







CO₂ Enrichment in Anaerobic Digesters

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Improvement of biogas production by enriching anaerobic digesters with CO₂

Goal

- methane yield and composition
- Kinetics
- CO₂ emissions

Previous research works

13 Publications

Sato et Ochi, 1994 ; Alimahmoodi et Mulligan, 2008 ; Francioso et al., 2010 ; Alimahmoodi et Mulligan, 2011 ; Salomoni et al, 2011 ; Bajon Fernandez et al., 2014 ; Bajon Fernandez et al., 2015 ; Koch et al., 2015 ; Mohd Yasin et al., 2015 ; Koch, Huber, Bajon & Drewes, 2016 ; Al-mashhadani et al., 2016 ; Muntau et al., 2021

Extremely diverse experimental conditions

→ Digesters 1L → 630 L, monophasic/biphasic

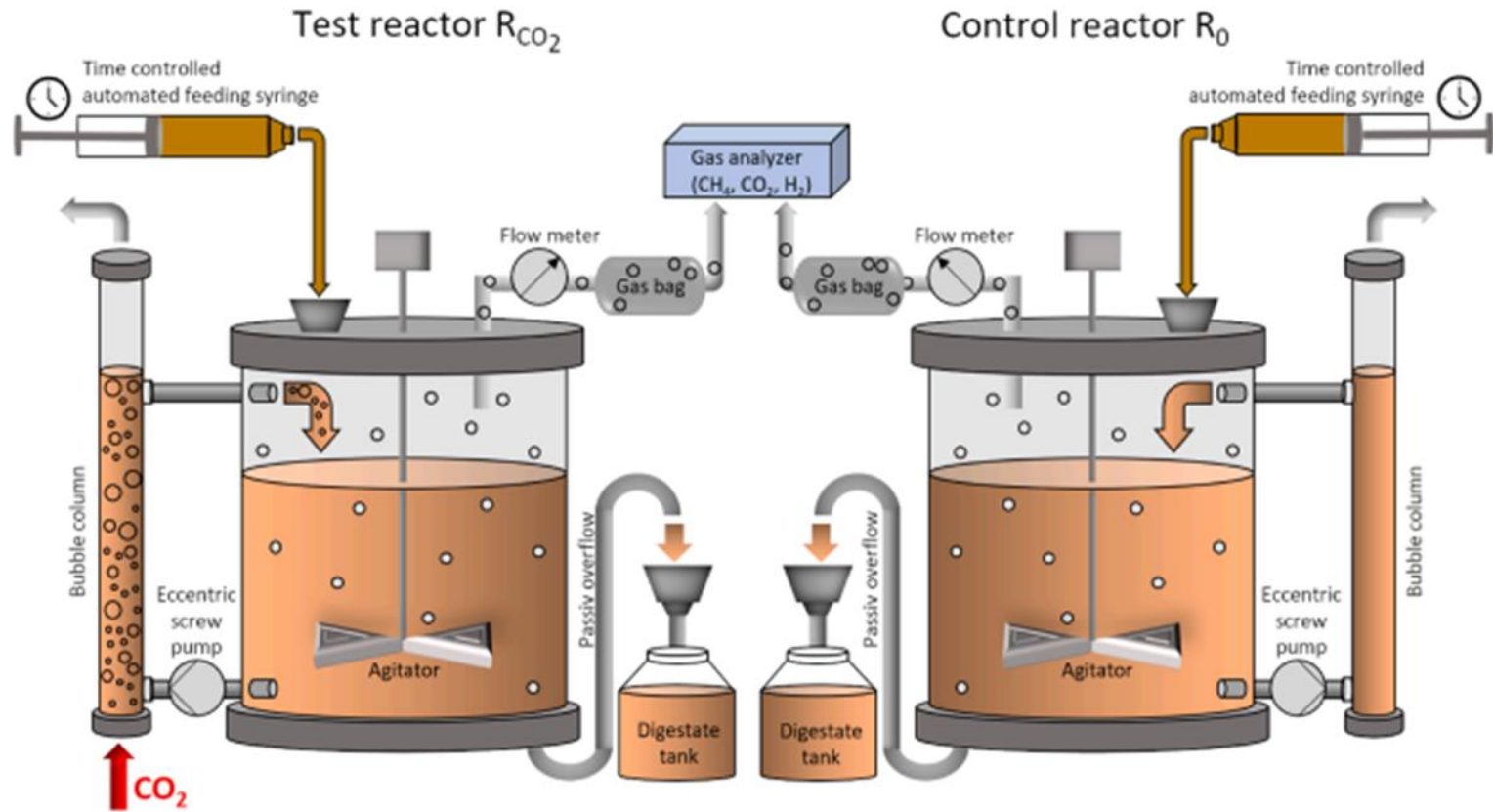
Diverse results

Increase of specific CH₄ yield production up to 100% at lab scale and 25% at pilot scale

Challenges

- **Digester enrichment of the without biogas dilution**
- **Effective measurement and accurate evaluation of CO₂ enrichment impact**
- **No acidification**

Muntau et al., 2021





In situ measurement of dissolved CO₂

Strategy

- Avoid problems related to sample degassing
- Rigorous monitoring and analysis of CO₂ dynamics in a digester

In situ measurement : Challenges

Same as those faced when measuring dissolved CO₂ in natural waters

1. Impact of the probe position/probe dynamics

→ Use of 2 probes

2. Need for high CO₂ selectivity

→ NDIR probe

3. Need for high spatial and temporal resolution

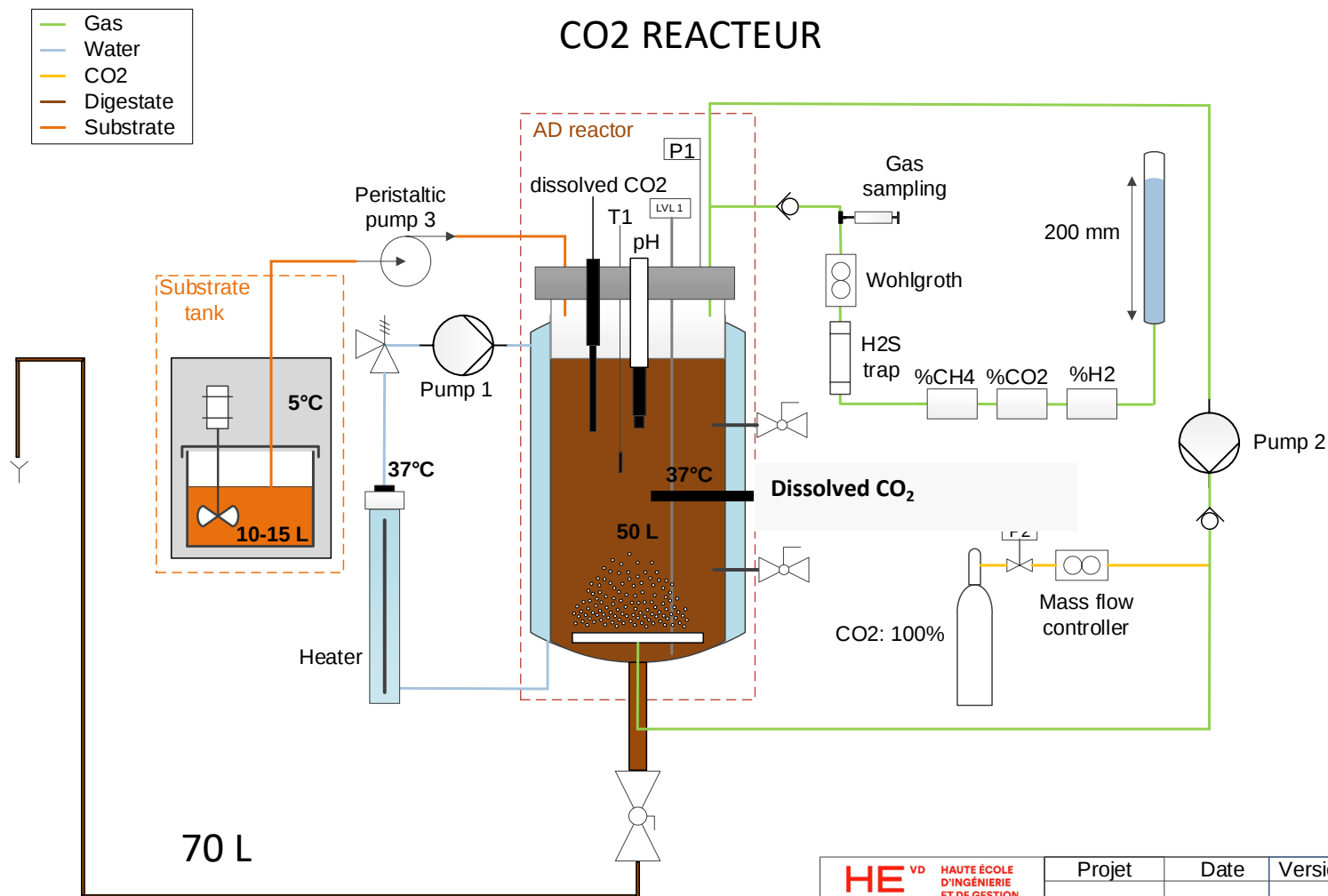
→ NDIR probe

4. Fooling/clogging

→ A risk to be taken

Conrad : Digester Set up

Substrate: Primary and secondary sludge

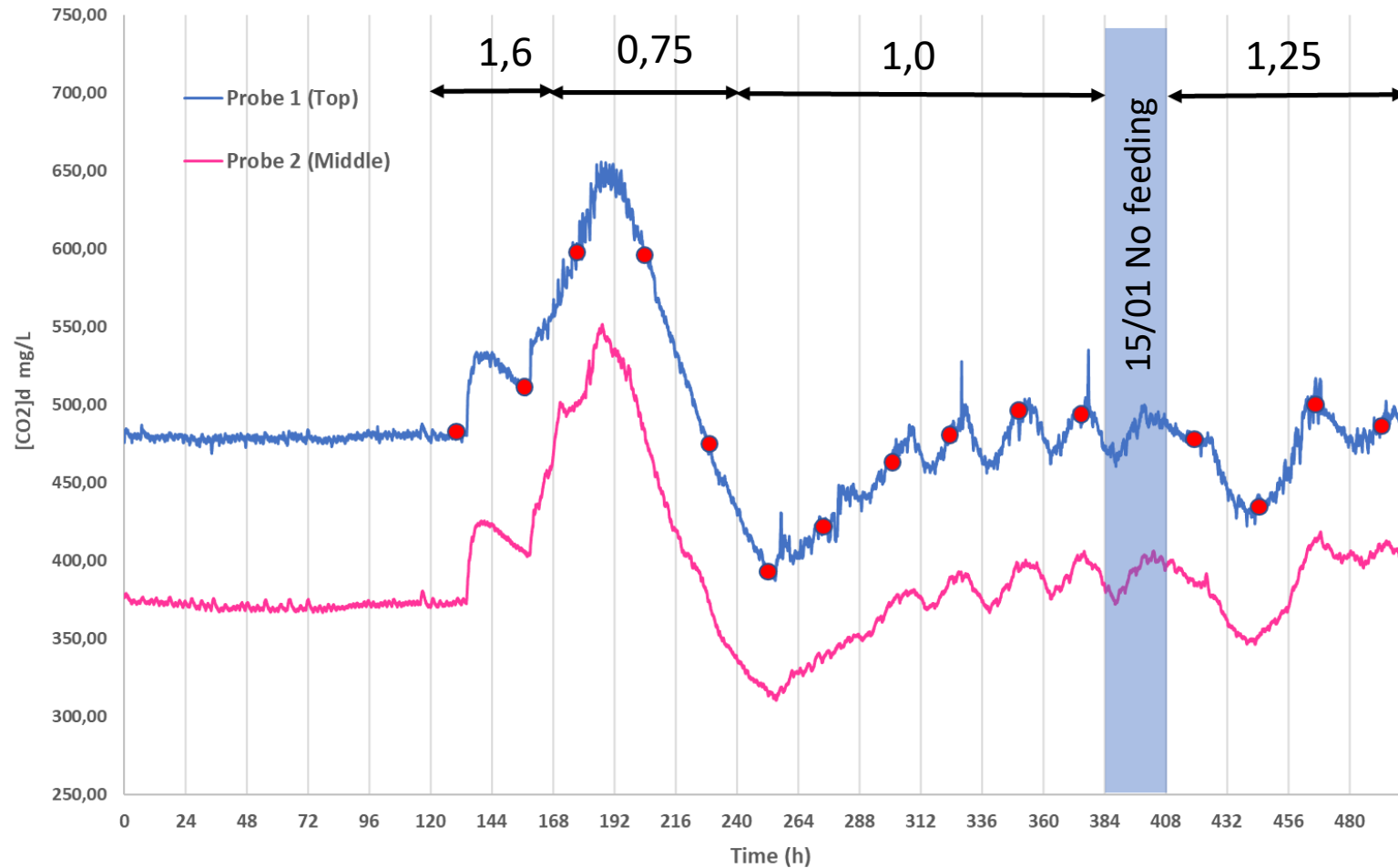


Results

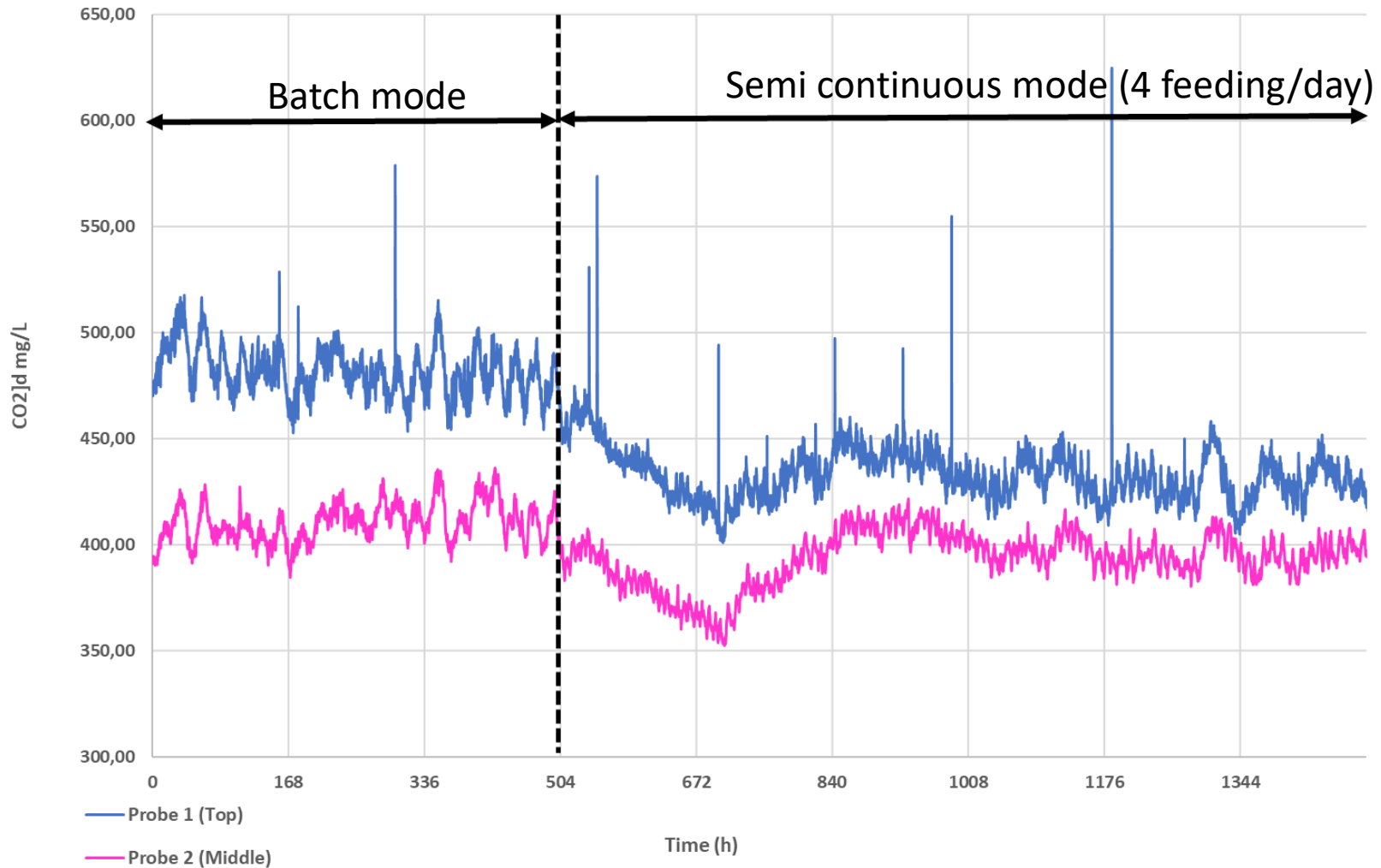
- Digester Start up (December – January)
 - Probe reactivity test
- Digester Stabilization (February/ March)
 - CO₂ dynamics

Digester Start up

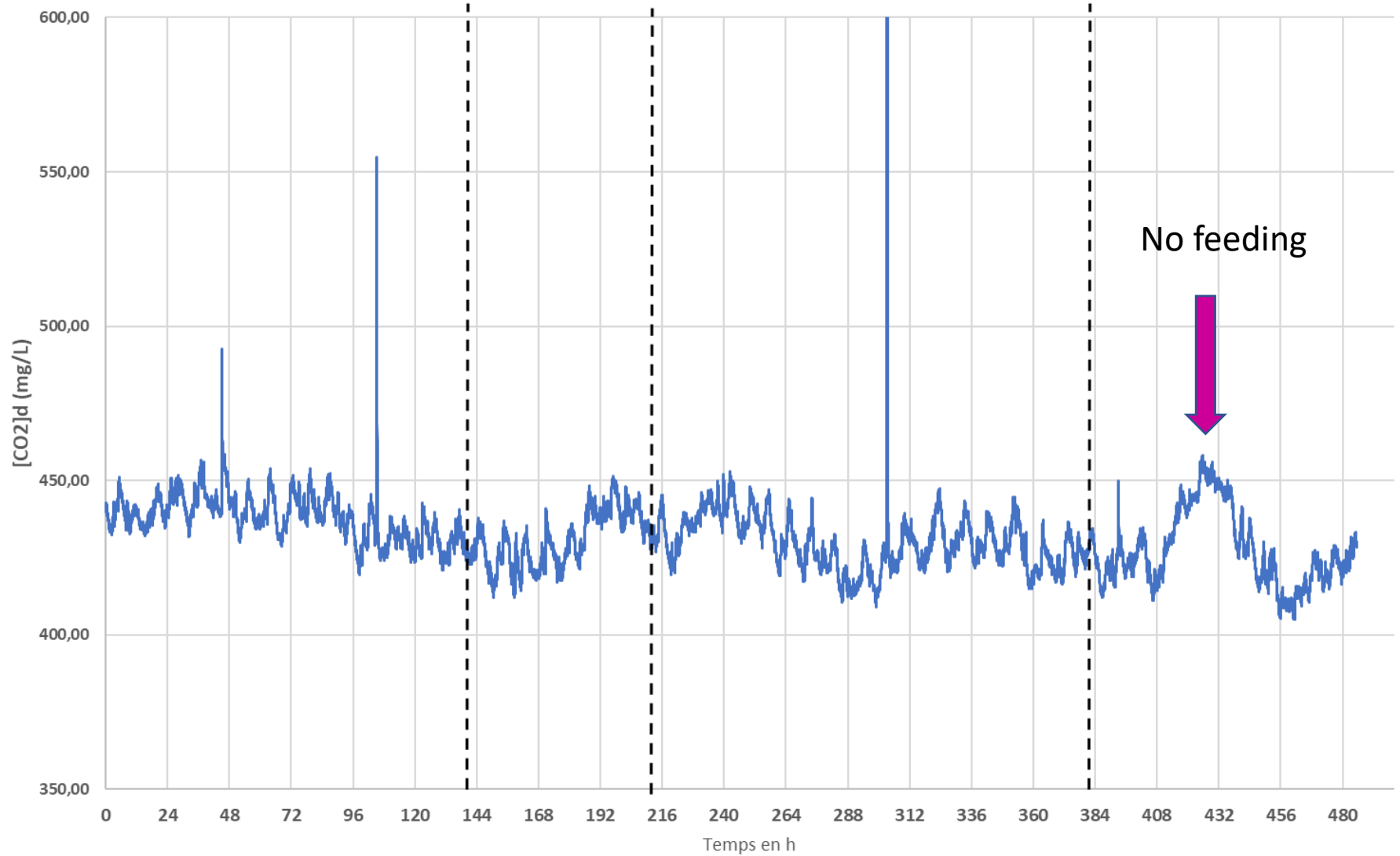
● Feeding (once a day) ↔ Organic loading rate ($\text{kg}_{\text{VSS}}/\text{m}^3/\text{d}$)

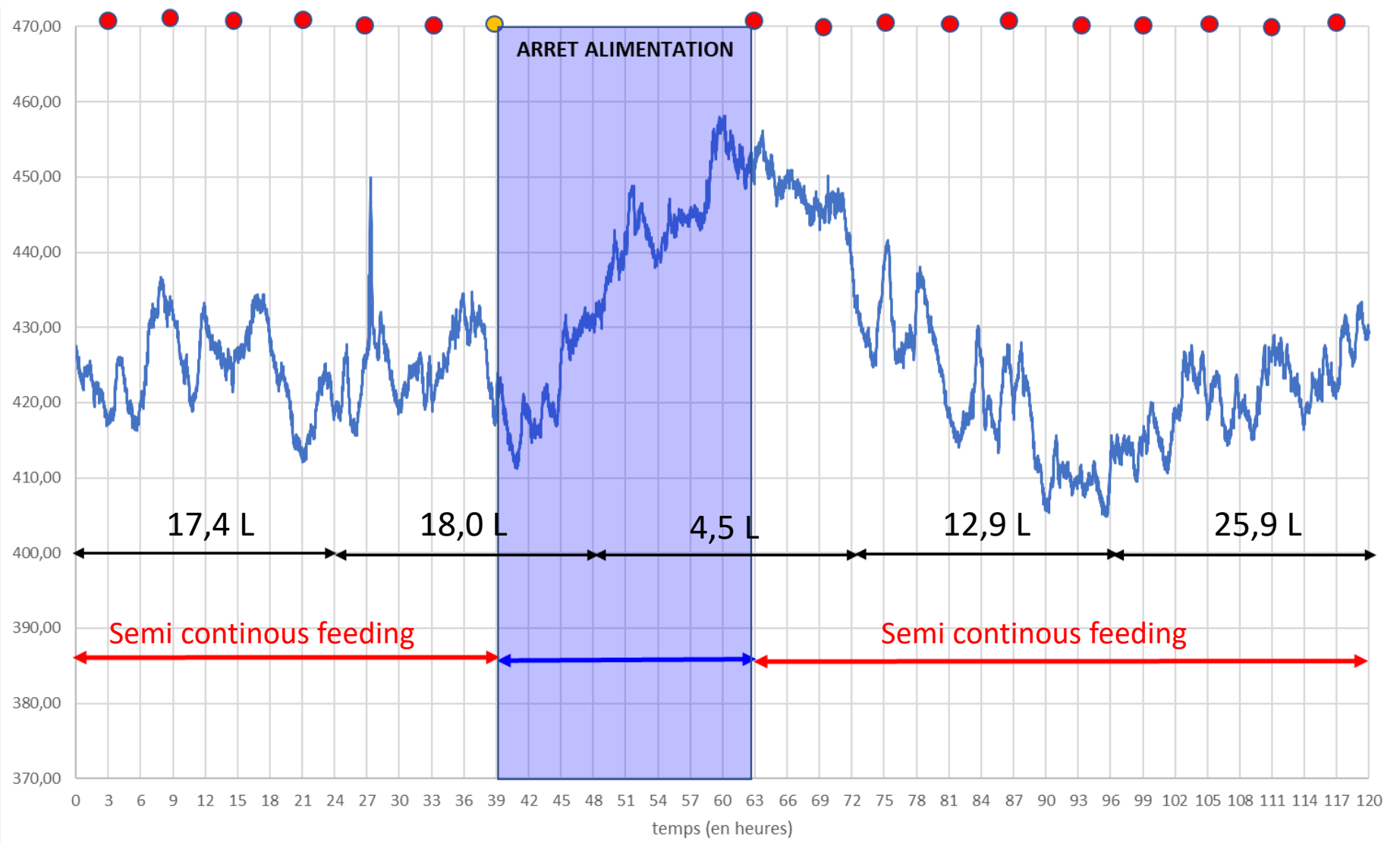


Digester Stabilization



Digester Stabilization





Conclusion

In situ dissolved CO₂ measurements

- Appropriate set up to monitor endogenous and exogenous CO₂
- A key factor to understand CO₂ dynamics
- A new way for digesters monitoring and control

Next step

- Rigorous monitoring and **analysis** of CO₂ dynamics in our digester
- Enrichment tests

Thank you for your attention !