

Producción Selectiva de AGVs mediante codigestión de lodos con residuos orgánicos industriales

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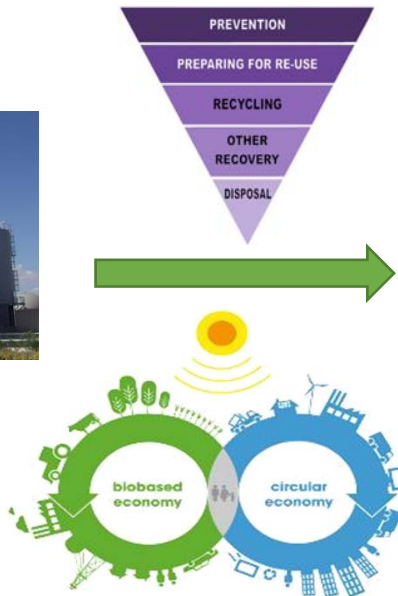
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Antecedentes



Biomethanation

- ✓ Mature technology
- ✓ Heat and electricity



Anaerobic Fermentation








Volatile fatty acid (VFA) production



- Under research
- Several applications

Antecedentes



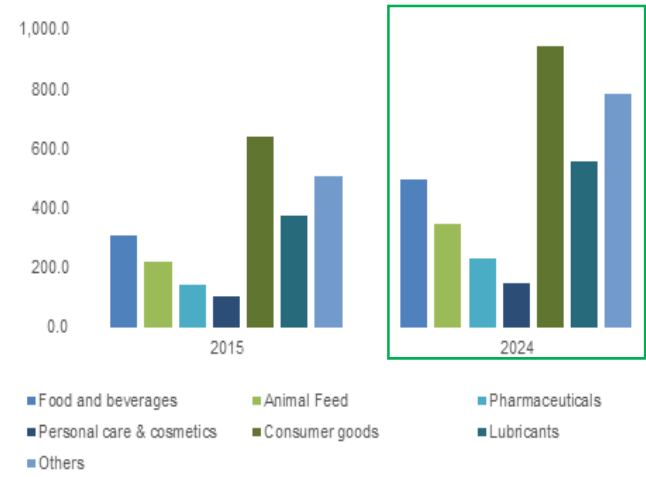








VFA market

VFA consumers

- Cosmetics
- Petrochemical synthesis
- Pharmaceutical industry
- Food & beverage industry
- Chemical industry

VFA Market size: 13 billion USD (2015)





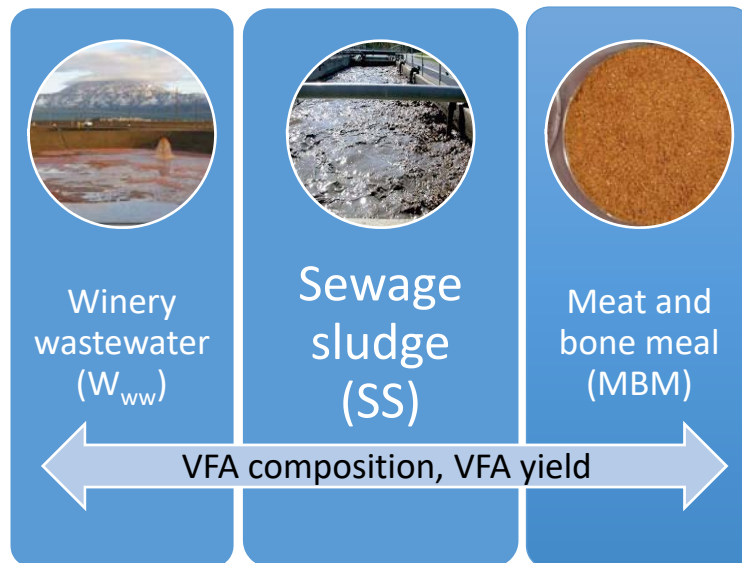
Antecedentes

Carboxylic acids	Chemical formula	Market size (tonnes/year)	Price per tonne (USD, \$)
Formic	HCOOH	30,000	800–1,200
Acetic	CH ₃ COOH	3,500,000	400–800
Propionic	CH ₃ CH ₂ COOH	180,000	1,500–1,650
Butyric	CH ₃ (CH ₂) ₂ COOH	30,000	2,000–2,500
Caproic	CH ₃ (CH ₂) ₄ COOH	25,000	2,250–2,500
Lactic	CH ₃ CHOHCOOH	120,000	1,000–1,800



Objetivos

✓ Acidogenic potential tests



✓ Pilot-scale fermentation tests



- Variation of pH
- Influence of inoculum
- Co-fermentation potential



Material y métodos



Waste streams

Experimental conditions

Batch tests

- Sewage sludge (SS)
- Meat and bone meal (MBM)
- Winery wastewater (W_{ww})

- pH 10 - 5.5
- T^a 35 – 55 °C
- RT = 10 d
- V = 500 mL
- 10 g COD/L waste
- 5 g SSV/L inoculum



Material y métodos

Waste characterization

	SS	W_{ww}	MBM	Inoculum
pH	6.2 ± 0.1	5.3 ± 0.2	NA	7.45 ± 0.2
TS (%)	5.25 ± 0.9	9.1 ± 0.46	99.21	3.19 ± 0.3
VS (%)	4.10 ± 0.6	6.5 ± 0.61	68.07	1.99 ± 0.2
tCOD (mg O ₂ /L)	56457 ± 10697	97170 ± 5864	1016.46 ^a	27205 ± 3254
sCOD (mg O ₂ /L)	2776 ± 697	38860 ± 7457	N.A.	1882 ± 684
TAN (mg N/L)	152 ± 33	224 ± 97	N.A.	1922 ± 296

^a mg g⁻¹; total solids (TS), volatile solids (VS), total chemical oxygen demand (tCOD), soluble chemical oxygen demand (sCOD), total ammonium nitrogen (TAN)



Material y métodos

Pilot-scale tests

Test	Objective of study	Waste stream	Inoculum	pH	T (°C)
1	Influence of pH	SS	DS	10	55
2	Influence of pH	SS	DS	9	55
3	Effect of inoculum	SS	AI	9	55
4	W_{ww} fermentation	W_{ww}	DS	5.5	55
5	Co-fermentation	W_{ww} + SS	DS	9	55
6	MBM fermentation	MBM	DS	5.5	35





Resultados

Batch tests

	Process conditions		W_{ww}	SS	MBM
VFA yield (mg COD _{eq} /gCOD _{fed})	35 °C	pH 5.5	190	1	306
		pH 10	207	190	443
	55 °C	pH 5.5	322	127	319
		pH 10	385	332	464
Degree of acidification (VFA/sCOD)	35 °C	pH 5.5	47	1	68
		pH 10	57	50	52
	55 °C	pH 5.5	69	47	62
		pH 10	54	49	53



Resultados

Pilot-scale tests

	Initial VFA (g COD _{eq} /L)	Final VFA (g COD _{eq} /L)	Solubilization (%)	VSS conversion (%)	VFA/sCOD (%)
Test 1	1.08	11.9	43	56	56
Test 2	2.22	11.1	47	53	57
Test 3	7.51	14.1	17	34	61
Test 4	1.51	11.2	0	17	52
Test 5	2.10	19.2	25	50	75
Test 6	1.28	41.6	19	38	37

✓ Co – Fermentation
Pretreatment method?

Test 1: SS (pH 10, 55 °C)
Test 2: SS (pH 9, 55°C)

Test 3: SS (pH 9, Al, 55 °C)
Test 4: W_{ww} (pH 5.5, 55 °C)

Test 5: W_{ww}+SS (pH 9, 55 °C)
Test 6: MBM (pH 5.5, 35 °C)



Conclusiones



Batch tests

- pH 5.5-10.5

- 35°C - 55°C

- RT = 10 d

- V = 500 mL

- 10 g COD/L waste

- 5 g SSV/L inoculum

- ✓ **VFA yield** was enhanced at alkaline values and thermophilic temperature.

- ✓ The **highest DA** was obtained at pH 5.5 and 35°C for MBM, pH 5.5 and 55 °C for W_{ww} and pH 10 and 55 °C for SS.

- ✓ **VFA production** could be directed towards desired products by process parameter control.

- **Acetic acid** should be promoted by adjusting the pH to alkaline values

- **Propionic** and **butyric acid** could be promoted with W_{ww} with temperatura shift at acidic pH.

- SS and MBM led to significant amounts of **iso-valeric and valeric acids** at alkaline pH






Conclusiones



Pilot-scale tests



- ✓ The **composition** of the fermentation broth was **reproducible** (primary fermentation products).
- ✓ **MBM** showed a high VFA potential.
- ✓ **Butyric acid** could be recovered from W_{ww} and MBM.
- ✓ A clear **synergistic effect** was observed during SS and W_{ww} fermentation.
- ✓ **Co-treatment** of complementary waste streams (urban, agro-industrial) may be a feasible scenario for future urban WWTP.



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