

Trade-offs between hydrochar quality and liquid fraction biodegradability in sewage sludge hydrothermal carbonization

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Introduction

The management of **sewage sludge (SS)** remains a major challenge for wastewater treatment plants due to increasing production and stricter environmental regulations. Conventional disposal routes often fail to exploit its full resource potential. **Hydrothermal carbonization (HTC)** is a promising thermochemical process for wet biomass treatment, producing:



While most studies focus on hydrochar optimization, the liquid fraction is often overlooked, despite its potential for energy recovery via anaerobic digestion.

Objective

To evaluate the biodegradability and biomethane potential of the liquid fraction generated during HTC of sewage sludge, considering:

- Different liquid fraction dosages
- Co-hydrothermal carbonization with bio-oil (BO)
- Trade-offs between hydrochar improvement and downstream anaerobic performance

Results

The figure below summarizes methane production across the three experimental tiers.

Tier 1: LF from HTC of sewage sludge increased methane production compared to the blank, confirming its biodegradability and suitability as co-substrate.

Tier 2: Higher LF dosage (50 mL per 500 mL reactor) showed no inhibition and resulted in higher cumulative methane production, demonstrating process robustness under increased loading.

Tier 3: Co-HTC of SS with bio-oil led to a progressive decrease in methane production as BO content increased, indicating a negative impact on LF biodegradability.

Methodology

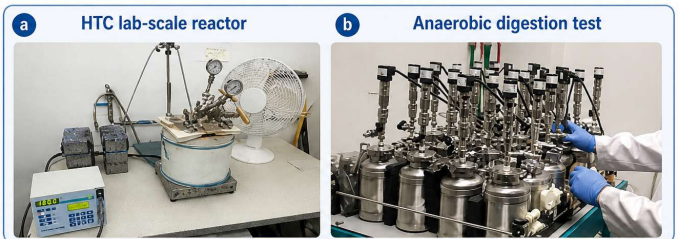


Table 1. Experimental conditions

	HTC process (190°C / 1h/pH 3)		BMP process	
	Feedstock	%	LF addition	Co-substrate
Tier 1	SS	100	5 mL	Pig manure
Tier 2	SS	100	50 mL	
Tier 3	SS: BO (=Tier 1)	100:0	5 mL	
	SS: BO	75:25	5 mL	
	SS: BO	50:50	5 mL	
	SS: BO	25:75	5 mL	
	SS: BO	0:100	5 mL	

SS: Sewage Sludge; BO: Biooil; LF: Liquid fraction from HTC

Figure 2. Experimental results

