Considerations for Co-digestion in Agricultural Anaerobic Digesters

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Overview

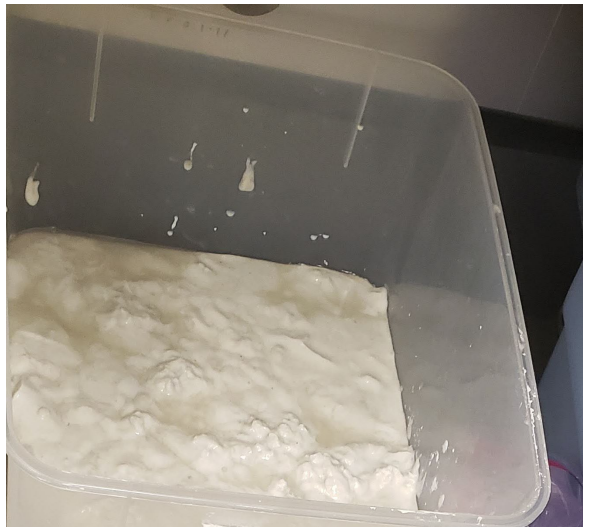
- Recap of co-digestion
- What does the research say about co-digestion?
- What does this mean for your digester?
- What steps can you take?

What is co-digestion?

What is co-digestion?

- Anaerobic digestion of more than one feedstock
- See our previous webinar for additional details
  - Chad Antle:

https://engineering.purdue.edu/adt/wm/index_files/MM.htm

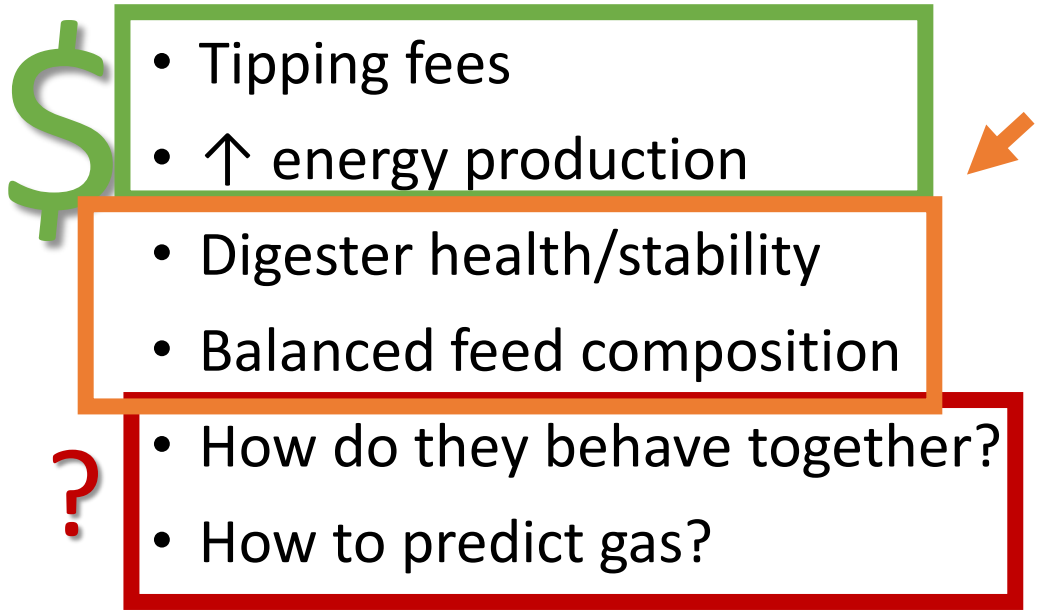


Why use co-digestion?

Agriculture

- Not economically feasible for some farms
- Biogas production dependent on manure alone

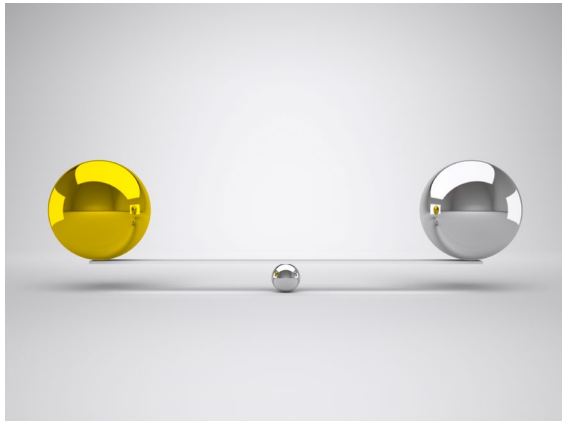
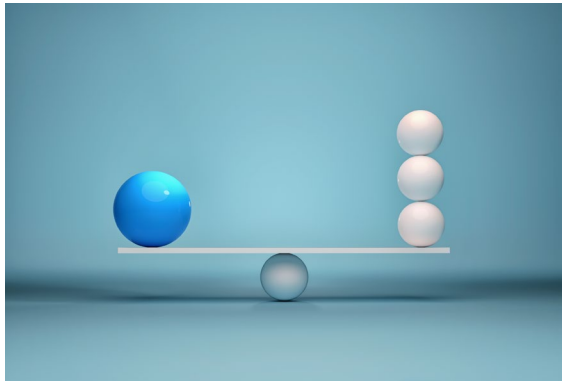
Co-digestion: anaerobic digestion of multiple feedstocks



Industry

- Large variety of feedstocks with diverse characteristics
- Insufficient supply of single feedstock
- Some feedstocks cannot be digested alone

How do you balance it all?

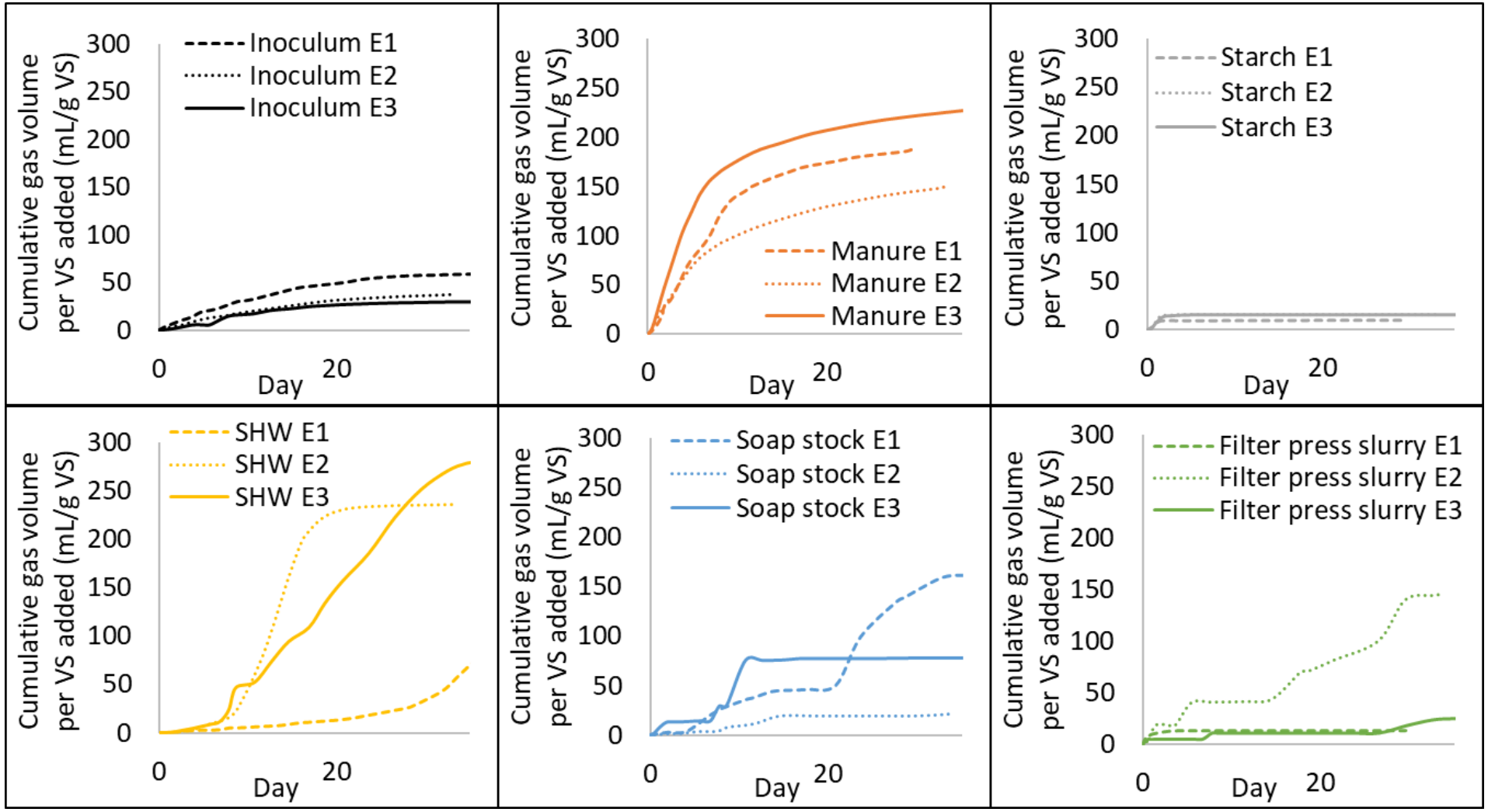
	What it looks like	What it feels like
Anaerobic digestion		
Co-digestion		

What does the research say?

How do we test co-digestion in a lab?

- Biomethane potential tests:
  - Mono-digestion: baseline
  - Co-digestion: how does the combination change?
  - 1 L working volume, mesophilic digesters, gas collected in bags
  - 30+ day batch experiments, triplicate digesters for each treatment
  - 1:2 inoculum:feedstock (VS basis)
- Bio Town Ag provided inoculum and feedstocks

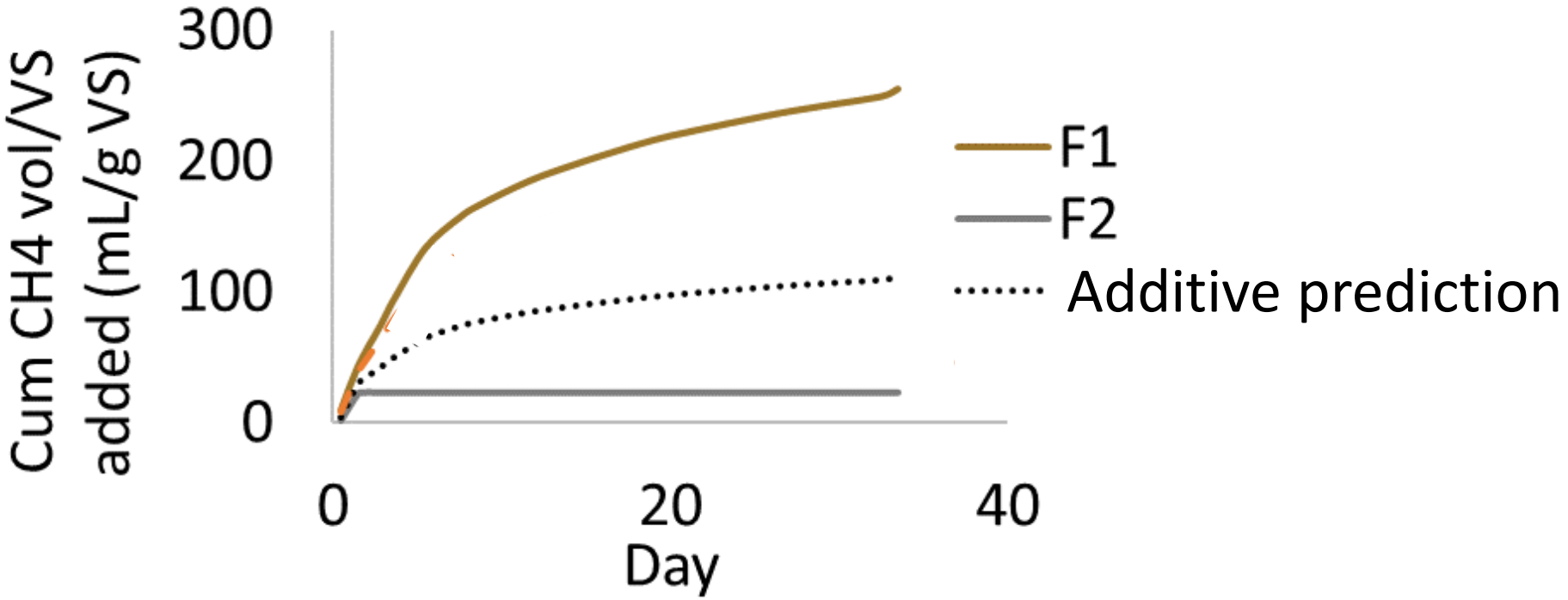
Large variability between/within feedstocks



SHW = slaughterhouse waste

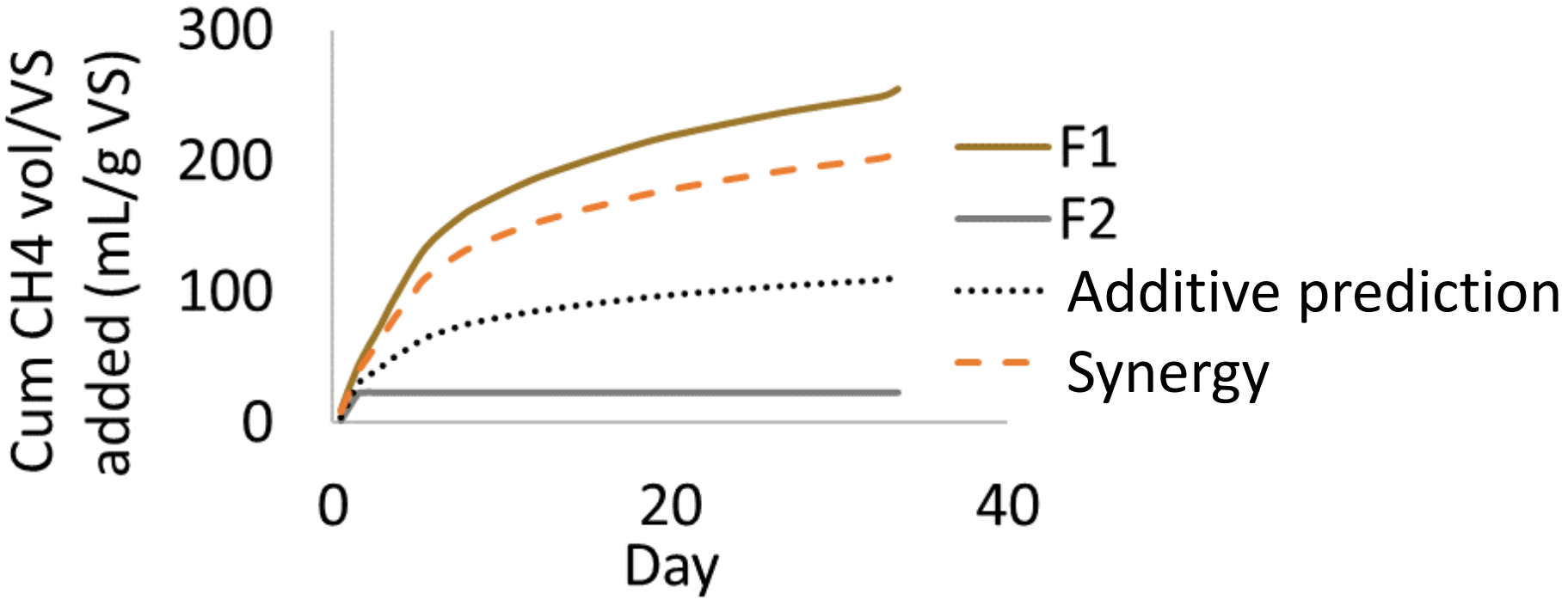
How much gas can you get?

- Additive BMP: *weighted average* yield (gas/stuff): 1 + 1 = 2
  - This usually happens -> you get more gas as you put more stuff in



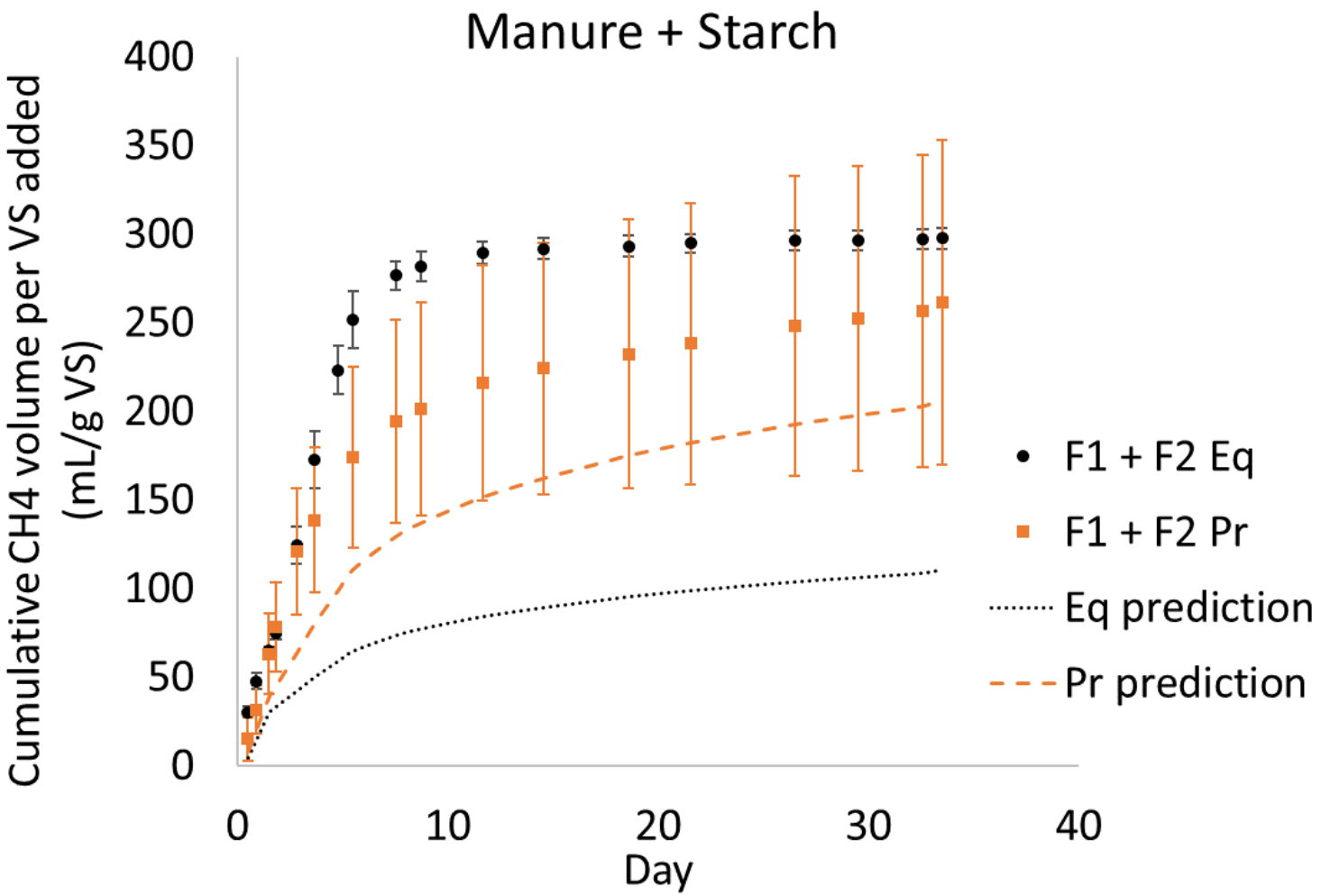
How much gas can you get?

- Synergy = 1 + 1 = 3
  - This **sometimes** happens: you can get extra gas (or get it faster) *depending on what you put in*



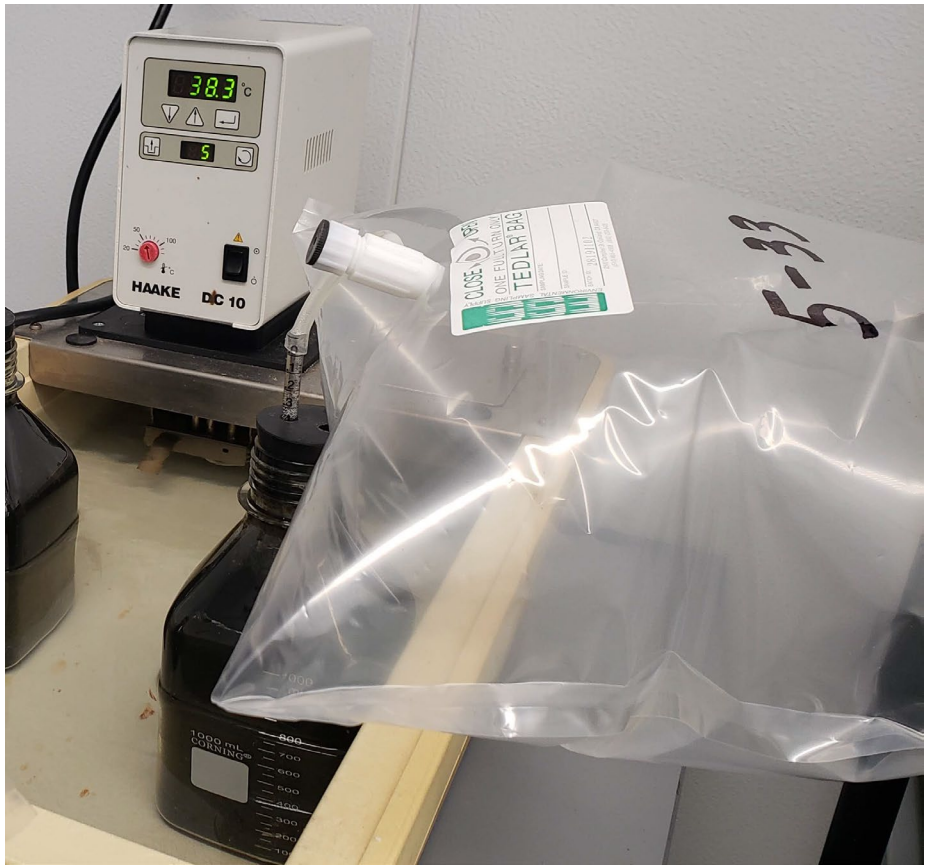
Example: Manure + Starch

- Eq = 1:1 ratio
- Pr = 6.3:1 ratio
- Points = treatment averages



But is faster always better?

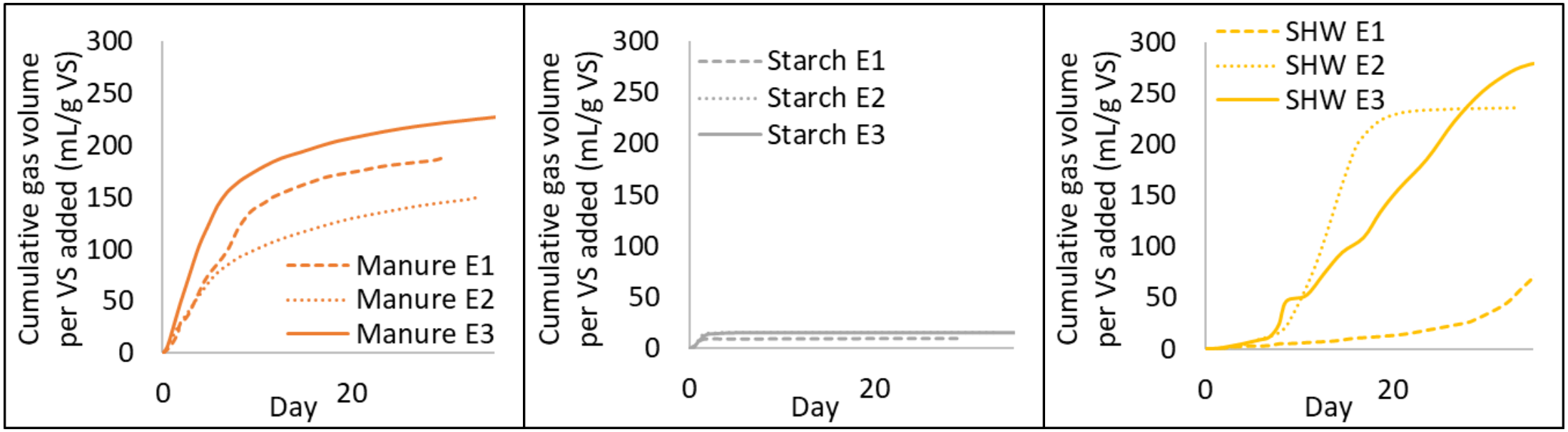
- That depends…is your system ready?



Watch out for foaming!

- Foaming is complicated
- More feedstocks > more chances for complications

Balance nutrients



SHW = slaughterhouse waste

Relative percentages for E3

Carbohydrate	34%	99.5%	3%
Protein	54%	0.1%	40%
Lipid	11%	0.4%	57%

Key considerations

- Co-digestion usually increases gas production
- Synergy (1+1 = 3) possible
- Balance is key: both for macro and micronutrients
- Watch out for: high variability, inhibition, foaming, and feedstocks that digest quickly

What does this mean for full-scale digesters?

SWOT for adopting co-digestion

STRENGTHS	WEAKNESSES
OPPORTUNITIES	THREATS

Strengths

- Manure-only AD:
  - Consistent and known feedstock
    - Volume
    - Composition
  - Predictable gas production
  - Lots of expertise already available

Weaknesses

- Manure-only AD:
  - May have additional unused digester capacity
  - Limited possible revenue streams:
    - Gas from manure (fixed)
    - Fertilizer

Opportunities

- Co-digestion
  - Additional possible revenue streams
    - Tipping fees
    - Additional gas
  - May improve digestion kinetics
  - Additional digestate (if you have a use for it)
  - Carbon credits? (Depends on the feedstock!)

Threats

- Co-digestion
  - Retrofitting needed? Will depend on your system
  - Inhibition or foaming
  - Dependence on a feedstock outside your control
  - Possibility of high variability in feedstocks
  - Additional digestate
  - May DISQUALIFY carbon credits (depending on the feedstock)
  - Too much gas or erratic production

What steps can you take?

Turning “Threats” into “Challenges”

- Inhibition or foaming
- Dependence on a feedstock outside your control
- Possibility of high variability in feedstocks
- Additional digestate
- Carbon credit disqualifying
- Too much/erratic gas

- Dilution, discover problems
- Mixing pit; diversify; seek a stable “base”
- Be aware of variability; do testing; adjust fees
- Treat and sell!
- Multiple digesters
- Flare, store, mixing pit

What steps can you take?

- Do your research about the feedstock in advance
  - Volume
  - Variability
  - Possible contaminants
- Test physical and chemical characteristics of feedstocks
  - Solids, pH, carbon/nitrogen ratio (remember 20-30:1), macromolecular composition
- Consider having someone do a biomethane potential test to give a rough idea of what to expect
- Explore upgrading/adding equipment to handle

Key takeaways

- Co-digestion can be a useful tool in your toolkit, but use carefully
- Lab testing can help avoid some problems (but isn't perfect!)
- Balance!

Questions?

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