

Substrate Degradation Rate Comparison between GAC and Bulk Liquid Biomass in SAF-MBR System

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Staged Anaerobic Fluidized Membrane Bioreactor System (SAF-MBR)

- Consists of anaerobic fluidized bed reactor (AFBR)
 - Fed raw sewage
- AFBR feeds anaerobic fluidized membrane bioreactor (AFMBR)
- System effluent is from membrane permeate
 - Has high effluent quality (COD \approx 20 mg/L)
- High solids retention time from biomass suspension on granular activated carbon (GAC) and size exclusion on membrane
- Produces methane, has potential to be energy positive

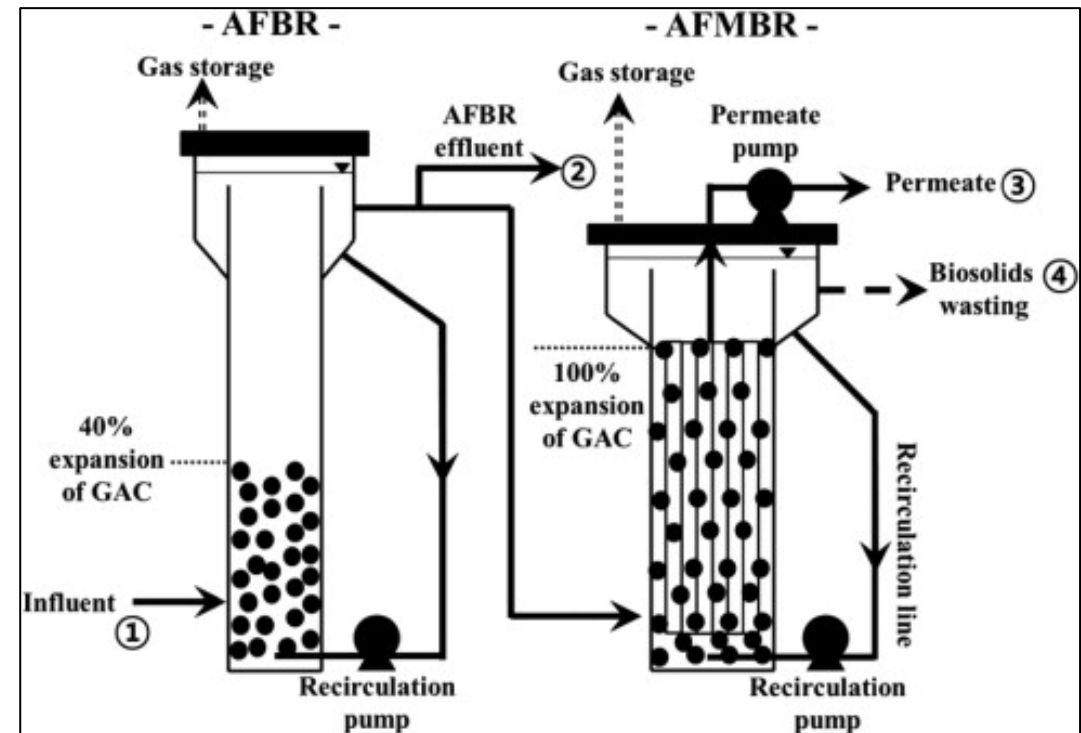


Figure 1 SAF-MRB schematic diagram

Performed degradation rate testing

- Test difference in **protein** (casein) and **polysaccharide** (cellulose) **degradation rates** for **GAC** and **AFBR bulk liquid**, results in Figure 2
 - Biochemical methane potential test setup, normalize to active acetoclastic methanogenic biomass
- Fit **consecutive reactions model** (two first order reactions), set k_2 , fit k_1 and V_{max} , see Figure 3
 - $Substrate \xrightarrow{1} Acetate \xrightarrow{2} Methane$
 - $V_{CH_4} = V_{max} \left(1 + \frac{k_1 e^{-k_2 t} - k_2 e^{-k_1 t}}{k_2 - k_1} \right)$

Results

- Hydrolysis rate **casein** > **cellulose**
- Hydrolysis rate **bulk** > **GAC**
 - Due to diffusion of hydrolysis enzymes out of GAC biofilm

	$k_{hyd} (d^{-1})$
Casein-GAC	0.261
Casein-Bulk	0.289
Cellulose-GAC	0.088
Cellulose-Bulk	0.218

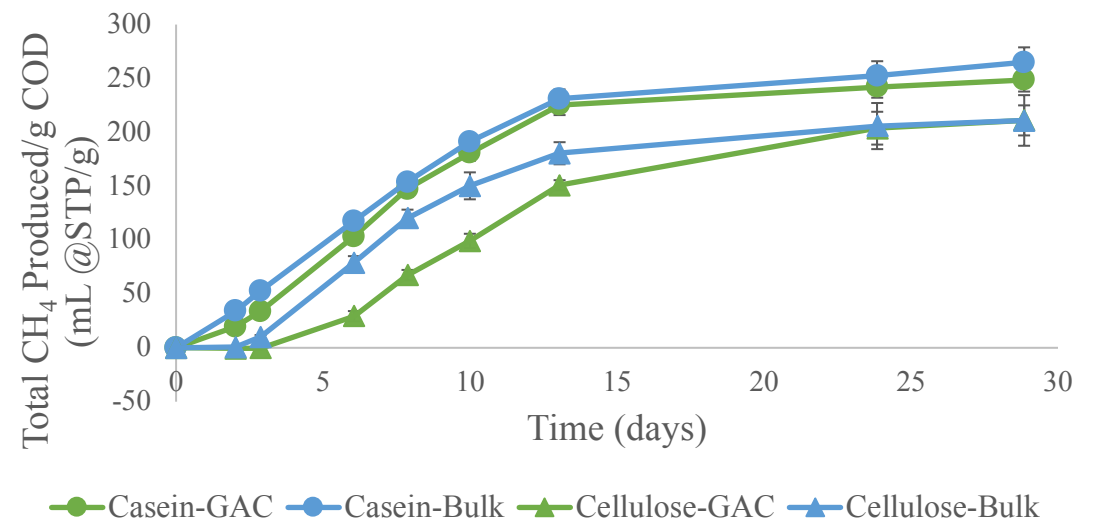


Figure 2 BMP test results

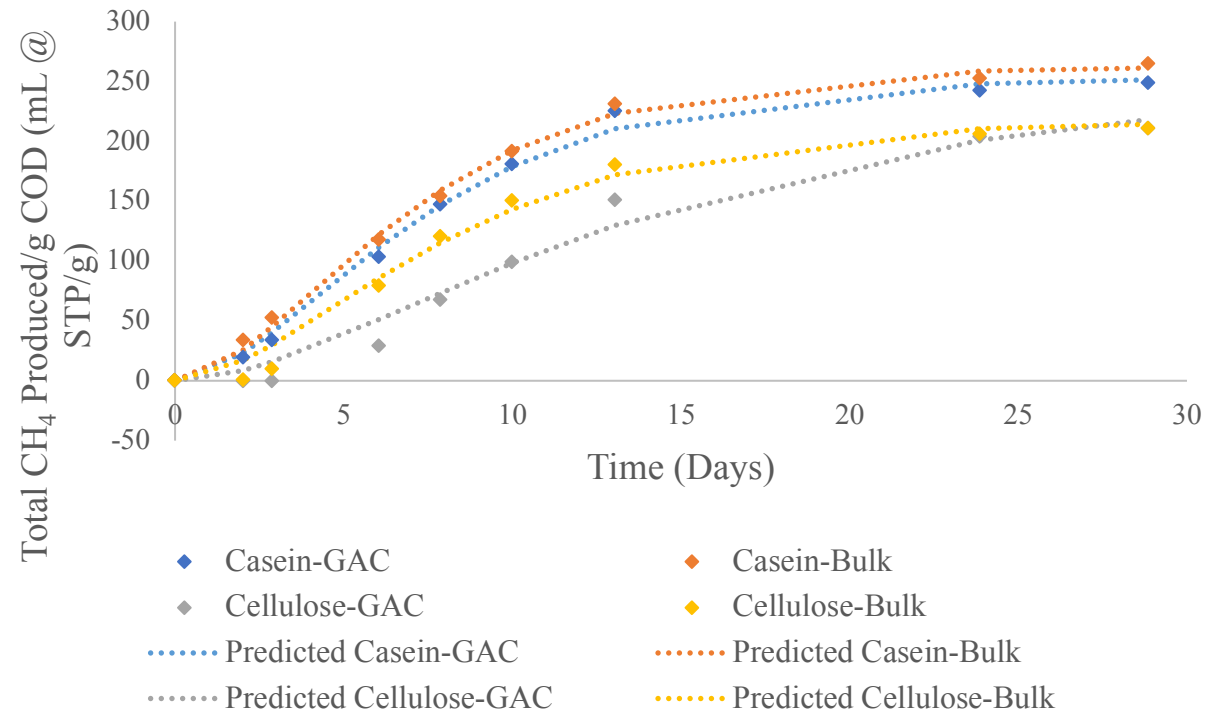


Figure 3 Consecutive reaction model fit to data