Supplementary Materials: Hydrothermal Carbonization of Waste Biomass: Process Design, Modeling, Energy Efficiency and Cost Analysis

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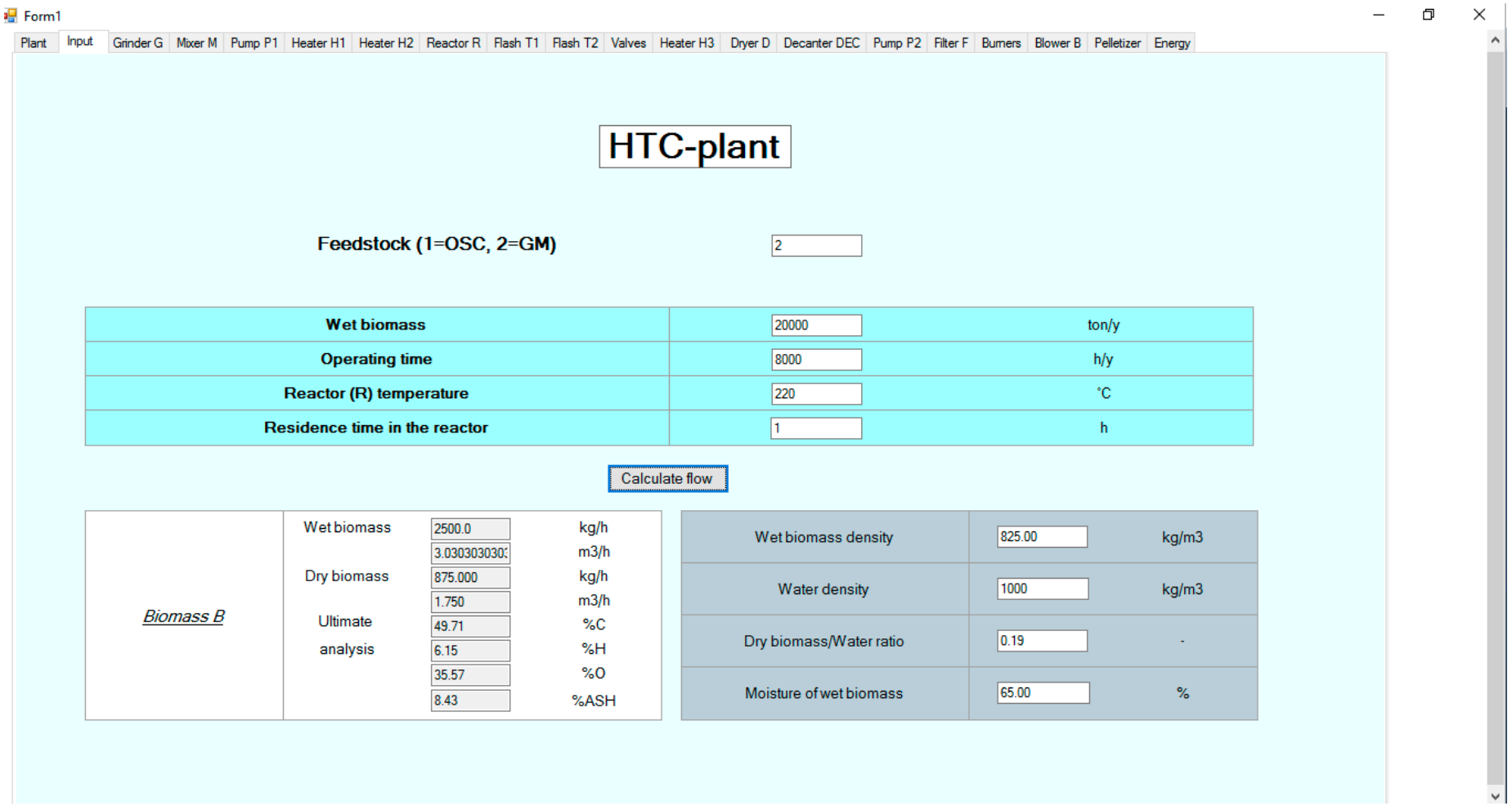
Table S1. Regression coefficients (a, b) and R-squared value (R^2) of linear correlations—Equation (1) in the text—between temperature and solid yield, gas yield, molar percentage of gaseous products at different residence times (1, 3, 8 h) for OSC and GM.

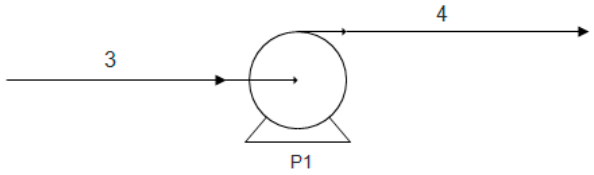
	Residence Time (h)	OSC			GM		
		a	b	R^2	a	b	R^2
Solid yield	1	−0.0057	1.8385	1	−0.0018	1.0949	0.9840
	3	−0.0015	0.9646	0.8229	−0.0020	1.0812	0.9408
	8	−0.0037	1.2893	0.8697	−0.0029	1.2724	0.9382
Gas yield	1	0.0008	−0.1449	0.9276	0.0007	−0.1085	0.9989
	3	0.0009	−0.1345	0.9932	0.0007	−0.0985	0.9989
	8	0.0010	−0.1596	0.9745	0.0009	−0.1241	0.9884
Molar %							
CO_2	1	−0.1256	122.9900	0.9699	−0.0772	112.9900	1
	3	−0.1268	122.7300	0.9980	−0.0578	109.0600	0.9792
	8	−0.0417	102.3800	0.9840	−0.0286	103.0400	0.7112
CO	1	0.1143	−20.9090	0.9736	0.0743	−12.6700	1
	3	0.1140	−20.4510	0.9987	0.0535	−8.4946	0.9784
	8	0.0261	0.0811	0.8206	0.0246	−2.6622	0.5768
CH_4	1	0.0017	−0.3060	0.9999	0.0014	−0.2595	0.6757
	3	0.0019	−0.3380	0.9167	0.0014	−0.2595	0.6757
	8	0.0014	−0.1245	0.3024	00028	−0.5149	0.9932
H_2	1	0.0095	−1.7748	0.8920	0.0030	−0.4108	0.8176
	3	0.0109	−1.9387	0.9900	0.0028	−0.3149	0.9932
	8	0.0142	−2.3417	0.8979	0.0024	−0.1270	0.1824


Form1
Plant
Input
Grinder G
Mixer M
Pump P1
Heater H1
Heater H2
Reactor R
Flash T1
Flash T2
Valves
Heater H3
Dryer D
Decanter DEC
Pump P2
Filter F
Burners
Blower B
Pelletizer
Energy
HTC-plant
Feedstock (1=OSC, 2=GM)
2
Wet biomass
20000
ton/y
Operating time
8000
h/y
Reactor (R) temperature
220
°C
Residence time in the reactor
1
h
Calculate flow
Biomass B
Wet biomass
2500.0
kg/h
3.0303030303
m3/h
Dry biomass
875.000
kg/h
1.750
m3/h
Ultimate analysis
49.71
%C
6.15
%H
35.57
%O
8.43
%ASH
Wet biomass density
825.00
kg/m3
Water density
1000
kg/m3
Dry biomass/Water ratio
0.19
-
Moisture of wet biomass
65.00
%

Form1

Plant | Input | Grinder G | Mixer M | Pump P1 | Heater H1 | Heater H2 | Reactor R | Flash T1 | Flash T2 | Valves | Heater H3 | Dryer D | Decanter DEC | Pump P2 | Filter F | Burners | Blower B | Pelletizer | Energy

3.Pump



3	Flow	5480.2631578	kg/h
	Liquid flow	4605.2631578	kg/h
	Solid flow	875.000	kg/h
	Dry biomass	875.000	kg/h
	Water	4605.2631578	kg/h
	T	20	℃
	P	1,01	bar

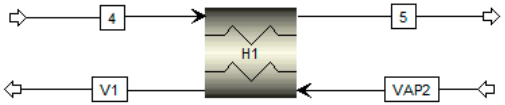
4	Flow	5480.2631578	kg/h
	Liquid flow	4605.2631578	kg/h
	Solid flow	875.000	kg/h
	Dry biomass	875.000	kg/h
	Water	4605.2631578	kg/h
	T	20	℃
	P	39.242369679	bar

Pump	Power consumption	6.49212659080	kW
	Pump motor power	12.9842756106	kW
	Mechanical efficiency	0.5	-

Form1

Plant | Input | Grinder G | Mixer M | Pump P1 | Heater H1 | Heater H2 | Reactor R | Flash T1 | Flash T2 | Valves | Heater H3 | Dryer D | Decanter DEC | Pump P2 | Filter F | Burners | Blower B | Pelletizer | Energy

4. Heater H1



4			
Flow	5480.263157	kg/h
Liquid flow	4605.263157	kg/h
Solid flow	875.000	kg/h
Dry biomass	875.000	kg/h
Water	4605.263157	kg/h
T	20	°C
P	39.24236967	bar

5			
Flow	5480.263157	kg/h
Liquid flow	4605.263157	kg/h
Solid flow	875.000	kg/h
Dry biomass	875.000	kg/h
Water	4605.263157	kg/h
T	75.50164136	°C
P	36.24236967	bar

V1			
Flow	389.427104	kg/h
Liquid flow	389.427104	kg/h
Vapor flow	0	kg/h
Phenol	0.55919197	kg/h
Water	388.867912	kg/h
T	121	°C
P	1.54040456	bar

VAP2			
Flow	389.427104	kg/h
Liquid flow	0	kg/h
Vapor flow	389.427104	kg/h
Phenol	0.55919197	kg/h
Water	388.867912	kg/h
T	121	°C
P	2.04040456	bar

Block H1			
U	1500	W/m2K
Area	2.33721069	m2
Heat duty	307.742036	kW
Pressure drop (liquid side)	3	bar
Pressure drop (vapor side)	0,5	bar

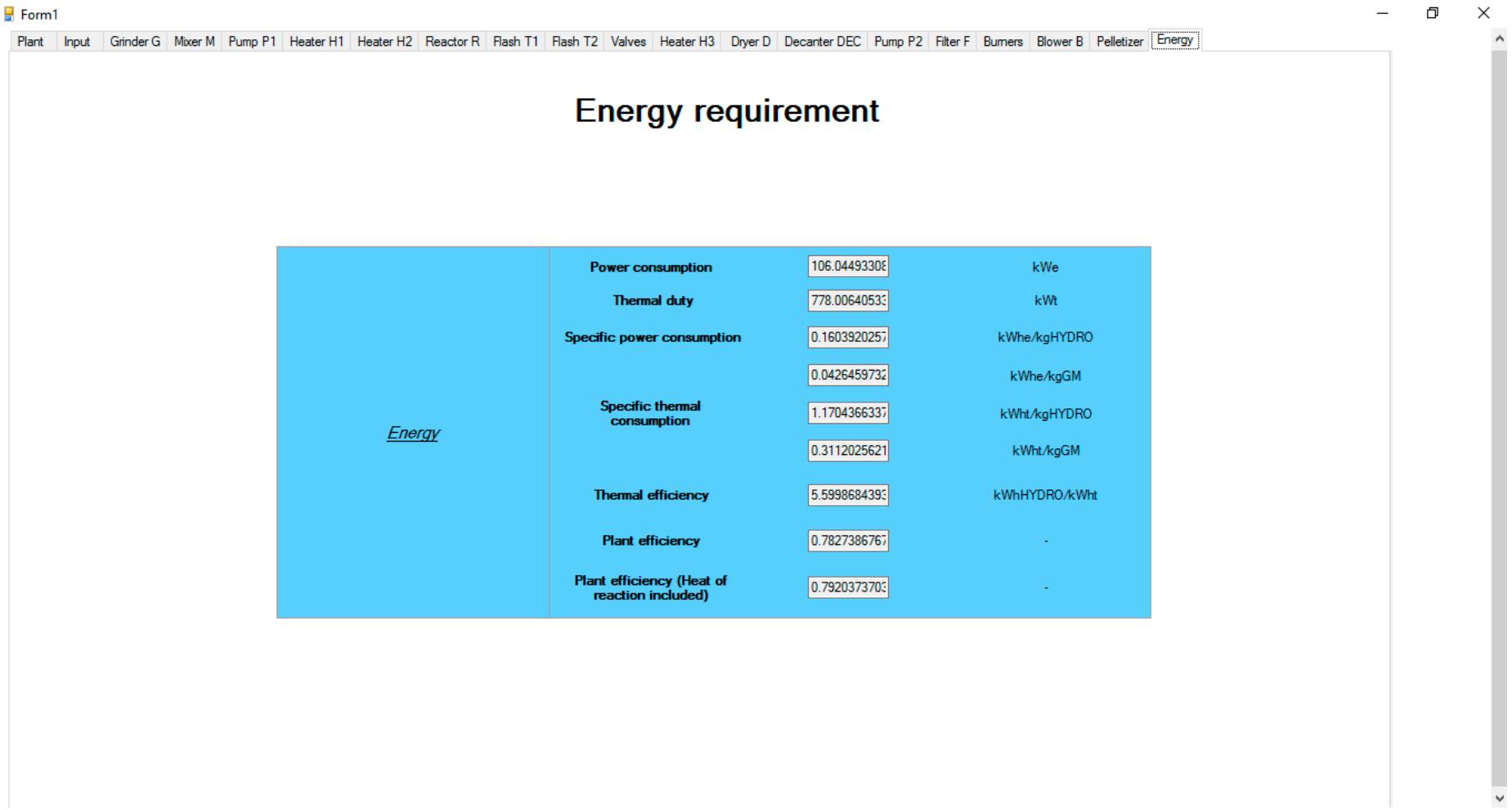


Figure S1. User-interfaces of the software code developed in C#.