

Bioenergy, Electricity, Biogas Production, and Emission Reduction using the Anaerobic Digestion of Organic Municipal Solid Waste in Campinas, One of the Largest Brazilian Cities

Lívia Alencar Pacheco ¹, Jenniffer Tamayo-Peña ¹, Bruna de Souza Moraes ² and Telma Teixeira Franco ^{1,*}

¹ School of Chemical Engineering, University of Campinas, Campinas 13083-852, Brazil

² Interdisciplinary Center of Energy Planning, University of Campinas, Campinas 13083-896, Brazil

* Correspondence: tfranco@unicamp.br

Table S1. Parameters used to estimate electricity generation potential and environmental and economic impacts.

Data	Value	Source
FFW (NmLCH ₄ gVS ⁻¹)	381.9 ± 14.5	Present study
GFW (NmLCH ₄ gVS ⁻¹)	294.5 ± 15.6	Present study
PFW (NmLCH ₄ gVS ⁻¹)	373.3 ± 31.2	Present study
OFMSW (NmLCH ₄ gVS ⁻¹)	410.7 ± 24.9	Present study
Population in Campinas	1,213,792	[8]
Number of households	348,268	[66]
Energy consumption (MWh)	1,099,629	[67]
Electric energy price (R\$ kWh ⁻¹)	0.62	[67]
Conversion of biomethane to diesel (L diesel m ⁻³ CH ₄)	1.0	[43]
Waste generated in Campinas (t day ⁻¹)	1,301.7	[10]
Distance from Campinas to Paulínia (km)	25	[10]
Compactor truck capacity in Campinas (m ³)	15	[68]
Specific Weight MSW (t m ⁻³)	0.65	[68]
Vehicle methane (%)	90	[43]
Heavy vehicle (diesel consumption), γ_{diesel} (km L ⁻¹)	2.2	[43]
Biomethane consumption (heavy-duty vehicles), γ_{CH_4} (km Nm ⁻³ CH ₄)	2.02	[43]
CO ₂ emission factor (diesel), E_f (kgCO ₂ L ⁻¹)	2.67	[69]
Diesel price, Price _{diesel} (R\$ L ⁻¹)	3.211	[70]
Biomethane price, Price _{CH₄} (R\$ Nm ⁻³ CH ₄)	0.55	[43]

1 US\$ = BRL 5.27

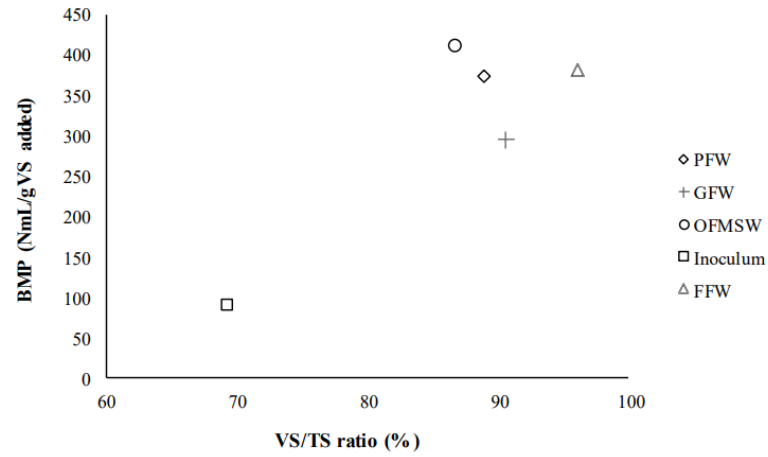


Figure S1. Relationship between VS/TS ratio and methane production.

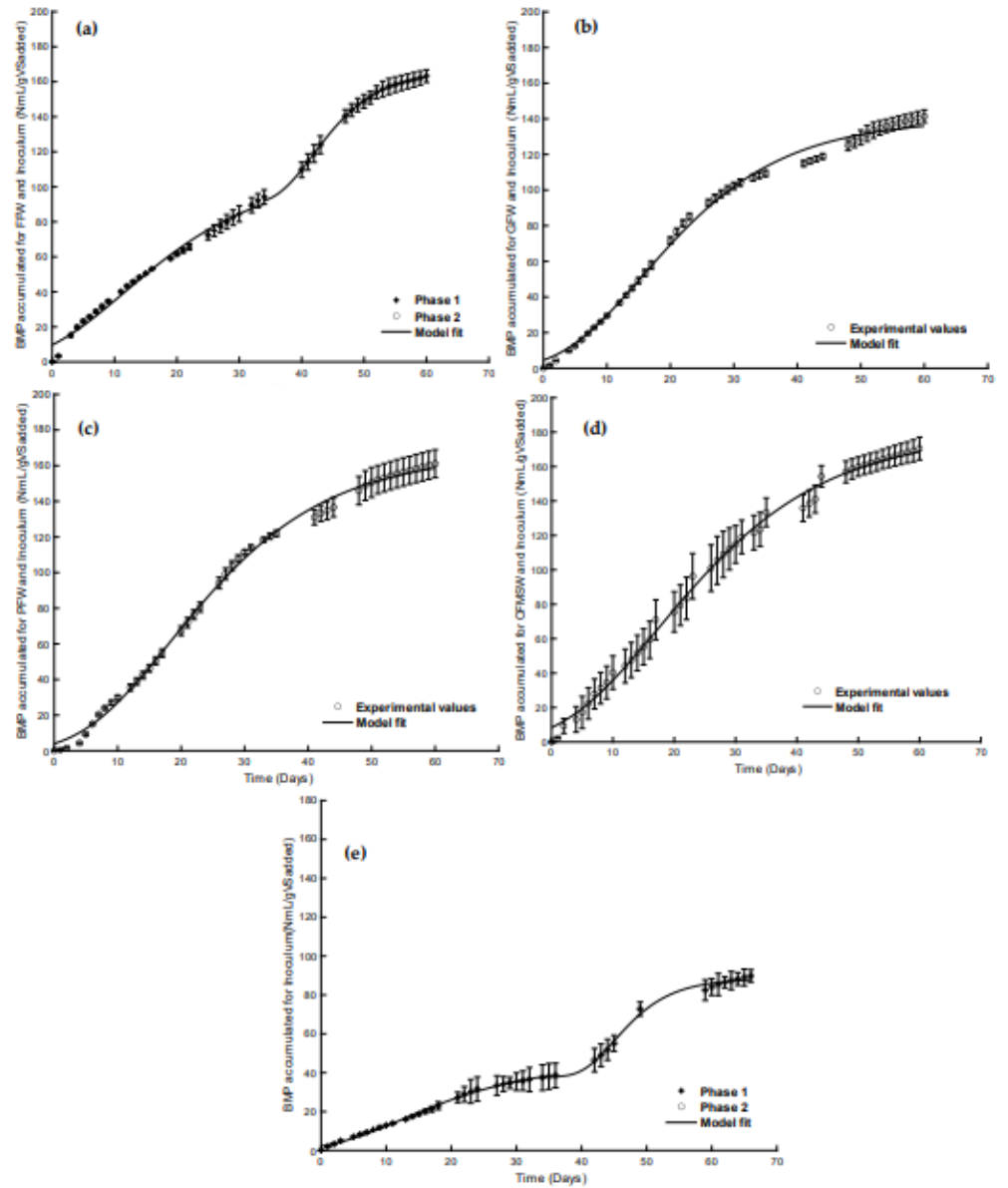


Figure S2. Modified Gompertz model results for the BMP experiment: (a) FFW + inoculum; (b) GFW + inoculum; (c) PFW + inoculum; (d) OFMSW + inoculum and (e) Inoculum.

References Supplementary Material

1. IBGE. Campinas Panorama Available online: <https://cidades.ibge.gov.br/brasil/sp/campinas/panorama> (accessed on 1 July 2020).
2. CETESB *Inventário Estadual de Resíduos Sólidos Urbanos*; Companhia Ambiental do Estado de São Paulo: São Paulo, SP, Brazil, 2020;
3. Ornelas-Ferreira, B.; Lobato, L.C.S.; Colturato, L.F.D.; Torres, E.O.; Pombo, L.M.; Pujatti, F.J.P.; Araújo, J.C.; Chernicharo, C.A.L. Strategies for Energy Recovery and Gains Associated with the Implementation of a Solid State Batch Methanization System for Treating Organic Waste from the City of Rio de Janeiro - Brazil. *Renew. Energy* **2020**, *146*, 1976–1983, doi:10.1016/j.renene.2019.08.049.
4. IBGE. Características Da População e Dos Domicílios. Available online: <https://cidades.ibge.gov.br/brasil/sp/campinas/pesquisa/23/24304> (accessed on 5 August 2020).
5. ANEEL Ranking Das Tarifas Available online: <http://www.aneel.gov.br/ranking-das-tarifas> (accessed on 15 August 2020).
6. ABLP. *Limpeza Pública - Coleta e Transporte*; Associação Brasileira de Resíduos Sólidos e Limpeza Pública: São Paulo, SP, Brazil, 2015;
7. MMA. *Primeiro Inventário Nacional de Emissões Atmosféricas Por Veículos Automotores Rodoviários*; Ministério do Meio Ambiente Secretaria de Mudanças Climáticas e Qualidade Ambiental Departamento de Mudanças Climáticas Gerência de Qualidade do Ar: Brasília, DF, Brazil, 2011;
8. ANP. Resumo Por Município - Posto Available online: http://preco.anp.gov.br/include/Resumo_Por_Municipio_Posto.asp (accessed on 20 August 2020).