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HYDROTHERMAL LIQUEFACTION OF BIOMASS WASTE IN A CIRCULAR ECONOMY FRAMEWORK

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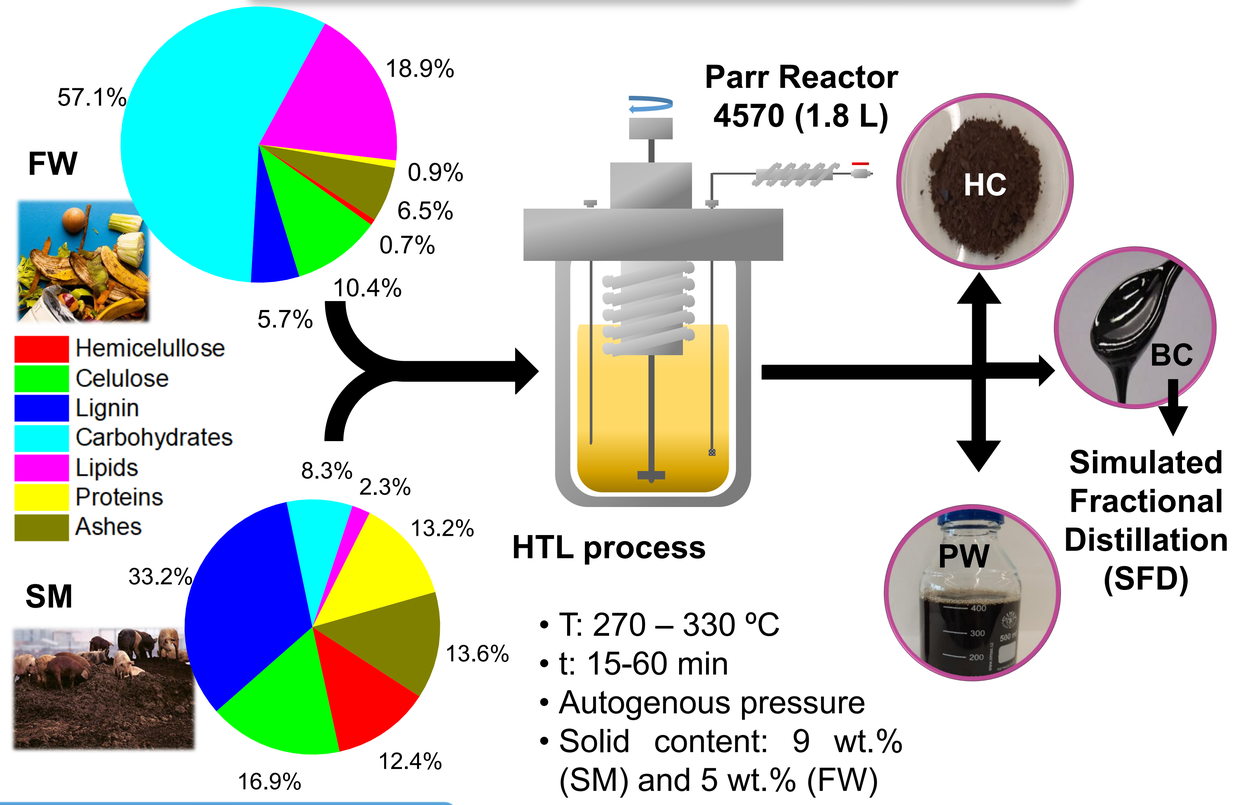
INTRODUCTION

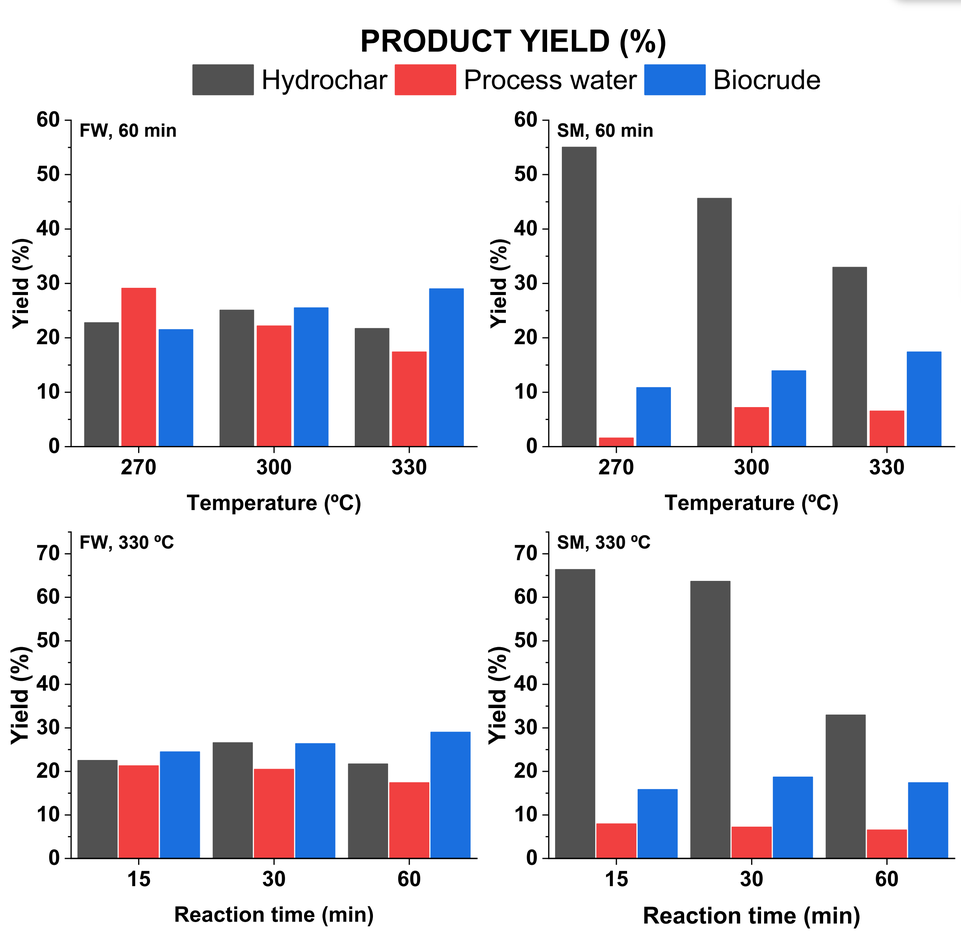
- Hydrothermal liquefaction (**HTL**) is an efficient technology for the **treatment of high-moisture waste**, such as swine manure (SM, 70% moisture, 46% C, 13% ash) and food waste (FW, 92% moisture, 42% C, 6% ash).
- HTL carried out at moderate temperatures in an aqueous environment, allow to obtain three main products: two energy-dense products (a solid fraction known as **hydrochar** (HC) and a fraction known as **biocrude** (BC), both with a high calorific value), and additionally a liquid fraction, usually called as **process water** (PW), rich in organic compounds.
- These products can be exploited within a circular economy framework for various applications. HC can be use as **solid biofuel**, **soil amendment** or **catalyst** support, BC can be used as liquid fuel, and process water can be used for **methane production** through anaerobic digestion.

MATERIALS AND METHODS



RESULTS AND DISCUSSION

PRODUCT YIELD (%)



- The highest biocrude yield was observed at 330 °C and reaction times between 30 and 60 min.

HYDROCHAR AND BIOCRUDE CHARACTERIZATION

HC

FW	C (%)	H (%)	N (%)	S (%)	O (%)	Ash (%)	HHV (MJ/kg)
270ºC 60 min	62.0	4.9	4.0	0.3	17.8	10.9	25.4
300ºC 60 min	63.1	4.8	3.8	0.3	12.7	15.3	26.0
330ºC 60 min	63.8	4.2	3.6	0.4	4.1	24.0	26.3
330ºC 30 min	61.2	4.8	3.9	0.3	14.4	15.3	25.1
330ºC 15 min	66.1	4.4	3.4	0.2	13.7	12.2	26.5

SM	C (%)	H (%)	N (%)	S (%)	O (%)	Ash (%)	HHV (MJ/kg)
270ºC 60 min	58.4	4.7	2.9	0.9	10.4	22.6	24.5
300ºC 60 min	58.6	4.5	2.6	0.7	10.1	23.5	24.3
330ºC 60 min	61.8	4.6	2.6	0.7	7.4	22.9	25.8
330ºC 30 min	57.1	4.2	2.8	0.2	15.5	20.3	22.8
330ºC 15 min	55.0	4.4	2.9	0.3	12.6	24.9	22.5

BC

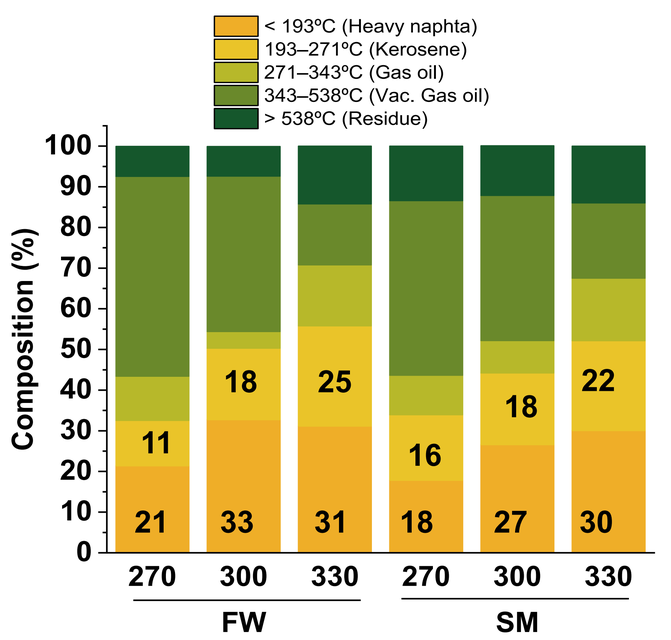
FW	C (%)	H (%)	N (%)	S (%)	O (%)	HHV (MJ/kg)	H/C	O/C
270ºC 60 min	74.0	8.2	2.8	0.3	14.7	34.2	1.32	0.15
300ºC 60 min	75.0	8.1	3.2	0.4	13.3	34.6	1.29	0.13
330ºC 60 min	74.4	8.4	3.3	0.4	13.5	34.8	1.34	0.14
330ºC 30 min	76.4	8.5	3.6	0.5	11.0	36.1	1.33	0.11
330ºC 15 min	75.0	7.8	2.7	0.3	14.2	34.1	1.25	0.14

SM	C (%)	H (%)	N (%)	S (%)	O (%)	HHV (MJ/kg)	H/C	O/C
270ºC 60 min	70.5	8.0	2.8	1.5	20.4	31.7	1.35	0.22
300ºC 60 min	74.9	8.2	3.0	1.5	15.6	34.3	1.30	0.16
330ºC 60 min	71.3	7.8	2.9	1.2	19.9	31.8	1.31	0.21
330ºC 30 min	72.1	7.7	2.6	0.9	19.7	32.0	1.28	0.21
330ºC 15 min	71.9	7.7	2.7	0.9	20.0	31.8	1.27	0.21

- HC obtained at 330 ºC and 60 min showed the highest HHV values for both feedstocks.
- BC reached values of HHV of 34-36 MJ/kg for FW and 32-34 MJ/kg for SM.

HC complied Spanish (RD 1051/2022, RD 824/2024) and EU (2019/1009) regulations on sustainable soil nutrition, heavy metal limits, and fertilizing product requirements.

SFD OF BIOCRUDE (t = 60 min)



- At 330 °C, a higher proportion of light products was observed in the biocrude (heavy naphtha and kerosene).

CONCLUSIONS

- ✓ HTL proved to be an effective strategy for the valorization of swine waste and food waste, producing an energy-dense hydrochar and biocrude.
- ✓ Biocrude obtained at 330 °C for 30-60 min showed the best performance, achieving the highest HHV value and a chemical composition with a high naphtha and kerosene content.
- ✓ The results highlight the role of HTL in sustainable waste management, consistent with biofuel production and circular economy strategies.

WASTE2VALUE

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