

Marine biomass pyrolysis over metal impregnated biochar based catalyst

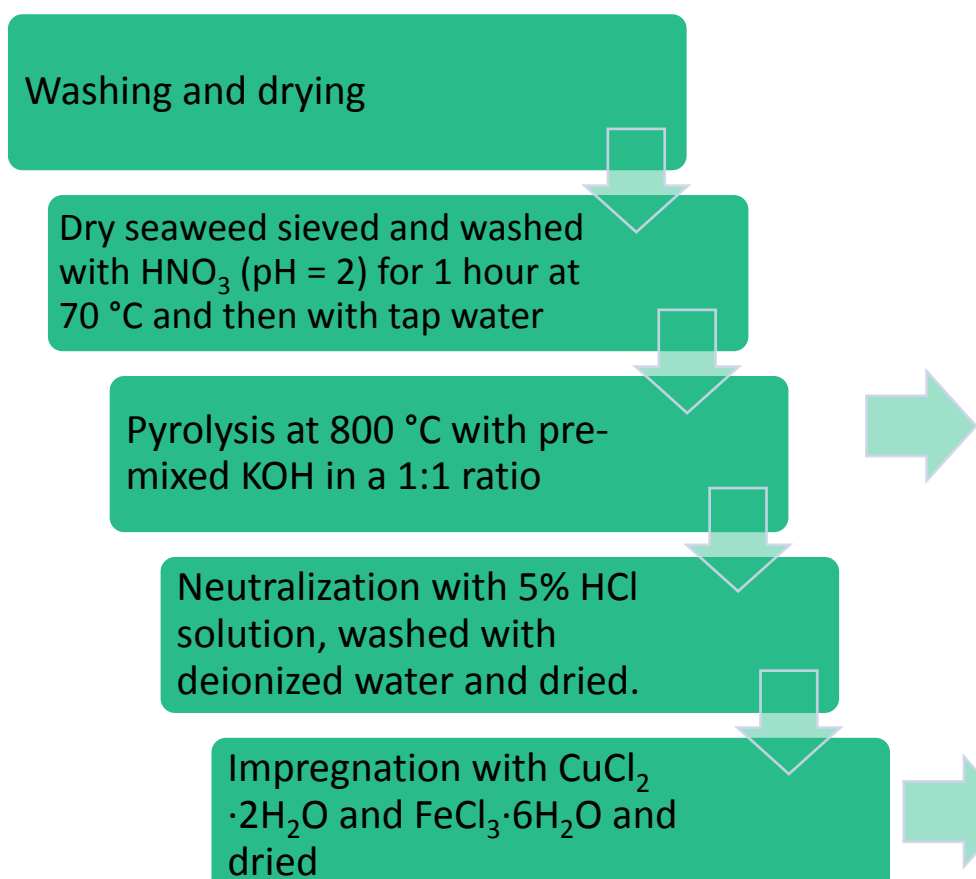
J. Eimontas, K. Zakarauskas, N. Striūgas*

*Laboratory of Combustion Processes, Lithuanian Energy Institute, Kaunas, Lithuania, nerijus.striugas@lei.lt

Abstract

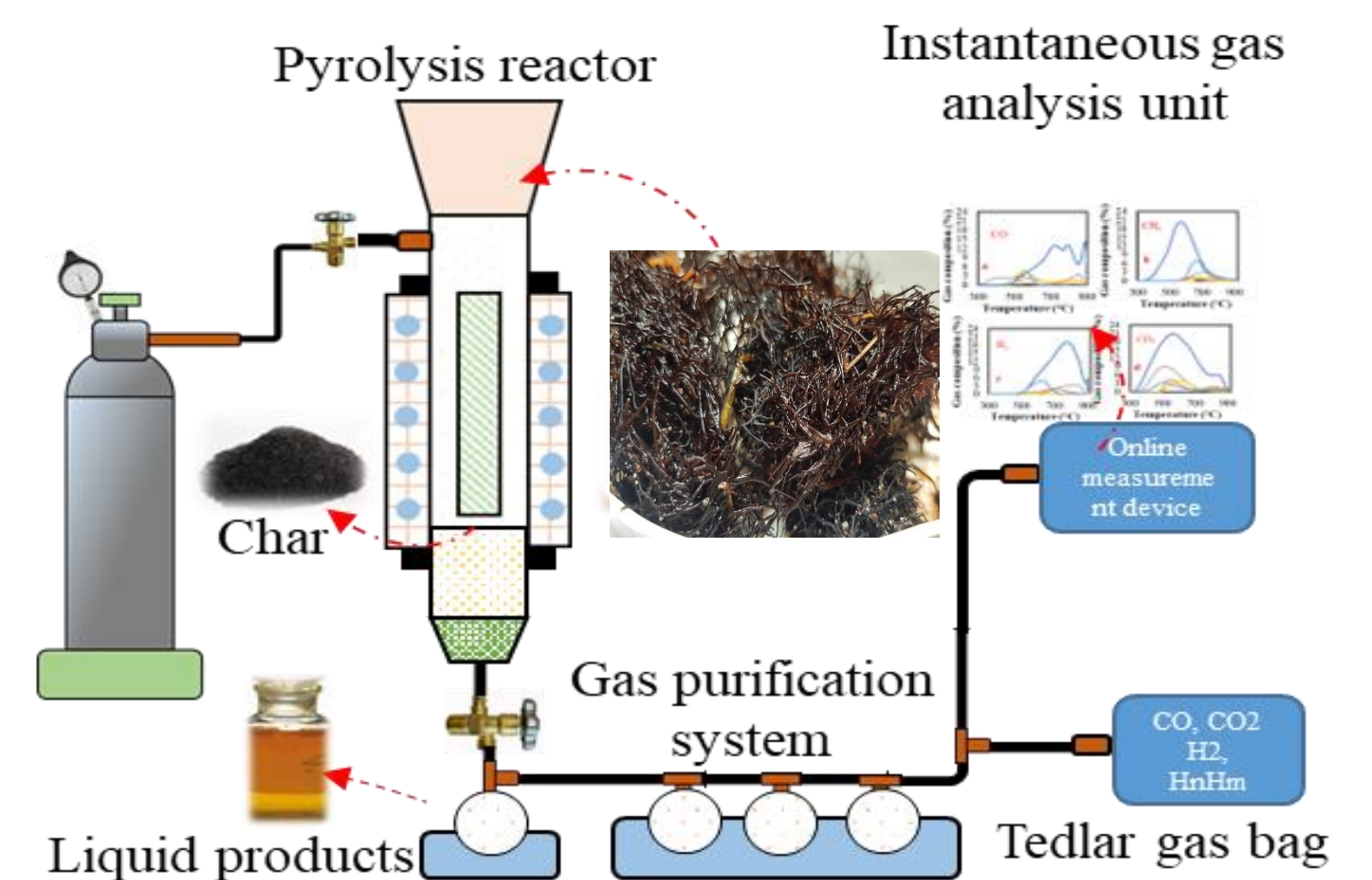
This study aims to investigate a newly prepared seaweed biochar-based metallized catalyst and its application for a catalytic pyrolysis. The pyrolysis process was carried out in a laboratory-scale pyrolysis reactor at the temperature of 700 °C with a feedstock load of 250 g. The GC/MS analysis of the liquid products revealed, that catalyst significantly increase the formation of liquid products up to 42.12 wt.% with the seaweed sample. The most common compounds in the seaweed liquid products are variously substituted phenolic (19.47%) and aromatic (21.47%) compounds, some acids (11.12%), and alcohols (7.46%). Moreover, copper-impregnated catalyst increased the amount of toluene in one of the batches up to 84.24% showing potential for this solvent recovery.

Materials and methods



Char parameters

Element	Before wt., %	with Cu wt., %	with Fe wt., %
C	72.74	48.99	46.68
O	12.0	8.45	18.68
K	6.24	0.18	1.40
N	3.67	4.50	2.98
Fe	1.72	1.59	12.06
Cl	1.70	19.76	12.61
Si	1.12	0.87	4.51
S	0.74	0.31	0.55
Al	0.34	0.19	1.89
Cu	-	14.84	-
Pore volume cm ³ /g	0.197	0.560	0.473
Pore diameter nm	0.852	0.818	0.524
Surface area, m ² /g	335	1066	790



Feedstock Parameters:

C - 46.93 ± 0.05 wt.%, H - 4.73 ± 0.06 wt.%, N - 4.13 ± 0.14 wt.%, S - 5.13 ± 0.23 wt.%, Cl - 0.05 ± 0.01 wt.%, O (diff.) - 29.61 ± 0.06 wt.%, W - 0.60 ± 0.01 wt.%, VM - 58.30 ± 0.19, FC - 32.23 ± 0.15 wt.%, Ash - 8.87 ± 0.04 wt.%, LHV - 16.51 ± 0.07 MJ/kg.

Process Parameters:

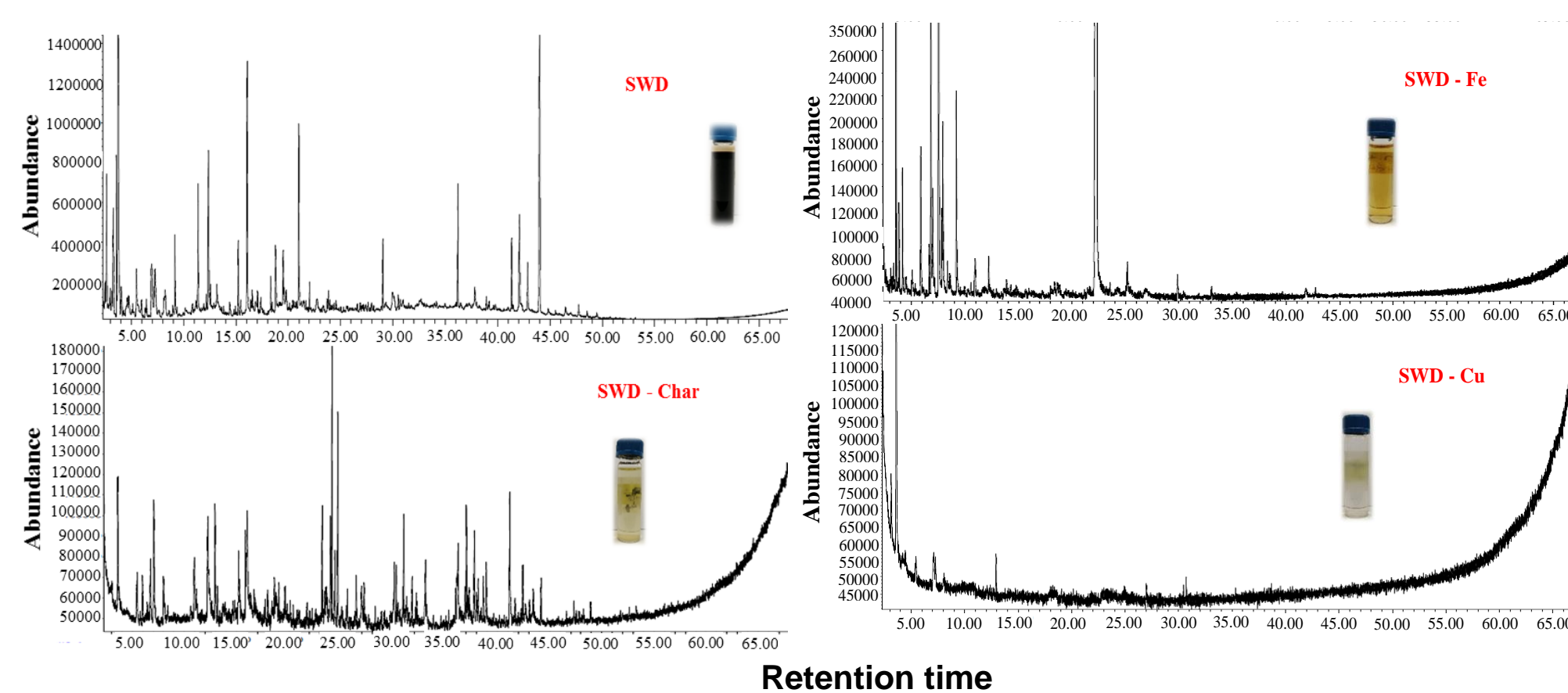
Atmosphere - N₂ with a 90 ml/min flow rate; Feedstock load - 250 g; Heating rate - 30 °C/min; Pyrolysis temperature - 700 °C;

Products distribution and conversion efficiency

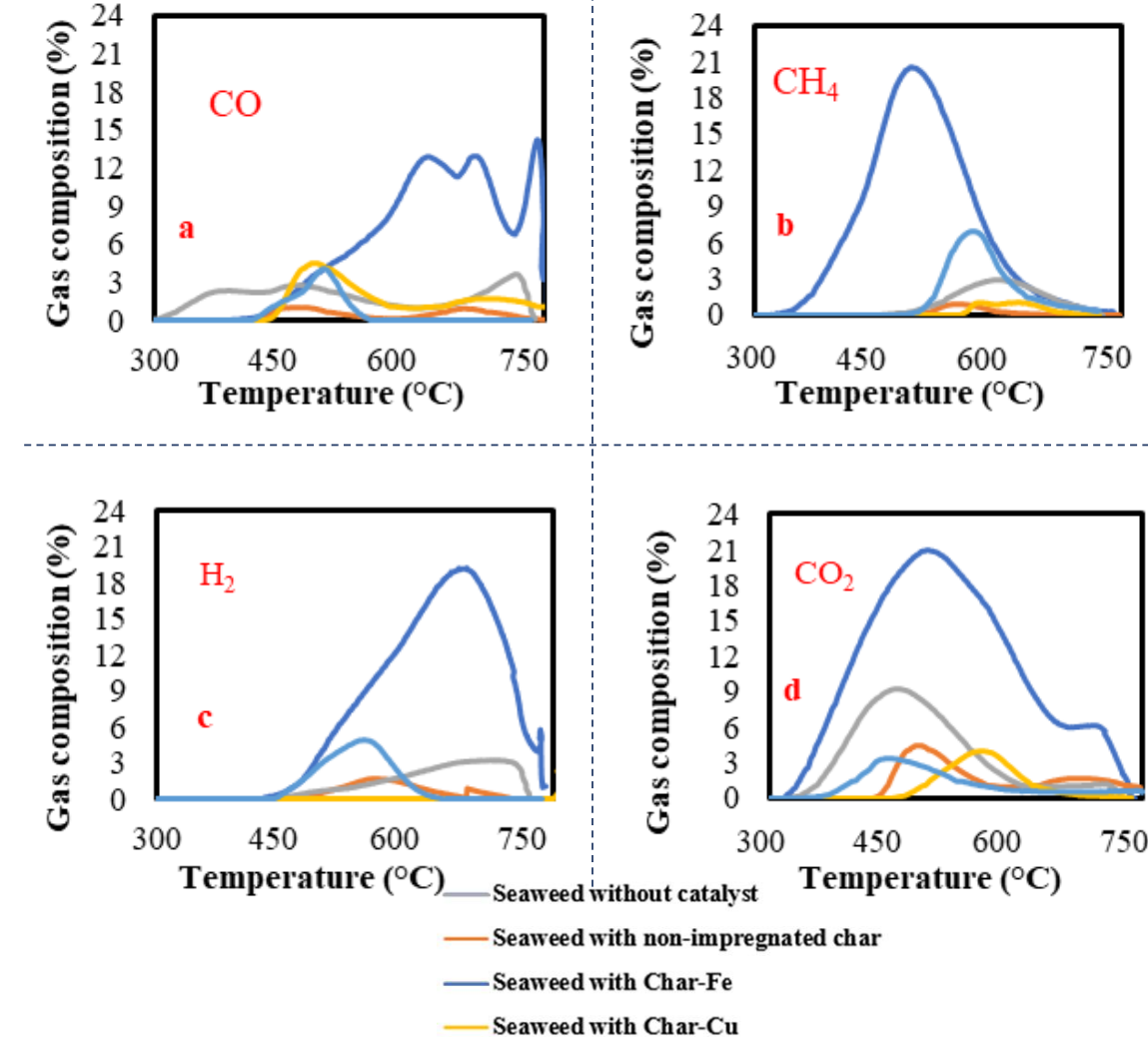
Conversion efficiency and product yields

Sample	Seaweed	SWD-Char	SWD-Fe	SWD-Cu
Pyrolysis oil, wt.%	17.20	38.73	42.12	41.83
Pyrolysis gas, wt.%	43.70	22.16	19.44	18.65
Pyrolysis char, wt.%	39.10	39.11	38.44	39.54
Conversion efficiency, %	60.90	60.89	61.56	60.46

Liquid products chromatograms



Gaseous products composition



Conclusions

The GC/MS analysis of the liquid products revealed, that catalyst significantly increase the formation of liquid products up to 42.12 wt.% with the seaweed sample. The most common compounds in the seaweed liquid products are variously substituted phenolic (19.47%) and aromatic (21.47%) compounds, some acids (11.12%), and alcohols (7.46%). Moreover, copper-impregnated catalyst increased the amount of toluene in one of the batches up to 84.24% showing potential for this solvent recovery. Based on the investigated results, char-based metallized catalyst significantly increased amounts of valuable products. It is clear that the pyrolysis process is a feasible and promising process for the marine biomass wastes utilization, obtaining additional higher-added value and energy products, contributing to the creation of a circular economy.