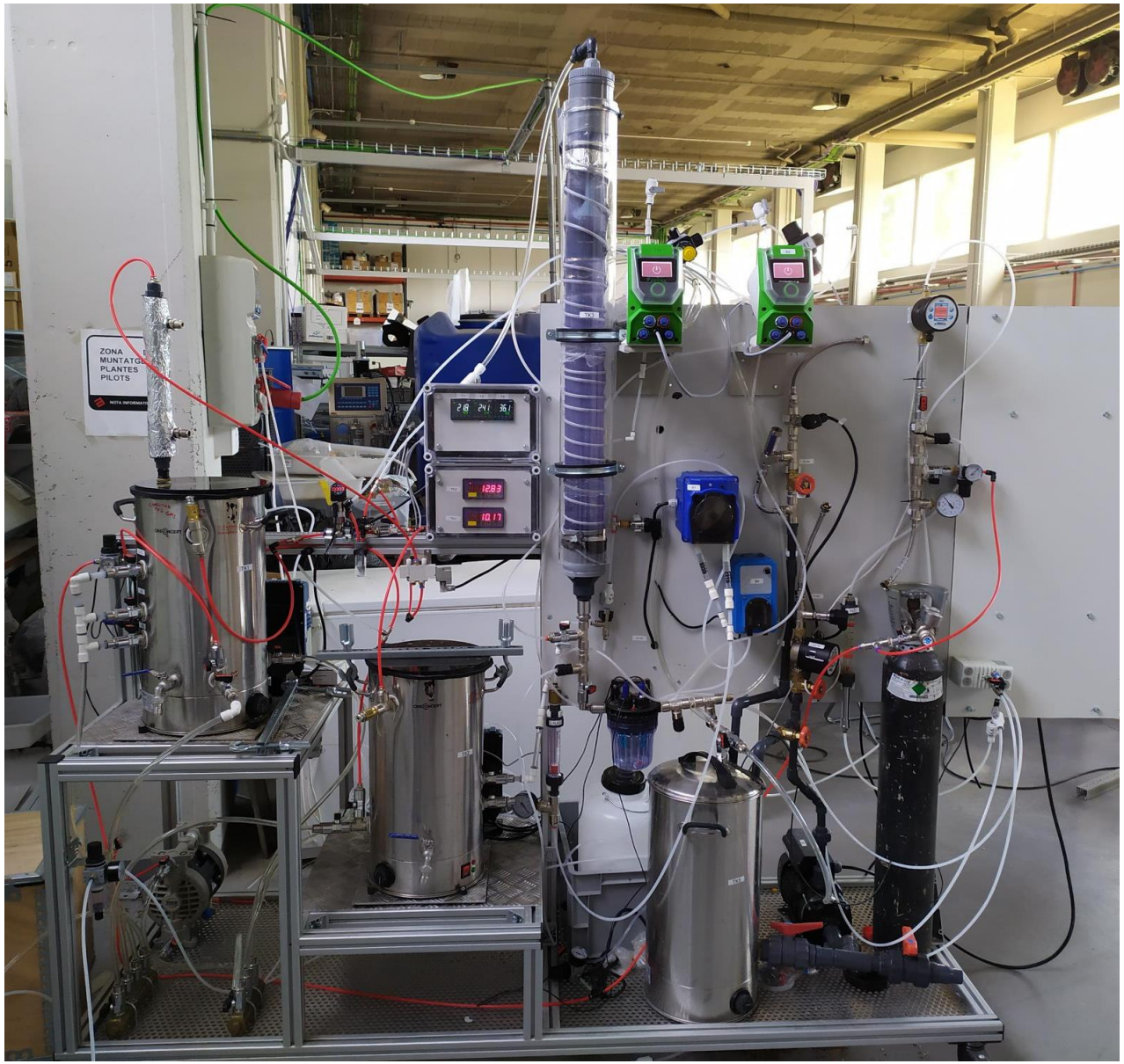


OBJECTIVE

Two-stage anaerobic digestion



AnMBR at laboratory scale



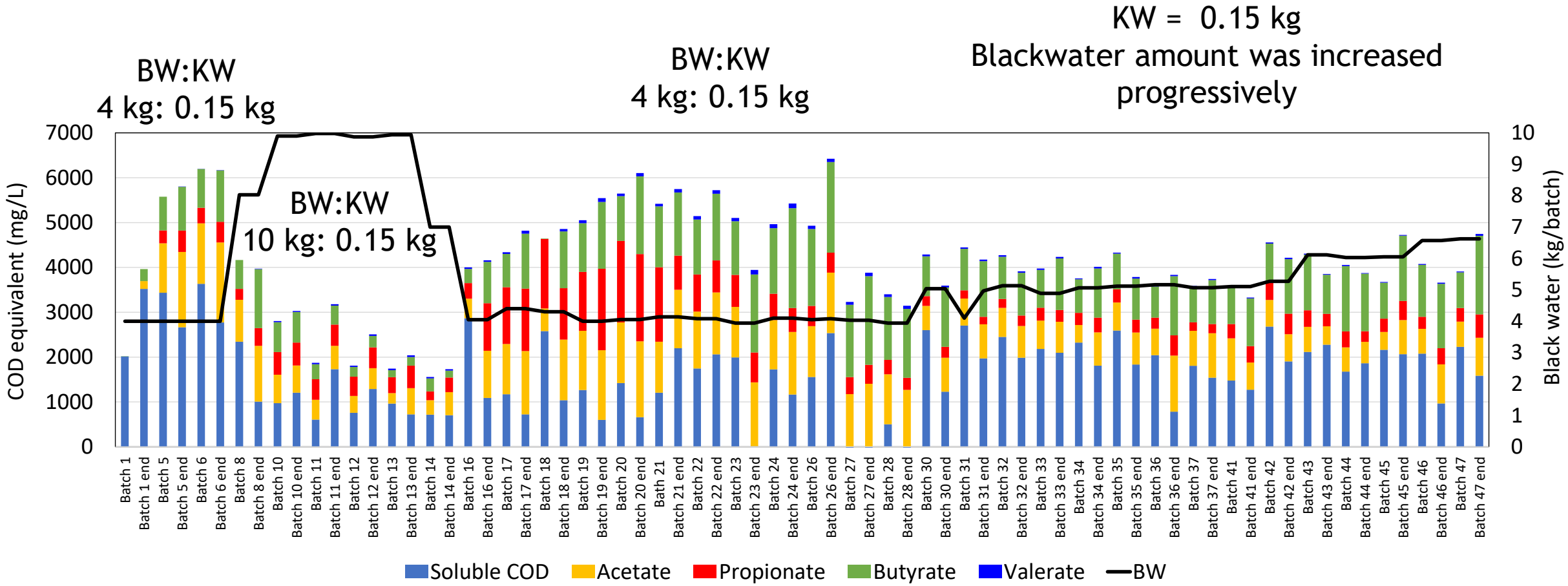
1. **Acidogenic fermentation:** Batch operation

   Inoculum: Sludge from the mesophilic anaerobic digester of Terrassa WWTP
   T = 55ºC
   pH = 5.5
   HRT = 3 - 2 days
   V = 15 L

2. **Anaerobic digestion:** Continuous operation

   Inoculum: Granular sludge from a UASB reactor installed in a juice factory.
   T = 35ºC
   pH = 7.5
   V = 5 L

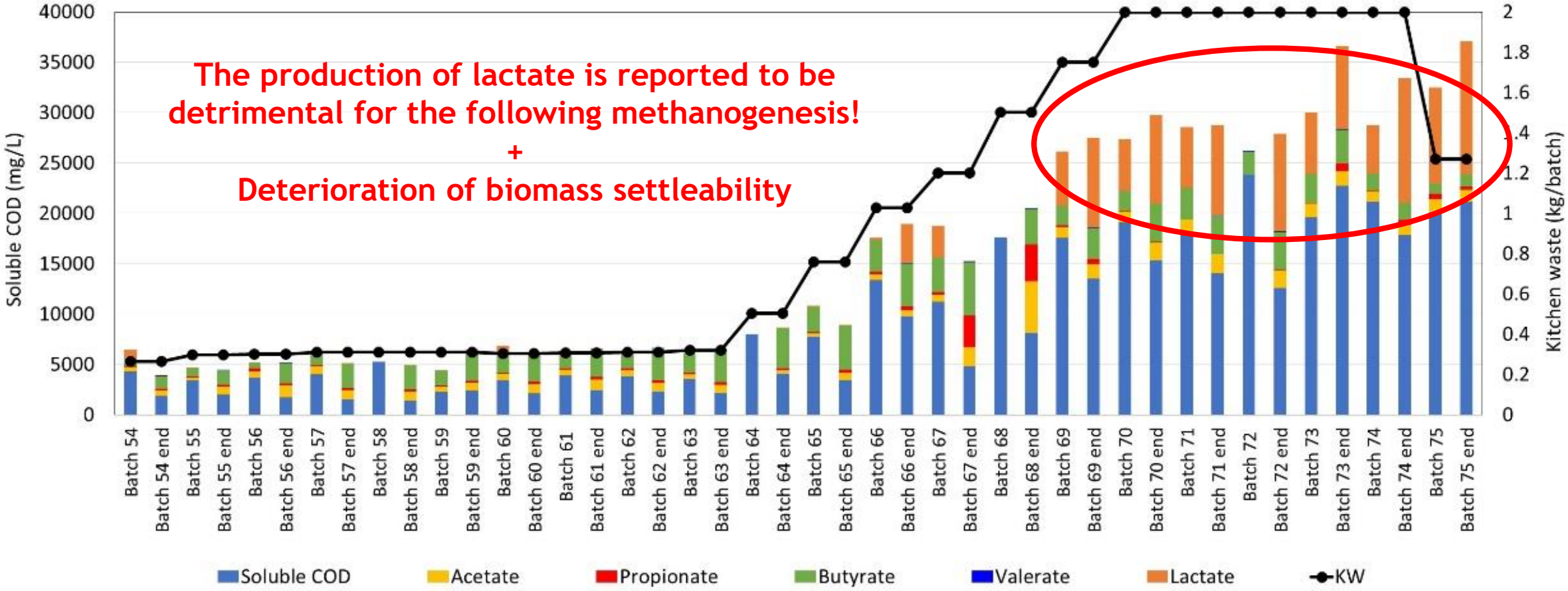
RESULTS: Acidogenic fermentation reactor



To increase the VFA production is needed to augment the KW added per batch due to its high biodegradability and the balance it brings to the carbon/nitrogen ratio of BW.

RESULTS: Acidogenic fermentation reactor

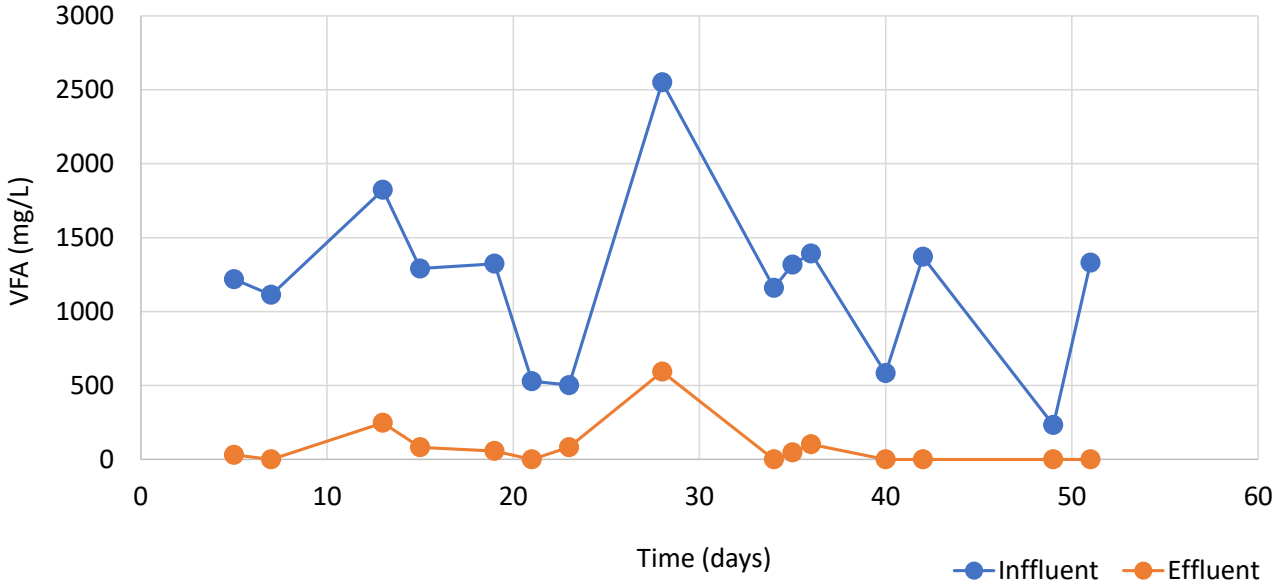
BW= 7 kg
KW was increased progressively until 2 kg.



RESULTS: UASB reactor

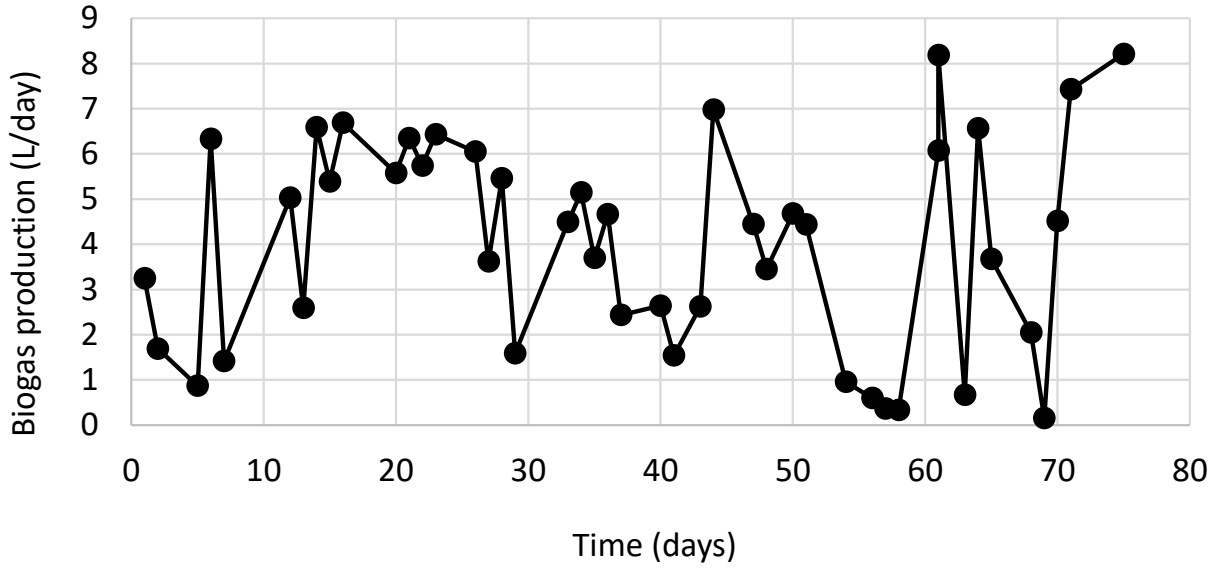
VFA valorization through anaerobic digestion to exemplify how to link the VFA bioproduction process with a real potential application.

High efficiency removal of VFA



Biogas composition

76 % CH_4
24 % CO_2

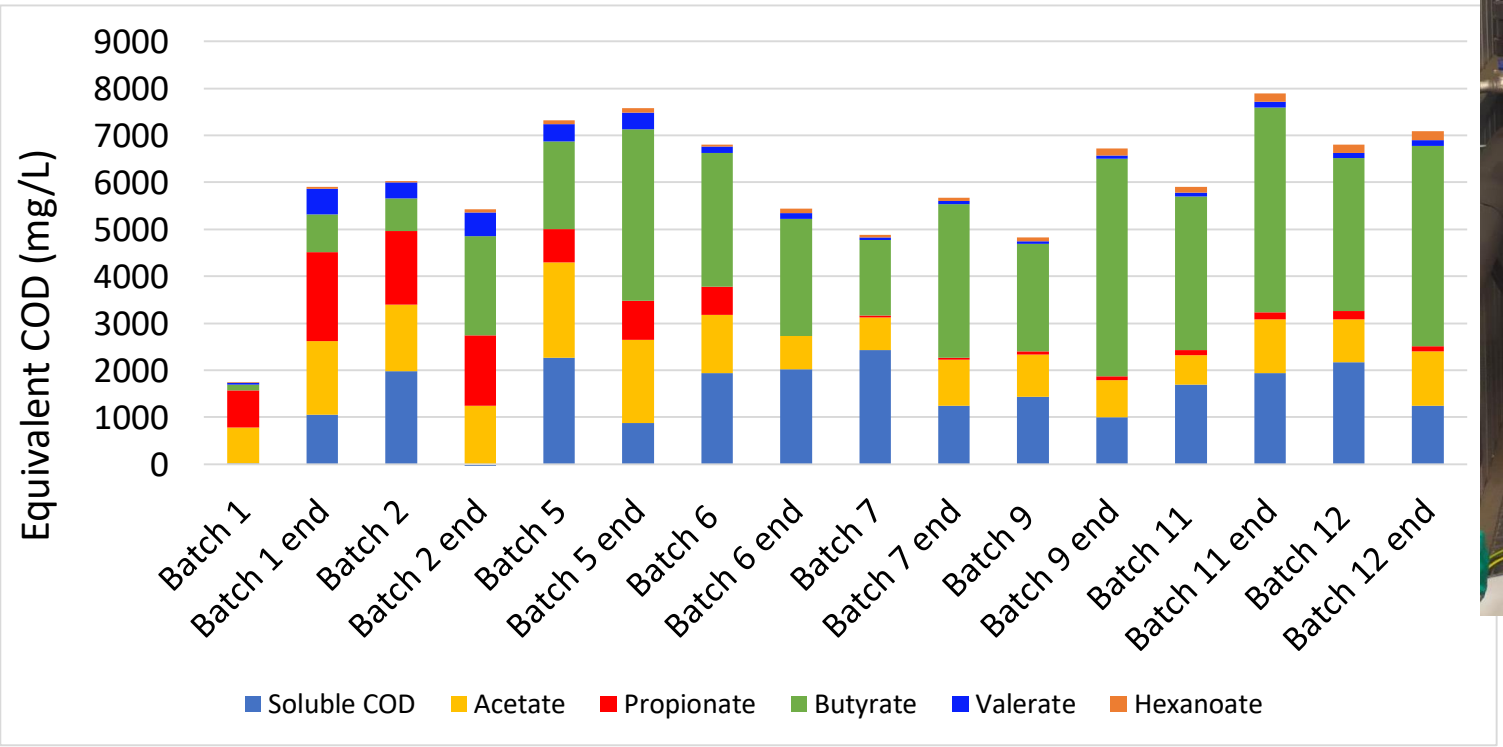


AnMBR pilot plant

1. Acidogenic fermentation

Reactor: 550 L of working volume.

Settler: 450 L of working volume



AnMBR pilot plant

2. Methanogenesis stage

UASB reactor: 250 L of working volume.

Start-up expected: End of June.

Conclusions

Scale-up

- This work allows to decide and obtain the key parameter to scale-up the technology
- Selection of the optimum conditions for each stage

KW:BW

- The higher the ratio KW:BW, the higher VFA concentration in the acidogenic fermentation and biogas production in the UASB reactor
- High concentration of suspended solids in the effluent of first stage that affects the UASB reactor performance

Validation

- Successfully technical validation of the AnMBR system demonstrating the capability of treating blackwater and kitchen wastes to obtain biogas, sludge and regenerated water with good quality
- Further optimisation is required for different ratios of KW:BW

QUESTIONS?

LEITAT
managing technologies

HOUSEFUL

THANK YOU!

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