17th IWA World Conference on Anaerobic Digestion

Struvite precipitation and anaerobic digestion of process water derived from hydrothermally treated chicken meat and bones meal

A.Sarrion[1], R.P. Ipiales[1,2], E. Diaz[1], M.A. de la Rubia[1], A.F. Mohedano[1]

[1]Engineering Department, Universidad Autónoma de Madrid, 28049 Madrid, Spain

[2]Arquimea-Agrotech, 28400 Collado Villalba – Madrid, Spain

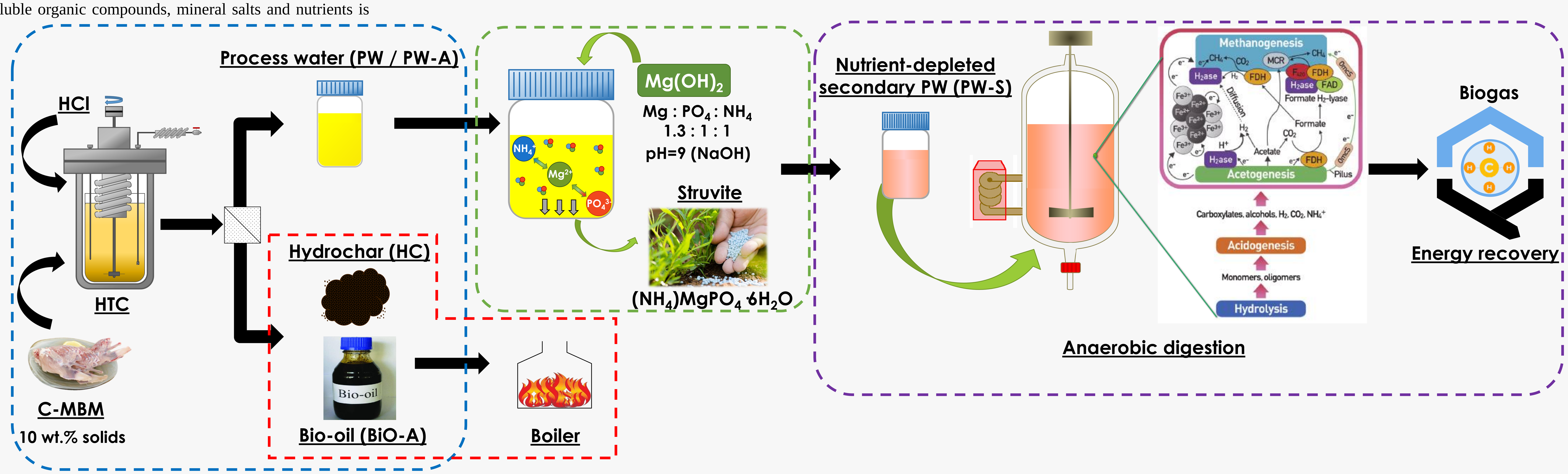
Email: andres.sarrion@uam.es

INTRODUCTION

Hydrothermal carbonization (**HTC**) is a thermochemical process that allows to process biomass waste with high moisture under mild temperatures (170 – 250 °C), low residence times (5 – 240 min) and autogenous pressure. As HTC product, a process water (PW) containing soluble organic compounds, mineral salts and nutrients is obtained. Additionally and depending on the feedstock characteristics and HTC conditions, a solid hydrochar or a bio-oil (BiO-A) are also obtained.

In this work, chicken meat and bones meal (C-MBM) was treated by acid-free HTC and HCl-assisted HTC at 170 and 200 °C for 1 h, to improve the solubilization of nutrients in the PW or PW-acid (PW-A).

1. Main nutrients such as P, N and Mg were recovered from PW as struvite.
2. The nutrient-depleted secondary PW (PW-S) still rich in organic soluble matter was evaluated for methanogenic potential by anaerobic digestion (AD).
3. Hydrochar and BiO-A were characterized according to ISO/TS 17225-8 to know its potential as biofuel.

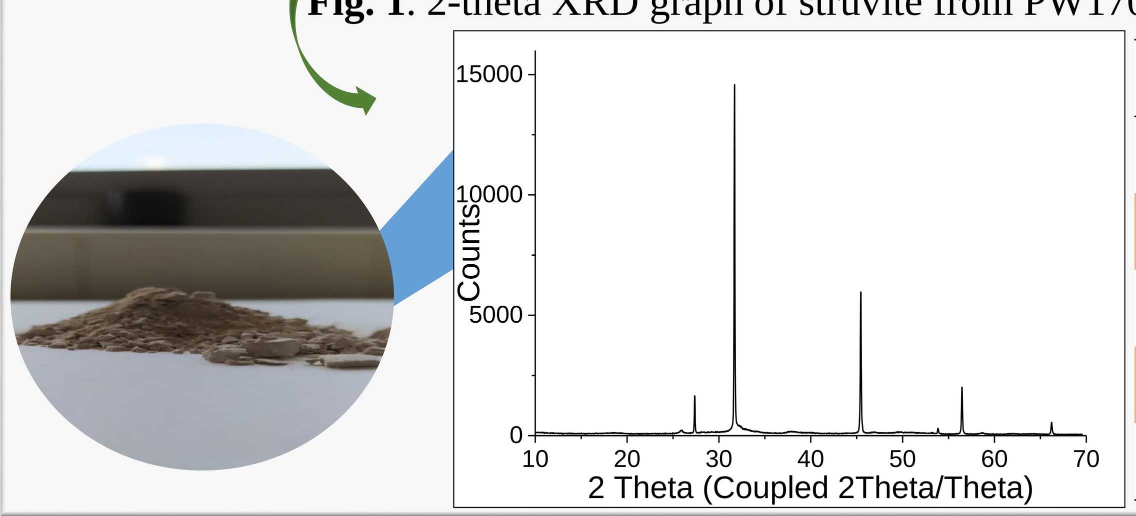


RESULTS

Table 1. Characterization of process water and secondary process waters

	PW170	PW200	PW170-A	PW200-A	PW170-S	PW200-S	PW170-A-S	PW200-A-S
pH	6.5	6.8	1.5	1.8	8.1	8.3	8.1	8.2
TCOD (g/L)	75.2	82.3	64.3	61.2	74.1	80.5	64.7	60.7
TS (g/L)	63.8	65.9	85.5	81.0	58.2	61.0	79.5	75.5
VS (g/L)	55.2	59.9	55.2	51.1	52.3	56.0	50.7	47.6
TN (g/L)	8.7	9.0	9.6	9.5	5.8	5.4	5.71	4.6
NH_4-N (g/L)	1.0	1.9	1.5	2.3	0.6	0.6	0.4	0.6
Org-N (g/L)	7.7	7.0	8.0	7.1	5.2	4.8	5.3	4.0
PO_4-P (mg/L)	268	350	2973	2984	< 0.1	< 0.1	1.0	0.5
Mg (mg/L)	0.9	0.6	110.1	384.8	< 0.1	< 0.1	4.3	1.5

Fig. 1. 2-theta XRD graph of struvite from PW170-A and mineral composition of struvite



Mineral (g/kg)	
Na	2.6
Ca	4.3
K	4.7
Mg	99.5
P	126.3

Fig. 2. Alkalinity and pH of PW-S and PW-A-S

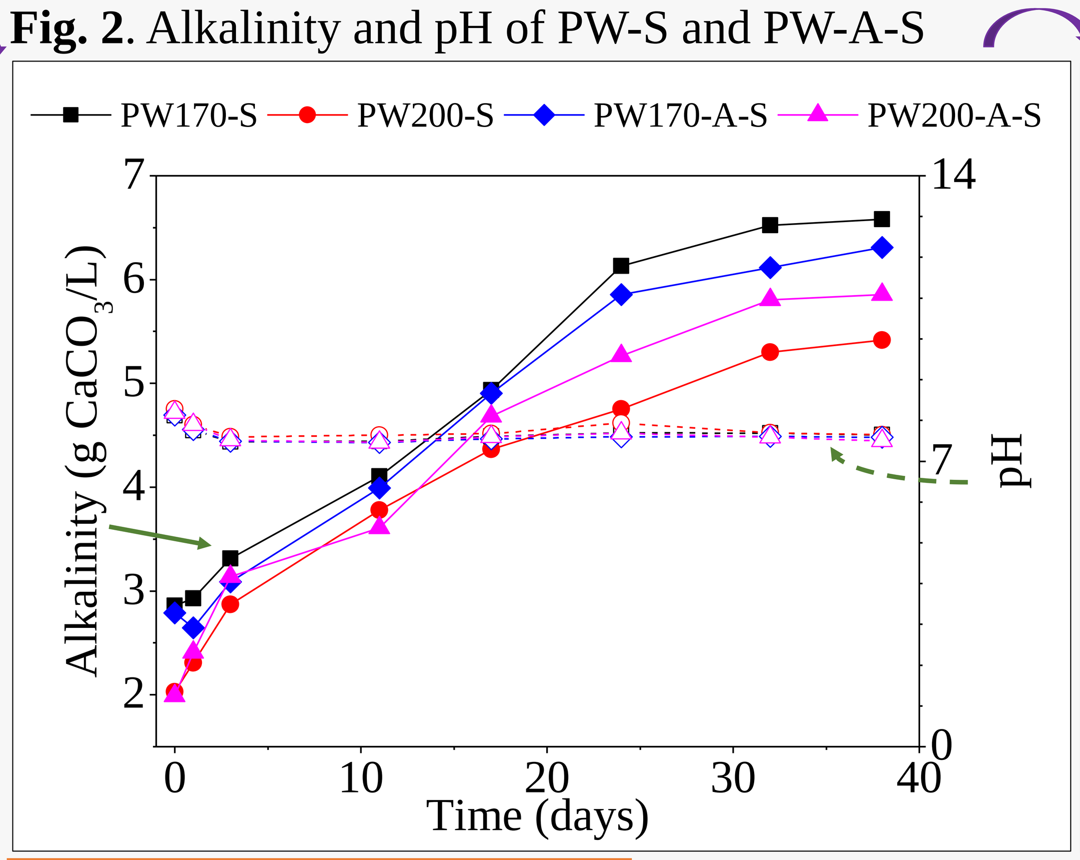


Fig. 3. TVFA and NH_3-N of PW-S and PW-A-S

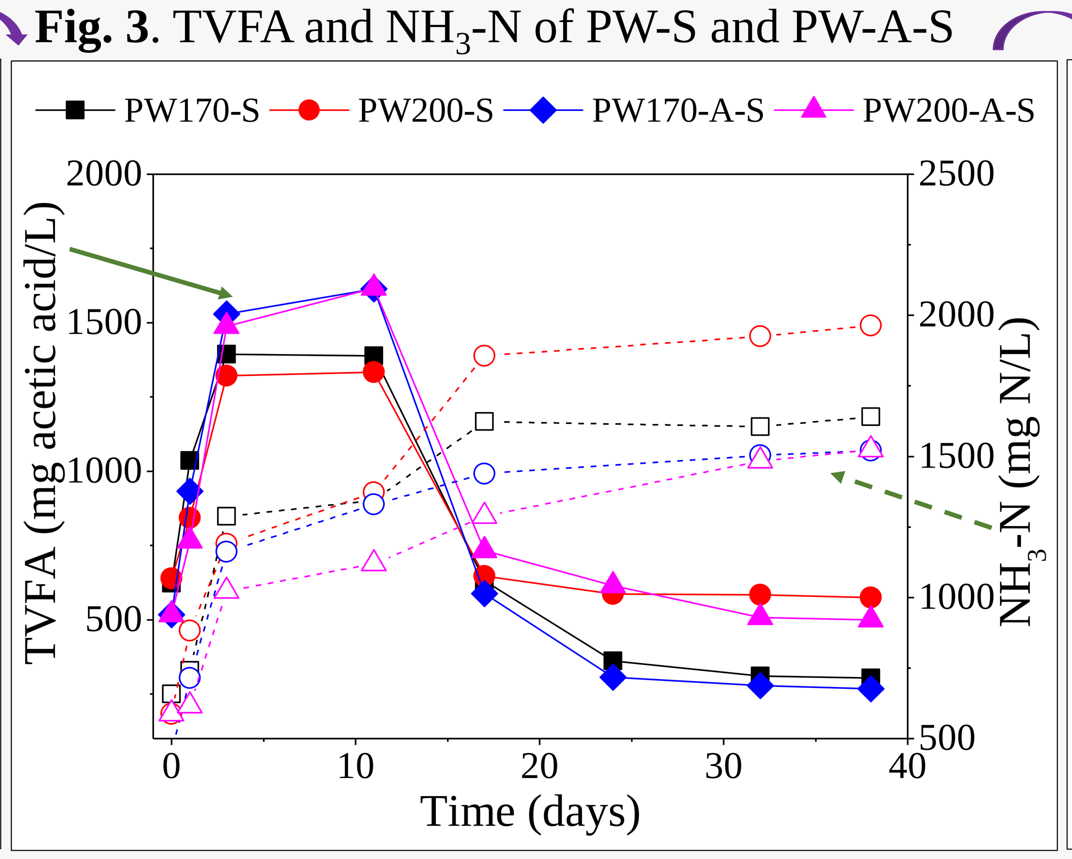
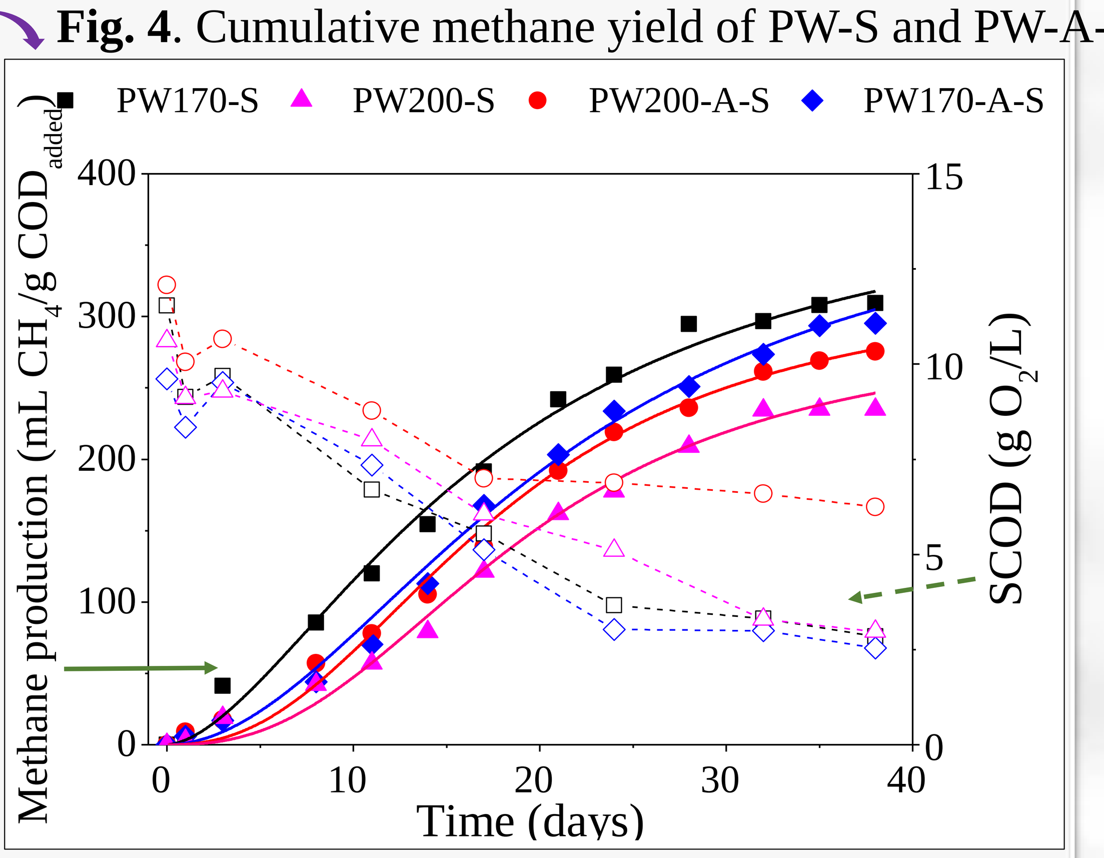


Fig. 4. Cumulative methane yield of PW-S and PW-A-S



CONCLUSIONS

- Acid-assisted HTC is presented as an excellent process for nutrients recovery since phosphorus, nitrogen and magnesium were almost completely transferred to PW.
- After PW neutralization with NaOH, the solid obtained was analyzed by X-ray diffraction, showing crystalline peaks corresponding to struvite, which is a value-added product with economic and profit viability in commercial agriculture applications. Furthermore, this material was rich in essential minerals for plants such as N, P, K, Mg, Na and low concentrations of heavy metals.
- PW-S and PW-A-S showed high methanogenic potential with methane production between 240 – 320 $mLCH_4/gCOD_{added}$ and COD removal up to 75%.

Acknowledgements

PID2019-108445RB-I00, PDC2021-120755-I00 and BES-2017-081515 (Spanish MINECO), and S2018/EMT-4344 (Madrid Community)