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Supplementary Materials: Hydrothermal Carbonization of Lemon Peel Waste: Preliminary Results on the Effects of Temperature During Process Water Recirculation

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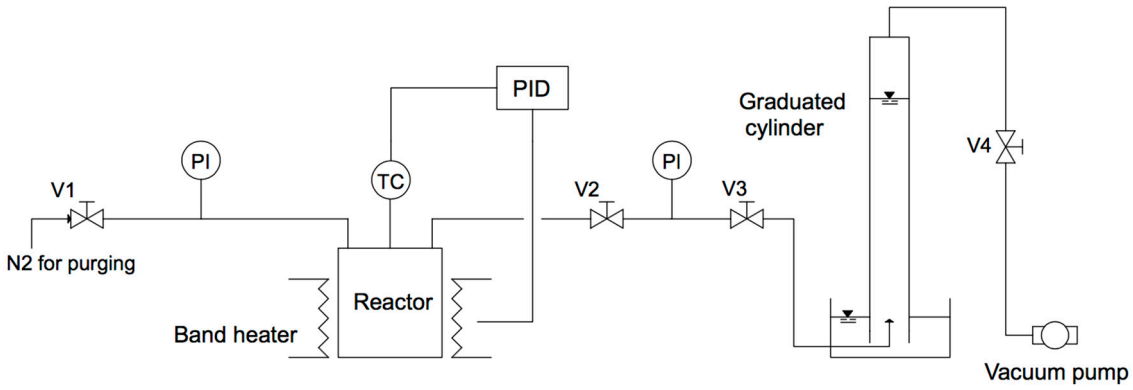

Figure 1. Piping and Instrumentation diagram (P&Id) of the HTC experimental system (TC= thermocouple; PI= pressure gauge; PID=temperature controller).

Figure 2. HTC apparatus: (**a**) HTC system during heating phase; (**b**) HTC reactor cooled down through a massive stainless steel disc at -10 °C; (**c**) HTC reactor cooled down through a stainless steel radiator with flowing tap water.

Table 1. Mass yields (dry basis) and process water characterization (Er% with three replications).

Sample	Mass Yields wt% d.b.			Process water	
	Solid	Liquid[1]	Gas	pH	TOC (g/L)
180_R0	50.1 ± 0.4%	43.7%	6.2 ± 0.5%	3.87 ± 0.41%	16.06 ± 0.54%
220_R0	49.2 ± 0.4%	40.7%	10.1 ± 2.3%	4.40 ± 0.22%	13.30 ± 0.51%
250_R0	40.9 ± 0.7%	44.4%	14.7 ± 0.9%	4.66 ± 0.34%	9.70 ± 0.42%
180_R1	55.9 ± 1.0%	37.6%	6.5 ± 0.5%	3.95 ± 0.21%	18.82 ± 0.54%
220_R1	51.2 ± 1.0%	37.6%	11.2 ± 1.4%	4.49 ± 0.21%	16.92 ± 0.51%
250_R1	41.9 ± 0.7%	43.4%	14.8 ± 2.2%	4.69 ± 0.32%	14.25 ± 0.43%
180_R2	55.0 ± 1.5%	38.1%	6.9 ± 0.5%	3.97 ± 0.33%	20.08 ± 0.51%
220_R2	49.9 ± 0.2%	38.7%	11.3 ± 1.0%	4.50 ± 0.23%	17.79 ± 0.33%
250_R2	42.5 ± 0.1%	42.8%	14.7 ± 1.9%	4.70 ± 0.12%	18.06 ± 0.11%

[1] Computed by difference.

Table 2. Proximate analysis and energy properties of raw LP and hydrochars (Er% with two replications).

Sample	Proximate Analysis wt% d.b.			Energy properties		
	VM	Ash	FC[1]	HHV (MJ kg^{-1})	EDR (%)	EY (%)
Raw LP	75.0 ± 0.2%	3.8 ± 0.1%	21.2 ±0.8%	17.1 ± 0.5%	100.0	100.0
180_R0	65.3 ± 0.7%	2.3 ± 2.9%	32.4 ±1.6%	22.4 ± 0.3%	130.8	65.5
220_R0	58.1 ± 0.6%	3.1 ± 2.2%	38.8 ±0.7%	24.4 ± 0.9%	143.0	70.4
250_R0	50.5 ± 0.8%	3.2 ± 0.1%	46.3 ±0.9%	26.7 ± 0.4%	156.0	63.7
180_R1	63.6 ± 0.4%	3.0 ± 0.6%	33.4 ±0.7%	22.0 ± 0.1%	128.9	72.0
220_R1	59.1 ± 0.7%	3.7 ± 1.6%	37.1 ±1.3%	23.9 ± 0.3%	139.9	71.7
250_R1	51.6 ± 0.1%	3.2 ± 0.2%	45.2 ±0.1%	26.8 ± 0.2%	156.9	65.7
180_R2	62.6 ± 0.3%	3.0 ± 0.5%	34.4 ±0.7%	22.2 ± 0.8%	129.9	71.5
220_R2	58.1 ± 0.1%	3.2 ± 0.4%	38.7 ±0.2%	24.7 ± 0.3%	144.6	72.2
250_R2	51.7 ± 0.5%	3.3 ± 0.3%	45.1 ±0.6%	27.2 ± 0.3%	159.3	67.7

[1] Computed by difference.