Causes of Souring During Food Waste and Fats/Oils/Grease Anaerobic Co-Digestion with Municipal Sludge

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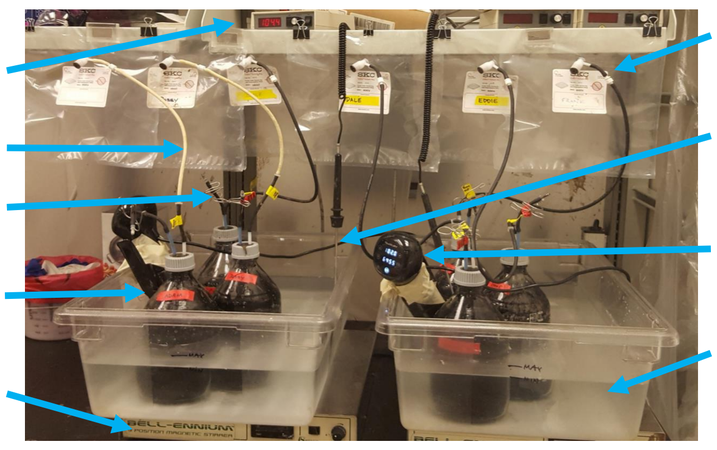
CAN WE IDENTIFY CAUSES AND LEADING INDICATORS OF ANAEROBIC CO-DIGESTION (AcoD) SOURING UNDER DYNAMIC CONDITIONS?

We performed experiments to identify the causes of rapid short-term and longer-term AcoD souring with constantly changing feedstocks. **Ultimately, souring was caused by depletion of bicarbonate (HCO_3^-) alkalinity in the system, leaving little buffering capacity to deal with the variable FW/FOG feed streams.** In rapidly souring reactors, the failures were caused by rapid fermentation of FW/FOG production of volatile fatty acids, depleting HCO_3^- alkalinity. Reactors that soured after several months of operation failed because of a slower depletion of HCO_3^- alkalinity due to rapid volatile fatty acid (VFA) production after feeding and increased off-gassing of CO_2 due to short-term decreases in pH. Souring was reversed when identified early and HCO_3^- added to the system. **HCO_3^- alkalinity concentration was the leading indicator of souring by 7-15 days** vs. other indicators.

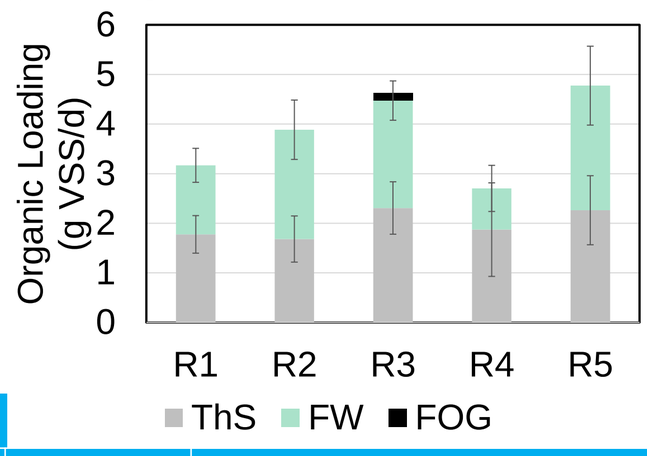
Background

FW and FOG account for > 15% of municipal solid waste in the US[1] and have high organic carbon content, making them ideal for energy production. Many municipalities are pursuing AcoD of FW and FOG at water resource reclamation facilities, but AcoD operations can be challenging due to rapid fermentation of FW/FOG, causing pH depression to < 6.0 causing souring and methanogenic inhibition. Here, we identify causes and leading indictors of souring under rapid, short-term tests and longer-term operations can provide industry with tools to identify upsets prior to irreversible failure.

AcoD Experiments

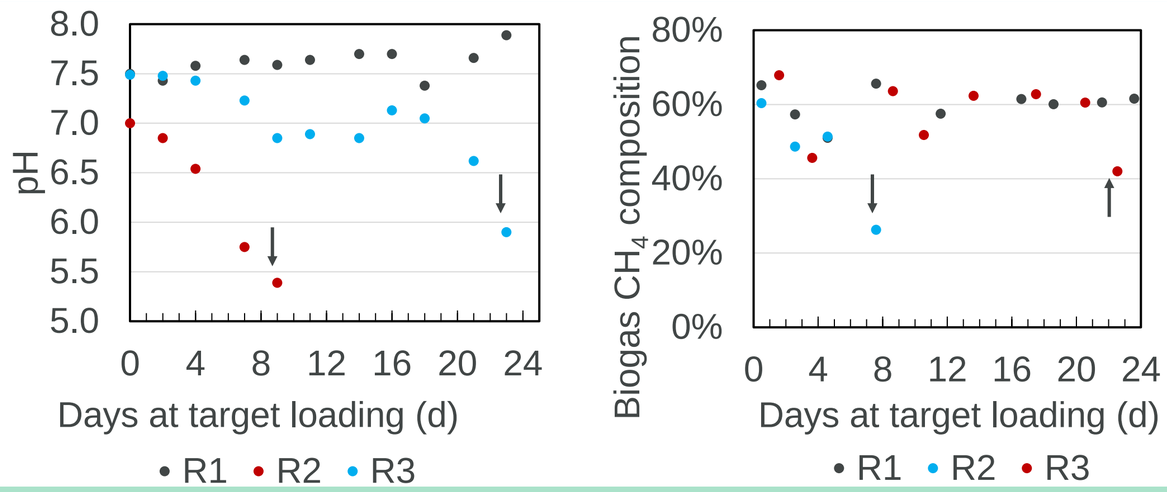


- Dynamic waste streams: Fresh thickened sludge (ThS) and FW obtained 3 times per week and FOG once per week
- Reactors fed 3x/week



	Feed volume ratio				
	ThS	FW	FOG	HRT (d)	Days of operation (d)
R1	1	1	0	12.9	130
R2	1	1.5	0	10.3	9
R3	1	0.5	0.1	16.1	23
R4	1	0.29	0	20	99
R5	1	0.5	0	17.2	114

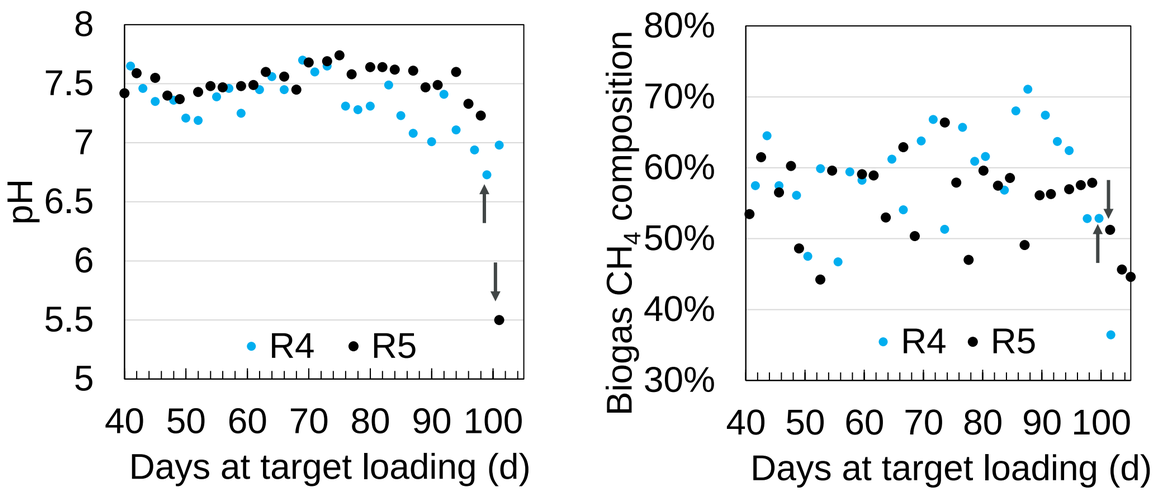
Rapid Souring Experiments



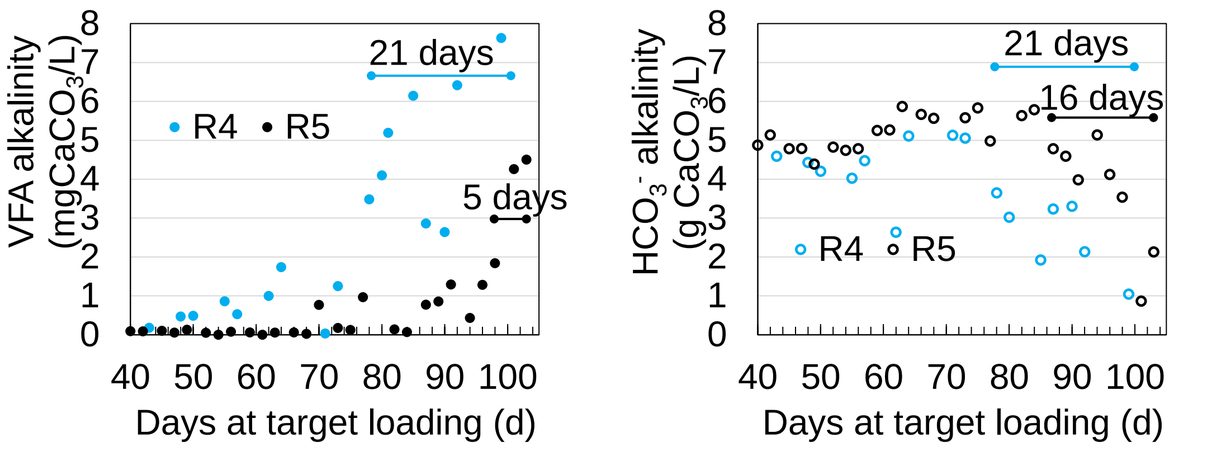
- Reactor R1 was stable while R2 and R3 soured (at the arrows)
- % CH_4 always a lagging indicator of souring
- VFA to SCOD ratio and HCO_3^- to total alkalinity ratio are both indicators of souring in rapid souring events

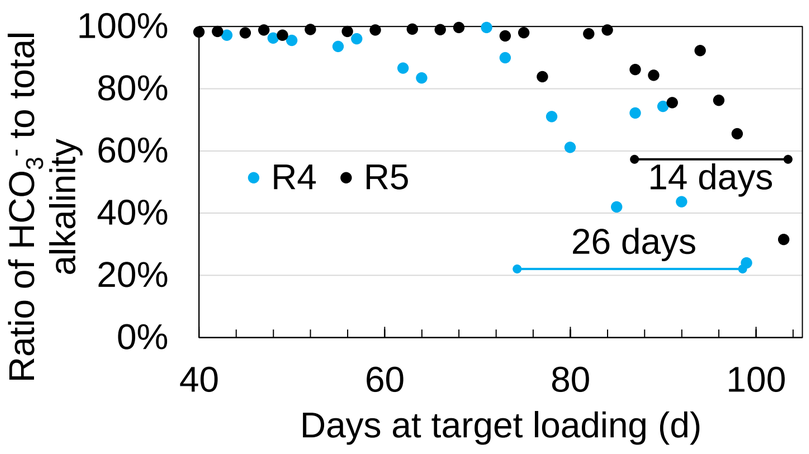
Longer-term Souring Experiments

Reactors R4 and R5 soured at the arrows



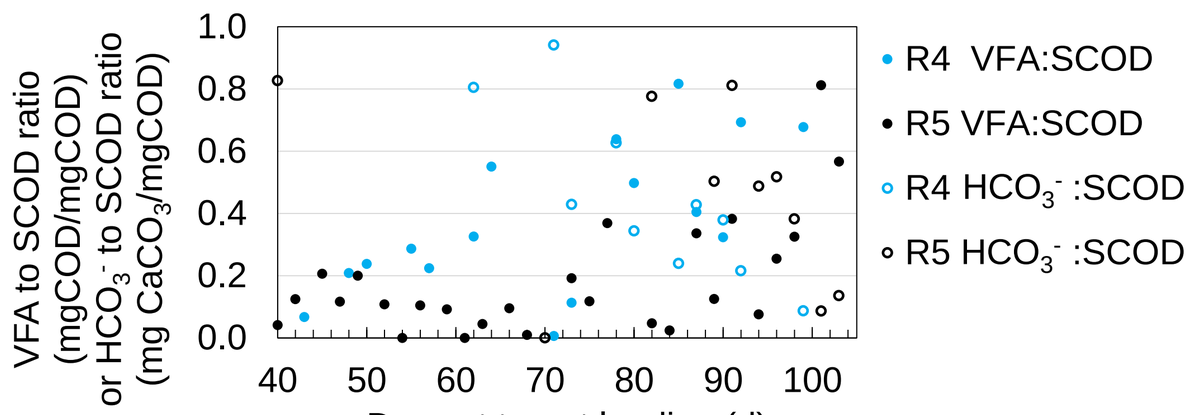
Indicators with alkalinity tended to be longer leading indicators than those with other parameters





Total alkalinity = HCO_3^- alkalinity + VFA alkalinity

SCOD-related trends were not consistent indicators of souring, largely due to variations in feed composition



Acetate and propionate ratios were not indicators of souring

References: [1]U.S. EPA. (2018). Advanced Sustainable Materials Fact Sheet.

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inspiring change