

Field study on intermittent mixing of septic tank fecal sludge

Lilith Astete Vasquez, EIT

NOWRA Mega Conference 2023

Hampton, VA

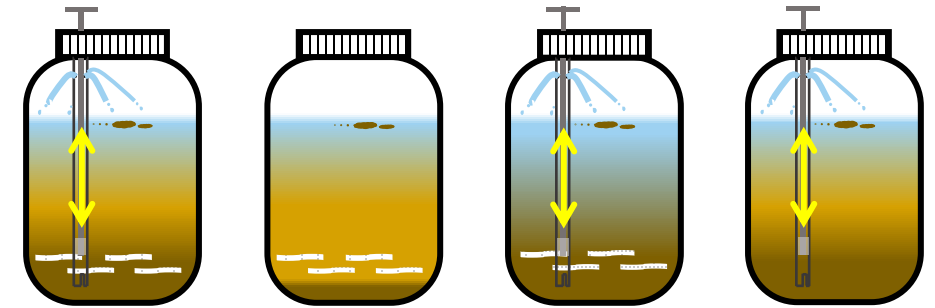


Introduction

- Previous work: design and important findings
- Motivation for septic study
- “Septic Mixer”
- Next steps: proof of concept
- Characterizing septic tank contents – field study
- Expected outcomes
- Questions & comments

Previous work - bench-scale anaerobic digesters

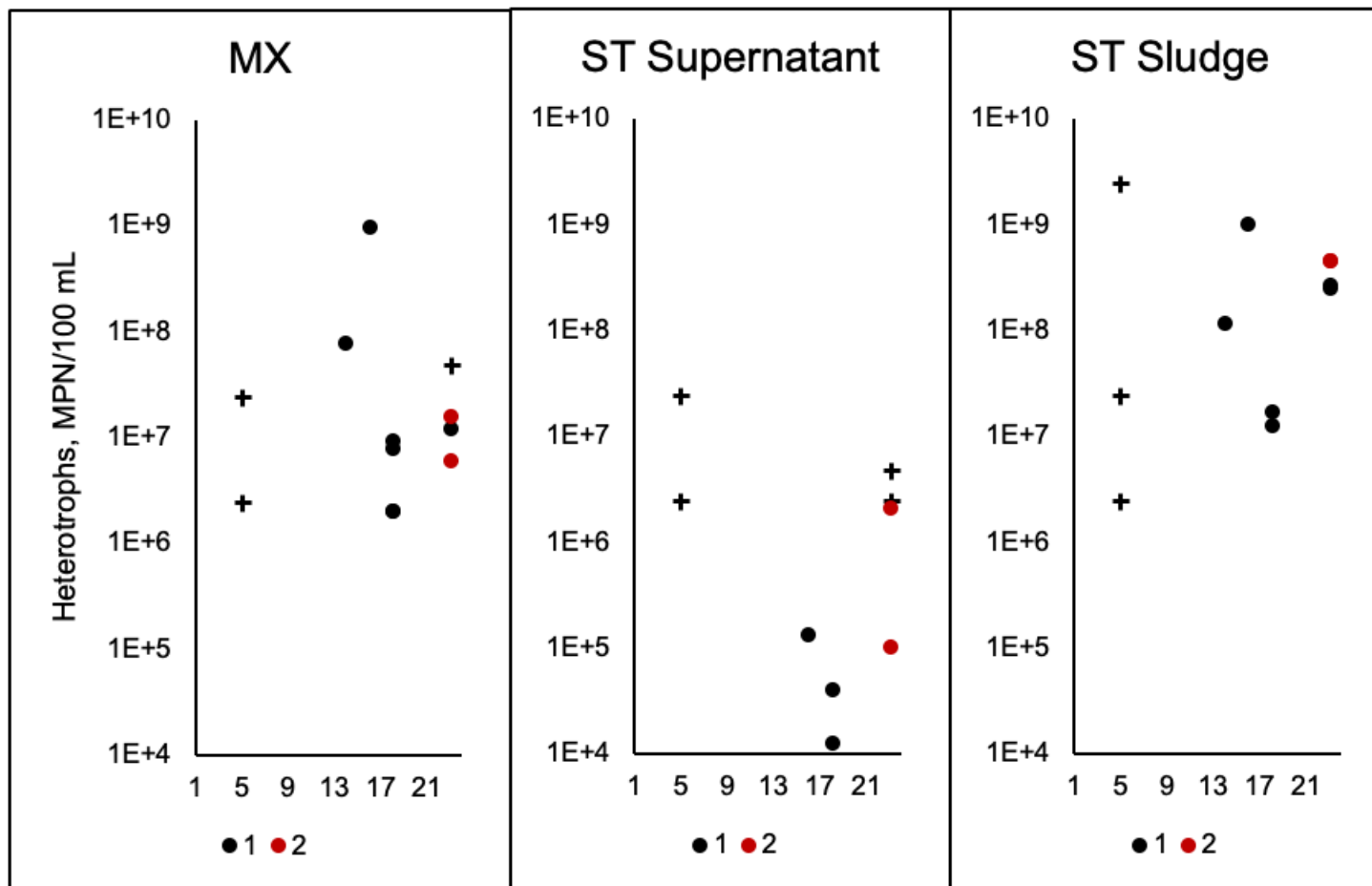
- Non-dilute waste products
 - Dog feces
 - Commercial grade toilet paper
 - Synthetic urine
- Intermittent mixing
- 725 days operation (~ 2 years)
- Monitoring chemical, physical, bacterial characteristics



Waste	MX	ST	UD	NO TP
Mixing	•		•	•
Feces	•	•	•	•
Urine	•	•		•
Toilet Paper	•	•	•	

Previous work - important findings

Heterotrophs



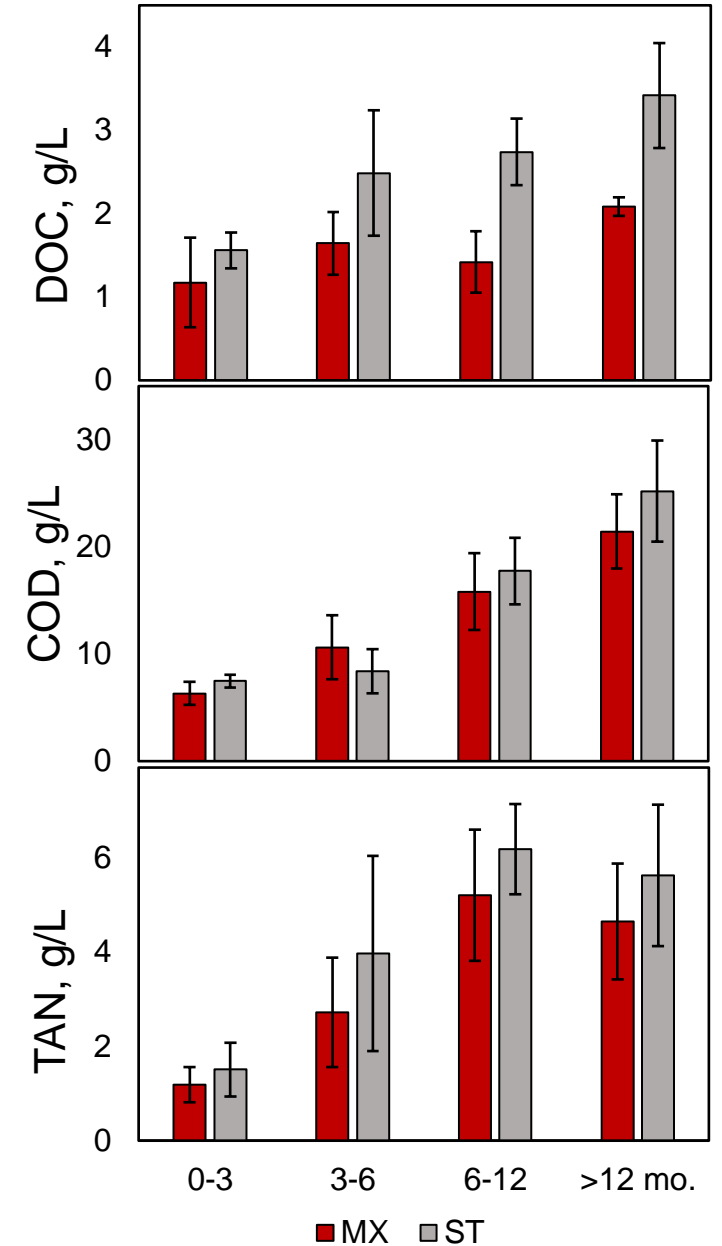
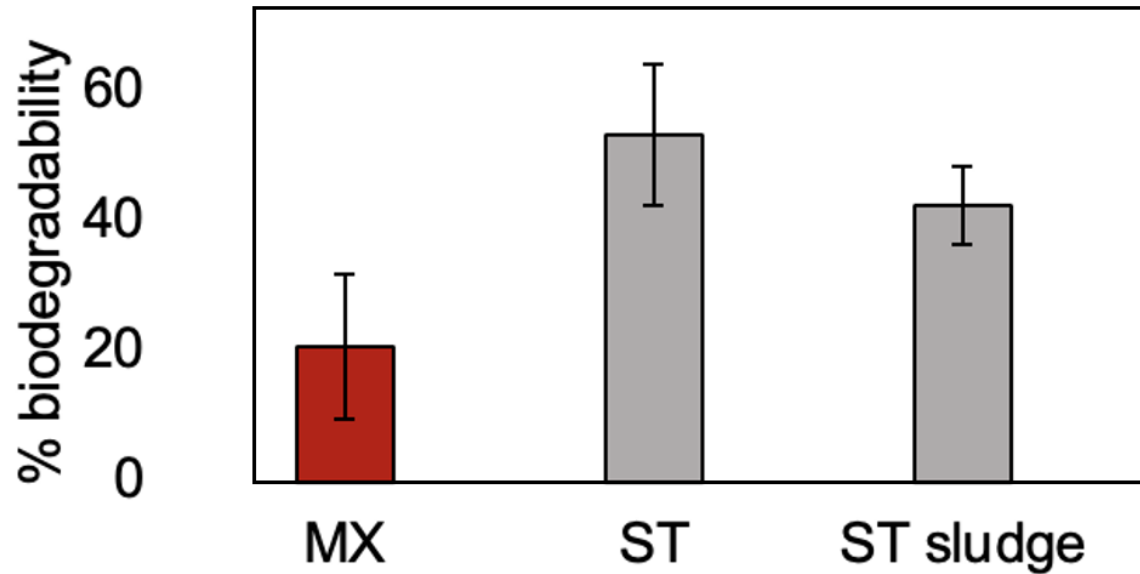
Operation time (months)

- minimum

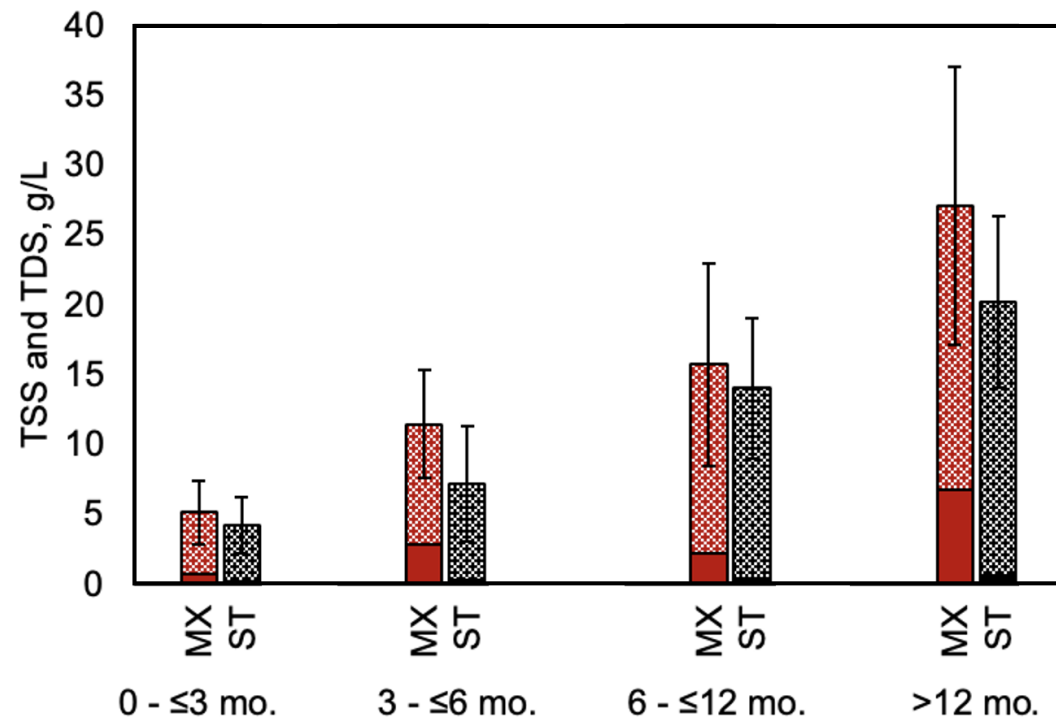
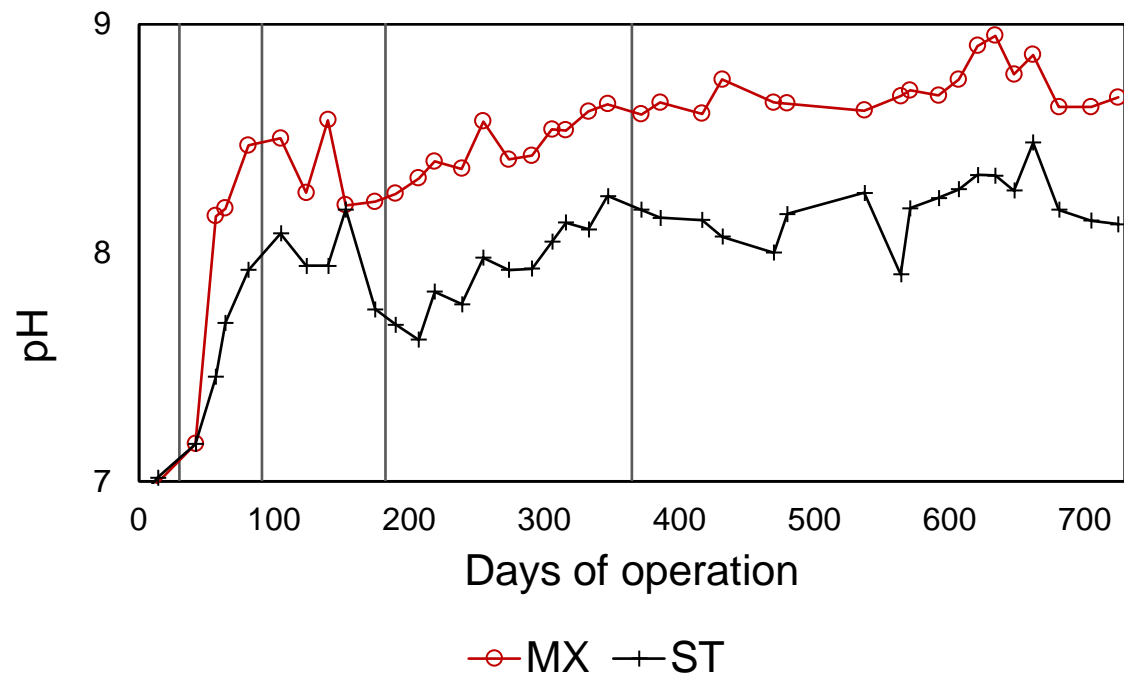
+ maximum

◇ maximum for ≥2 samples

Previous work - important findings

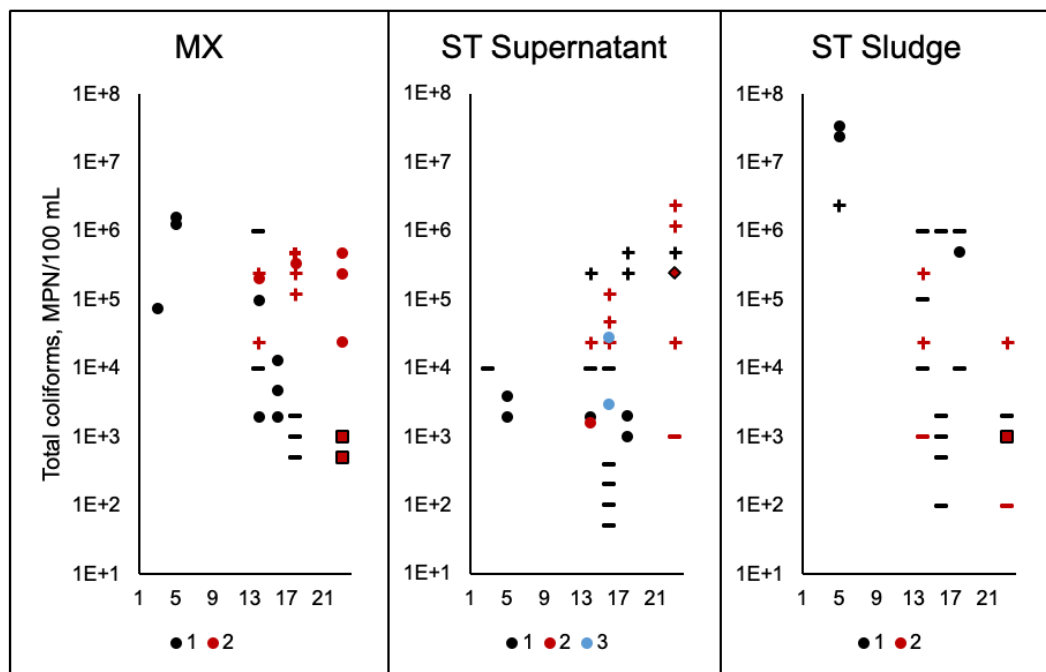


Previous work - important findings

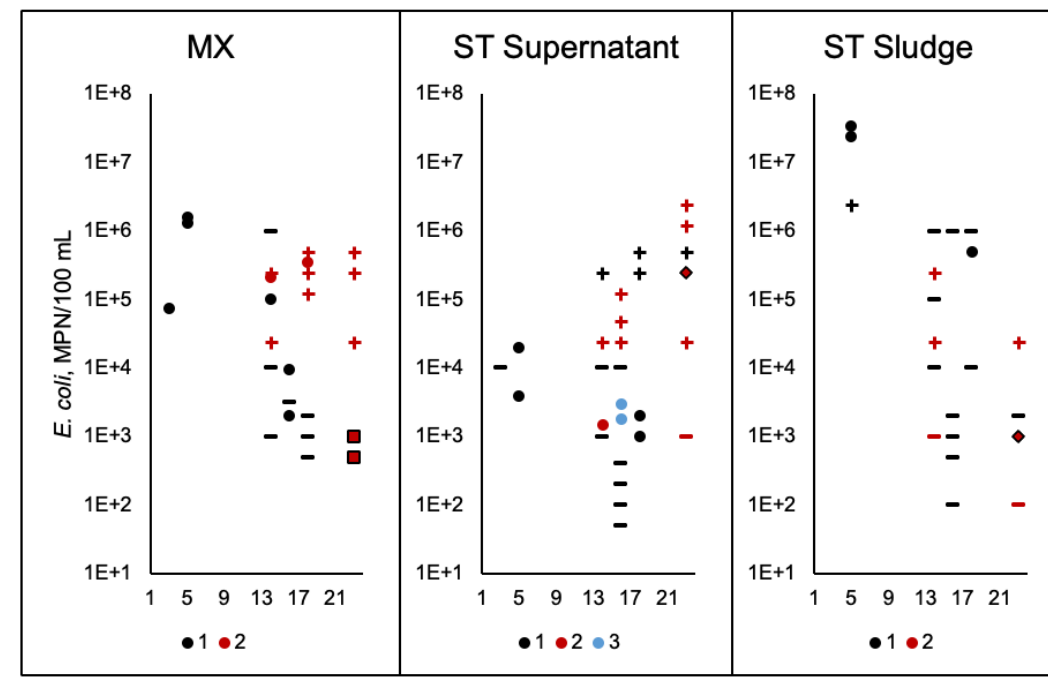


Previous work - important findings

Total Coliforms



E. coli



Operation time (months)

Operation time (months)

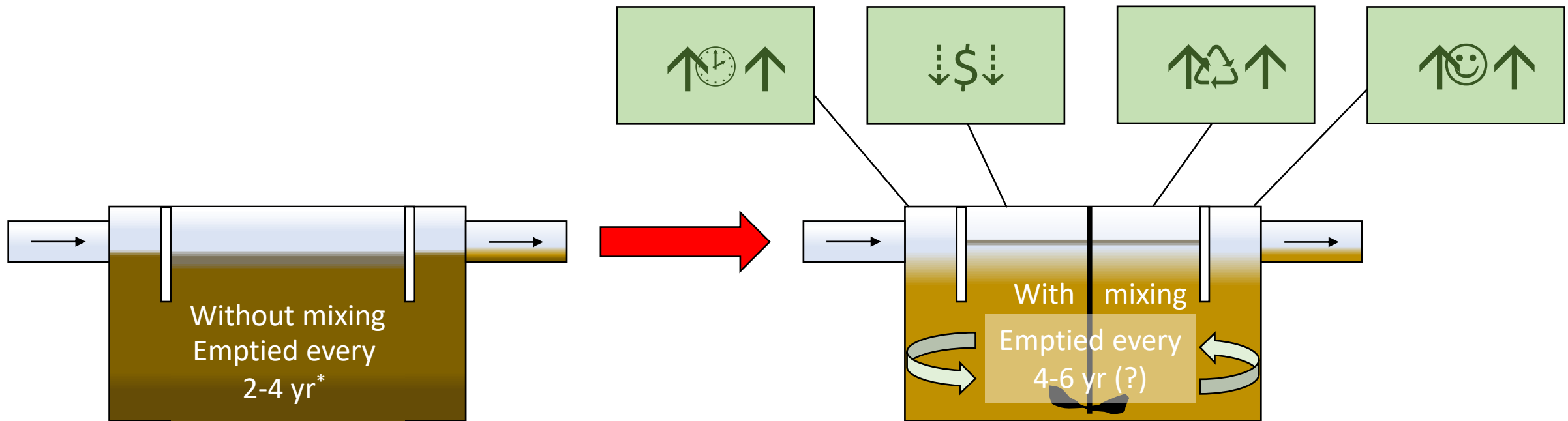
- minimum + maximum □ minimum for ≥2 samples ◇ maximum for ≥2 samples

- minimum + maximum □ minimum for ≥2 samples ◇ maximum for ≥2 samples

Motivation for study

Mixing in anaerobic digesters and latrines → increased stabilization

Mixing of settled sludge in septic tanks → system sustainability?



*Based on interviews with septic system owners and maintenance providers in San Diego, CA.

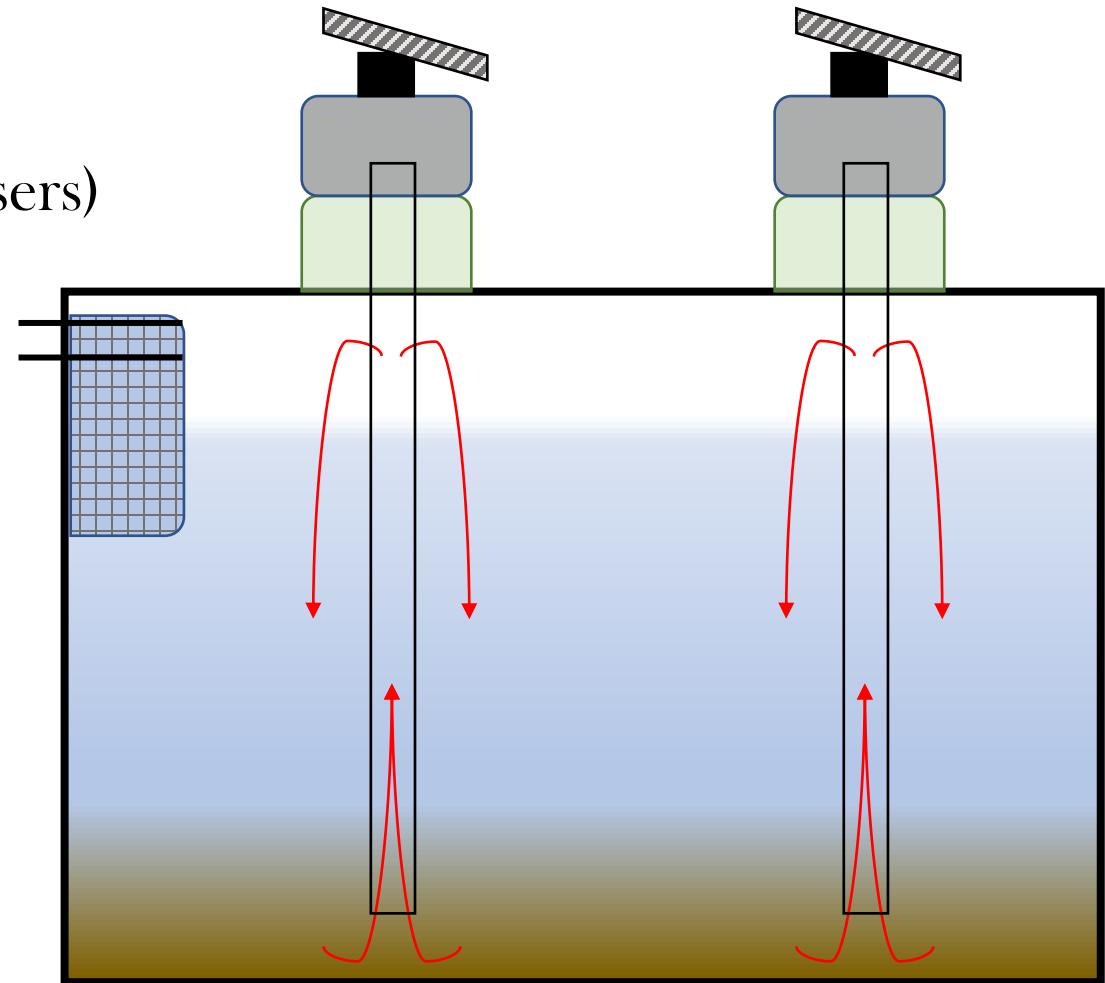
“Septic Mixer”

■ Prototype

- Access port configurations (with and without risers)
- Best mixing method (paddle, pump)
- Physical operation (clogging, tangling)
- Power requirements

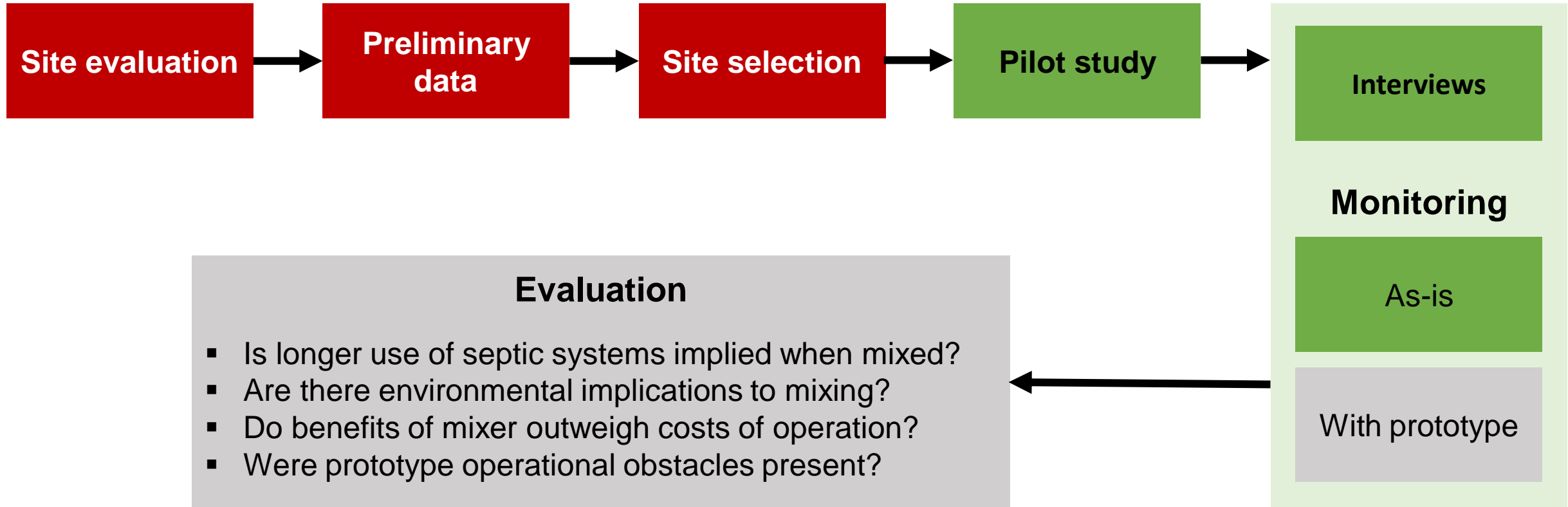
■ Comparison

- Without mixing (normal use, 12 months)
- With mixing (prototype installed, 12 months)

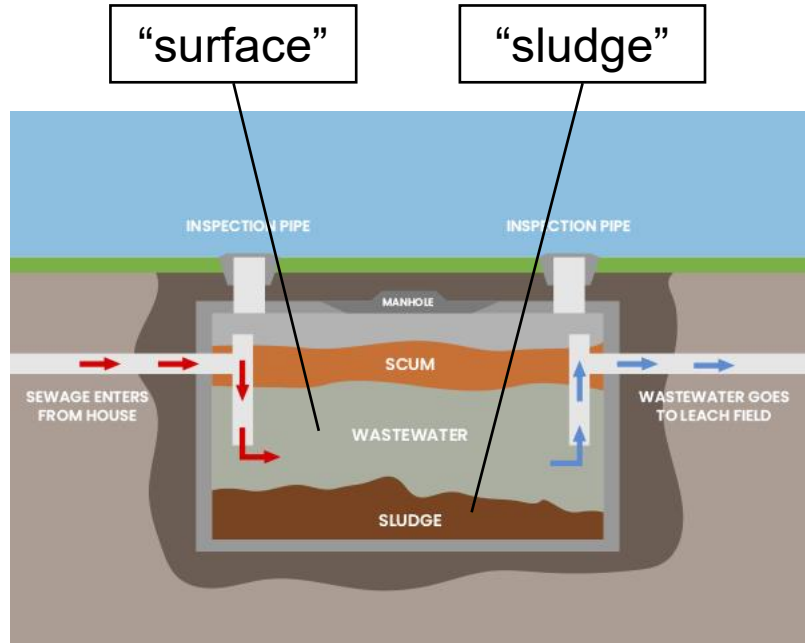


* Patent pending

Next steps - proof of concept

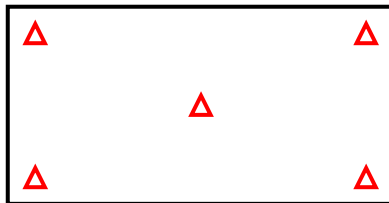


Characterizing septic tank contents - field study



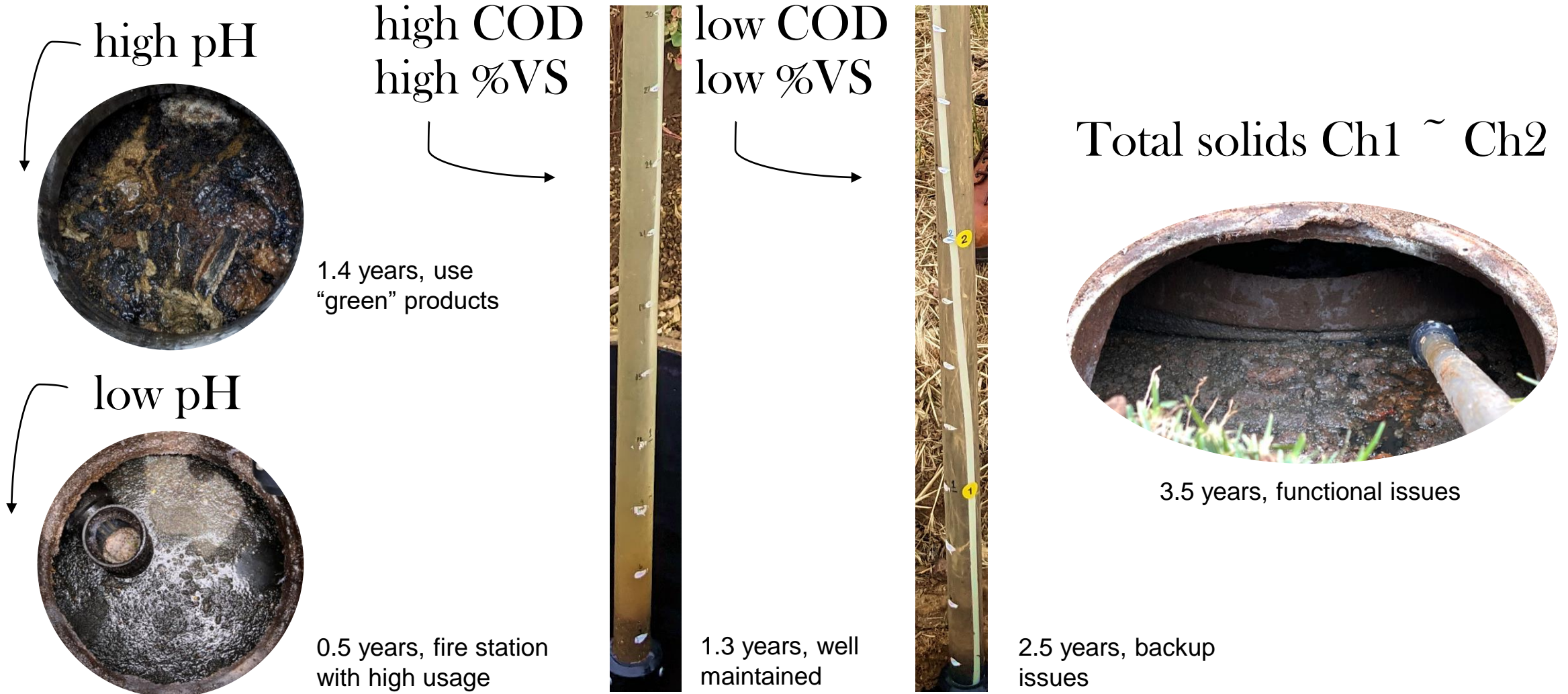
<https://www.jtplumbing.co.nz/tank-systems/septic-tanks/>

Composite samples:



	Chamber 1		Chamber 2	
	Surface	Sludge	Surface	Sludge
pH	7.09	6.98	7.11	7.22
Turbidity, NTU	181.72		107.31	
Conductivity, mS/cm	4.29	7.15	4.50	6.73
Total solids, mg/L	890	26,860	750	11,520
Volatile solids, %	56.85	77.08	54.47	56.55
Chemical oxygen demand, mg/L	720	16,860	590	9,160
Total coliforms, log CFU/100 mL	5.42		5.09	
Phosphorus, mg/L	17.77	80.08	18.46	23.15
Ammonia, mg/L	60.25	140.69	70.19	93.93
Nitrate, mg/L	0.44	1.88	0.41	0.45
Nitrite, mg/L	0.02	0.07	0.02	0.03

Characterizing septic tank contents - field study



Characterizing septic tank contents

Unknowns:

- How does number of users affect filling rates?
- How does diet influence septic tank contents?
- What types of household products influence internal processes?

Expected outcomes

- pH
 - Increase with mixing, organic degradation
 - Surface and sludge congruence
- Nutrients
 - Consumption = reduction
- Chemical oxygen demand
 - Stabilization = reduction
- Solids
 - Distributed across water column
- Biodegradability test
 - Stabilization = reduction
- Microbial consortia
 - Changes to community
 - Roles of bacteria
- Volatile fatty acids
 - Degradation = increase
- Interviews
 - Unmet needs of users

Questions?

Comments?