processes

Supplementary Materials: Sequential Hydrothermal Processing of Sewage Sludge to Produce Low Nitrogen Biocrude

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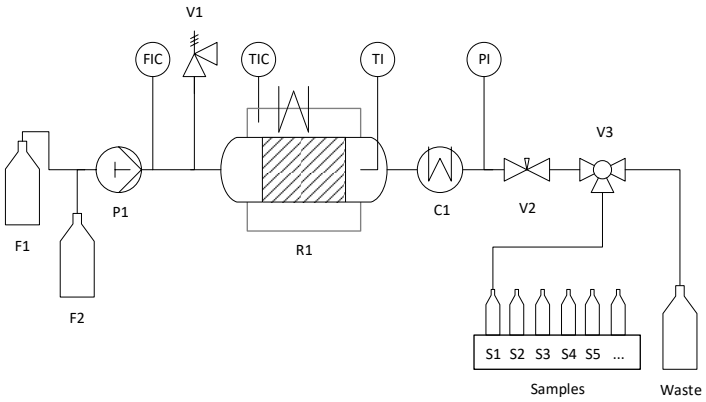
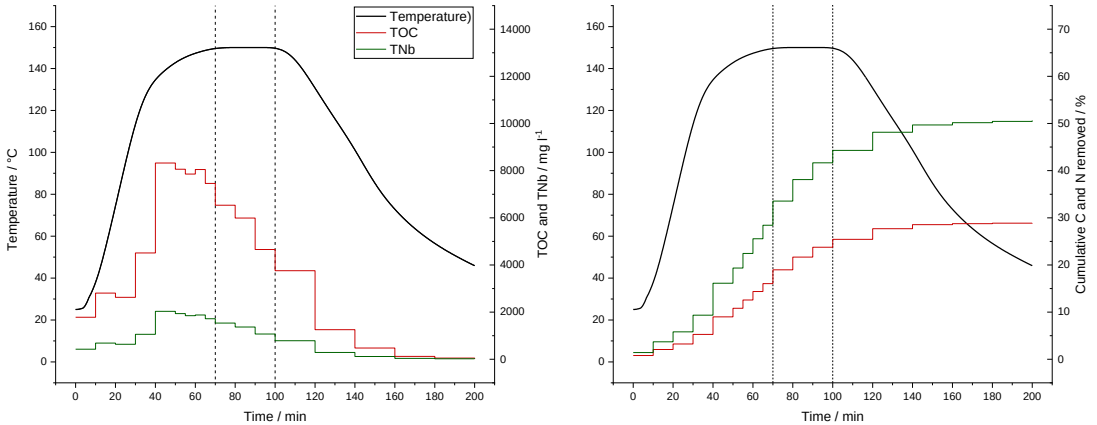


Figure S1. PID of test rig. F1: De-ionized water, F2: Leaching agent, P1: HPLC-pump, V1: safety valve, R1: Fixed Bed Reactor with heating block, C1: cooler, V2: Backpressure valve, V3: three-way valve.



(**a**)

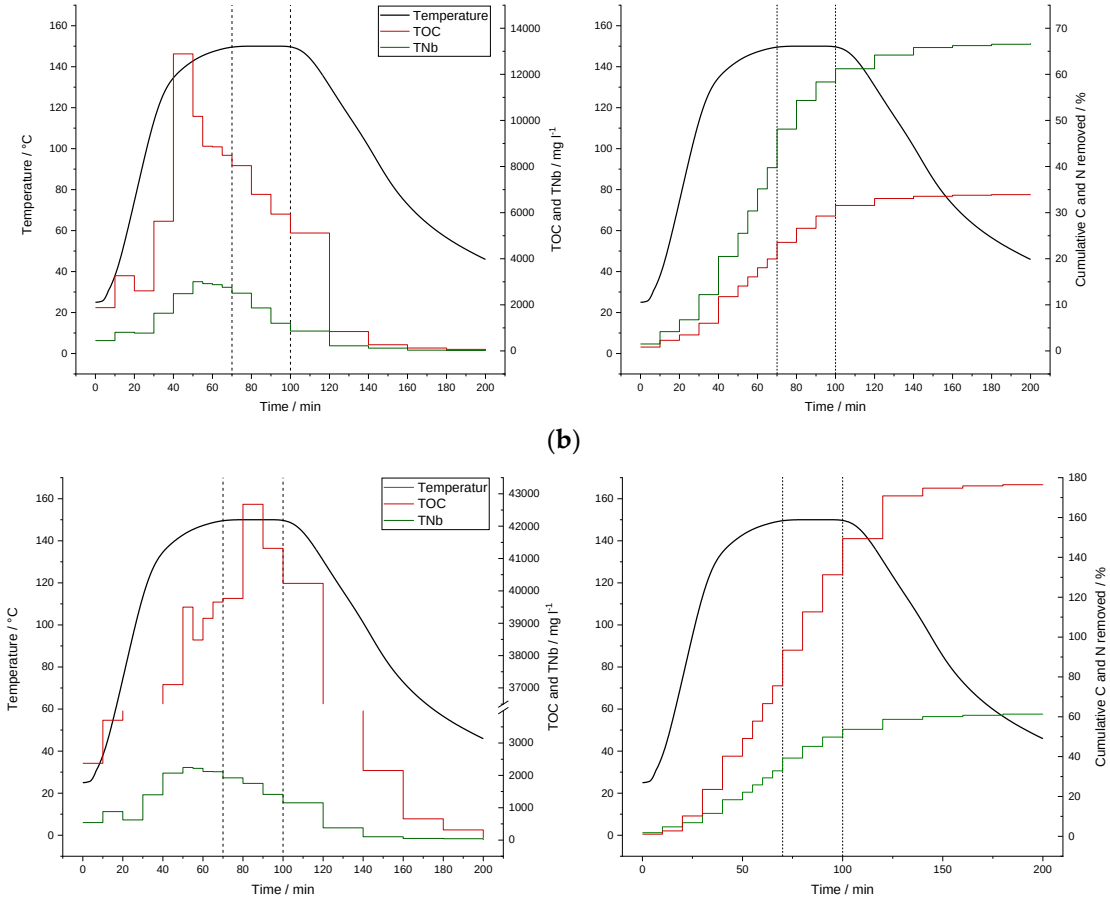


Figure S2. TOC and TNb concentration and cumulative C and N removal from MSS with (**a**) DW, (**b**) SA and (**c**) CA, as leaching agent. For CA-treatment the TOC-value of the 0.5 M CA was subtracted to receive the real and final cumulative C- removed from the solid.

Table S1. Content of amino acids in sewage sludge and pre-treated solids.

Amino Acid (Dry Ash Free) [wt. %]	MSS	DW	SA	CA
Alanine (Ala)	2.4	1.2	0.9	0.8
Arginine (Arg)	0.8	0.6	0.4	0.4
Aspartic acid (Asp)	2.2	1.6	1.0	0.7
Cysteine (Cys)	0.3	0.0	0.0	0.0
Glutamic acid (Glu)	2.8	2.4	1.6	1.5
Glycine (Gly)	1.8	0.7	0.6	0.4
Histidine (His)	0.3	0.2	0.1	0.2
Isoleucine (Iso)	1.2	0.7	0.6	0.6
Leucine (Leu)	1.8	1.2	1.1	1.1
Lysine (Lys)	1.2	0.3	0.4	0.2
Methionine (Met)	0.5	0.2	0.2	0.2
Phenylalanine (Phe)	1.1	0.8	0.7	0.7
Proline (Pro)	1.1	0.8	0.4	0.5
Serine (Ser)	0.9	0.7	0.5	0.5
Threonine (Thr)	1.3	0.7	0.5	0.4
Tyrosine (Tyr)	0.7	0.4	0.4	0.3
Valine (Val)	1.7	1.0	0.8	0.8
Sum of amino acids	**21.8**	**13.5**	**10.0**	**9.3**

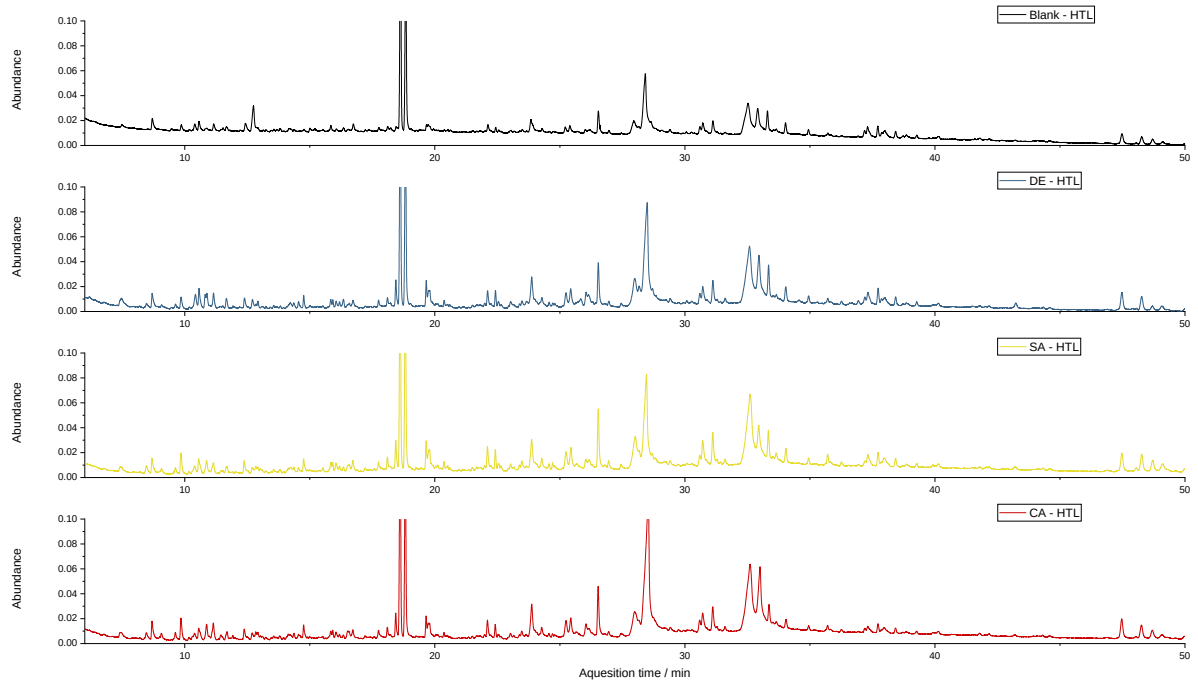


Figure S3. GC-TIC Chromatogram of derived biocrude.

Table S2. Concentration of fatty acids in biocrude samples. The values in brackets indicate the standard deviation.

Feedstock	MSS-HTL	DE-HTL	SA-HTL	CA-HTL
C12:0 [wt. %]	0.1 (0.0)	0.2 (0.0)	0.2 (0.0)	0.2 (0.0)
C14:0 [wt. %]	0.4 (0.0)	0.5 (0.0)	0.6 (0.1)	0.6 (0.0)
C15:0 [wt. %]	0.1 (0.0)	0.2 (0.0)	0.2 (0.1)	0.3 (0.0)
C16:0 [wt. %]	1.0 (0.1)	1.3 (0.1)	1.7 (0.1)	1.5 (0.0)
C16:1[a] [wt. %]	3.2 (0.3)	4.6 (0.2)	6.0 (0.7)	5.7 (0.3)
C18:0 [wt. %]	5.8 (0.3)	6.1 (0.6)	8.1 (0.4)	7.7 (0.2)
C18:1[b] [wt. %]	2.4 (0.2)	3.4 (0.2)	3.4 (1.4)	4.3 (0.3)
Sum	13.1 (0.5)	16.4 (0.7)	20.2 (1.6)	20.3 (0.5)

[a] Containing all hexadecenoic acid isomers.
[b] Containing all octadecenoic acid isomers.

Table S3. Concentration of representative compounds in biocrude samples. The values in brackets indicate the standard deviation.

	MSS-HTL	DE-HTL	SA-HTL	CA-HTL
Phenol [wt. %]	0.20 (0.01)	0.16 (0.01)	0.16 (0.02)	0.20 (0.03)
2-Piperidinone [wt. %]	0.35 (0.04)	0.09 (0.05)	0.07 (0.01)	0.08 (0.01)
1H-Indole, 3-methyl [wt. %]	0.49 (0.01)	0.26 (0.01)	0.29 (0.04)	0.29 (0.01)
Fatty acids[a] [wt. %]	13.09 (0.50)	16.37 (0.69)	20.24 (1.61)	20.27 (0.52)
Hexadecanol [wt. %]	2.62 (0.15)	3.16 (0.32)	4.01 (0.00)	3.44 (0.20)
Hexadecanamide [wt. %]	3.01 (0.21)	3.18 (0.20)	3.55 (0.06)	2.97 (0.02)

[a] Sum of all fatty acids detected.