The role of trace elements in rheology dynamics, foaming potential, and microbial response for efficient biogas production

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1. Effect of substrate type and general operational and process parameters on sludge viscosity

Sludge from 28 laboratory-scale CSTR reactors digesting a range of substrates was rheologically characterized in order to determine whether substrate type affects sludge viscosity, and if any of the commonly monitored process and performance parameters show a correlation to it.

Main conclusions:
- No specific substrate type could be connected to increased viscosity
- Only total solids (TS) found to be significantly correlated to viscosity, but with low correlation coefficients
- Specific cases where TS cannot be used to explain viscosity differences between reactors were identified, highlighting the need to identify other important components and parameters

TS is obviously not the only important parameter...So what are the other possibilities?

2. Effect of trace metal depletion on sludge viscosity

All substrate components except trace metal concentrations are kept equal among all reactors (experiment in progress).

Parameters believed to affect EPS production and potentially rheology are either controlled or monitored.

Results so far:
- No observable changes in Co depleted reactor
- Ni and Se/W depletion both lead to propionic acid accumulation and slow deterioration of process performance
- No major viscosity or foaming shifts so far

Preliminary results from the thermophilic reactor:
- Trace metal needs differ from mesophilic systems
- Observed viscosity shifts in relation to trace metal availability

Why does sludge viscosity matter?
- Affects mixing efficiency (important for heat transfer and process stability)
- Affects energy consumption
- Can lead to stirrer breakdown
- May affect foaming

3. Future steps

1. Analyses of samples from step 2
2. Based on the results from step 2, further experiments will be performed. There are several options:
   - Other trace metals
   - Trace metal combinations
   - Metal depletion during increased organic loading rate
   - Metal overdose

Based on More et al., 2014