Decarbonizing Wastewater Treatment with Sulfate-Reducing Microbes

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Problems

- **Treatment of organic waste globally produces gigatons of CO_2-eq emissions.**
- **Waste gypsum stacks produce acidity and metals and are costly to manage.**

Figure 1: A) waste gypsum stacks, B) Sources of organic and gypsum waste.

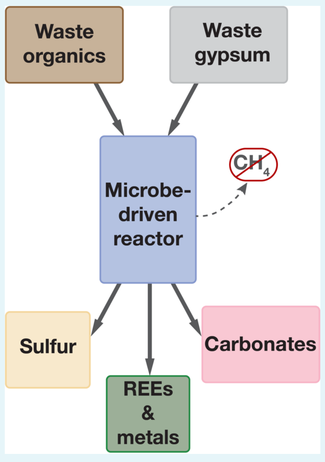

Figure 2: Process to treat waste organics and gypsum.

1. Sulfate reduction:
$CaSO_4 + 2CH_2O \rightarrow Ca^{2+} + 2HCO_3^- + H_2S$

2. Sulfide oxidation:
$H_2S + O_2 \rightarrow H_2O + S°$

3. Carbonate precipitation:
$Ca^{2+} + CO_3^{2-} \rightarrow CaCO_3$

Proposed process

Microbes can degrade sewage sludge using sulfate from waste gypsum. This process generates solutions that can be used to sequester carbon and produce valuable sulfur instead of emitting methane.

Our experiments demonstrate up to a 70x decrease in methane emissions while handling the same load of sewage sludge as commercial wastewater treatment facilities.

Objective

- **How can we control competition between sulfate reducing bacteria and methanogenic archaea?**

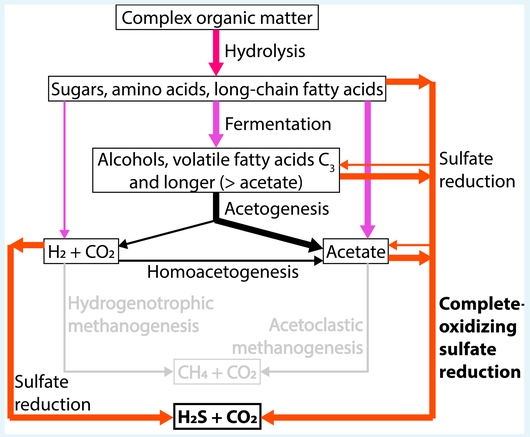

Figure 3: Breakdown of organic matter yields methane or sulfide + alkalinity.

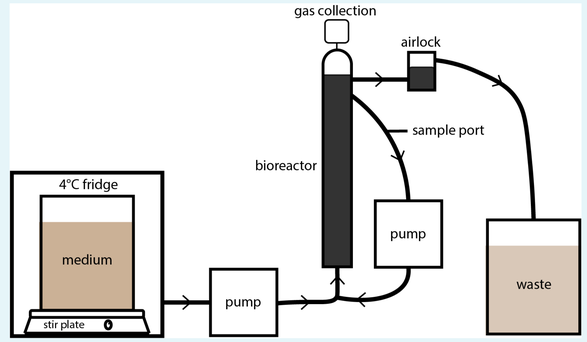

Figure 4: Reactor setup.

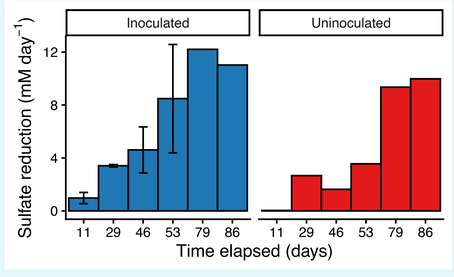

Figure 5: Sulfate reduction rates.

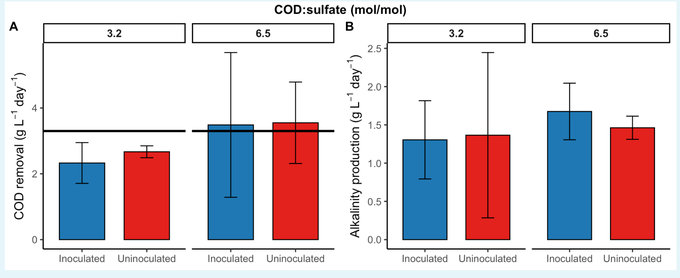

Figure 6: A) organic removal rates & B) alkalinity production.

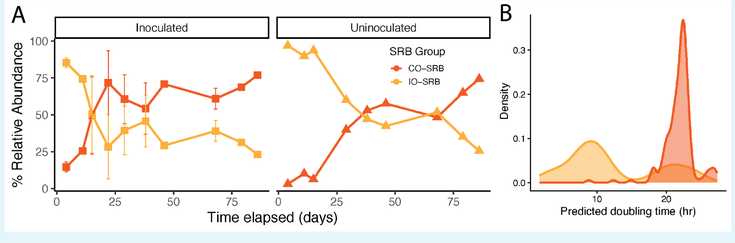

Figure 7: A) enrichment of different types of sulfate-reducing bacteria (SRB) based on B) growth rates.

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