

Supplementary data S1: Energy Requirements Analysis for Micro-aerobic with thickening process

Table S1.1: General analysis including all the components required

	Power (KW)	Working Hours (h)	Equipment working per day	Hours per year (h)	Energy requirement per year (MWh/year)
Centrifuge	37*	3*	2*	2190	81
Immersion Heater	6	24	4	35040	210
Feeding pumps	8*	3	2	2433	18
Blower	12	24	4	35040	405
Boiler	4638	1	1	357	1655
				Total (MW/year)	2370

*: * Data supplied by the Mapocho/Trebal WWTP

Table S1.2: Energy requirement of Boiler

Component	Value
Sludge Mass (Kg)	150000
Assuming $C_{p\text{sludge}} = C_{p\text{water}}$ (KJ/Kg*°C)	4.2
Temperature of the sludge before pre-treatment (°C)	22.0
Temperature of the sludge after pre-treatment (°C)	35.0
Heat requirement (KJ)	8162700
Saturated steam enthalpy (12 Bar) (KJ/Kg)	2783.0
Steam requirement by each reactor (Kg)	2933.05785
Number of reactors working per day	2.0
Steam requirement by both lines (Kg)	5866.1157
Steam rated output by the boiler (Kg/h)*	6000.0
Boiler Power (KW)	4638.33333
Total time (h)	0.97768595

*: Data supplied by the Mapocho/Trebal WWTP

Table S1.3: Energy requirement of Blower

Airation (vvm)	0.35
Pre-treatment reactor (m ³)	200
Effective Volume (m ³)	150
Airation Rate (m ³ /h)	3150
Blower* Power (kW)	12

*: Blower model: Repicky R 2.5, 3400 RPM ($\Delta P=100$ mBar)

Table S1.4: Energy requirement of feeding pump

Component	Value
Solid content of the sludge (g/L)	160
Volume to pre-treat (m ³)	300
Reactor volume (m ³)	200
Reactor effective volume (m ³)	150
Capacity of feeding pumps (m ³ /h)*	45
Time to feed each reactor (h)	3.33333333
Number of reactors per line	2
Number of lines	2
Number of reactors	4

*: Data supplied by the Mapocho/Trebal WWTP

Supplementary data S2: Energy Requirements Analysis for Micro-aerobic without thickening process

Table S2.1: General analysis including all the components required

	Power (KW)	Working Hours (h)	Equipment working per day	Hours per year (h)	Energy requirement per year (MWh/year)
Immersion Heater	6	24	16	140.160	841
Feeding pumps	8*	3	8	9.733	73
Blower	12	24	16	140.160	1.620
Boiler	4638	4	1	1.427	6.621
				Total (MW/year)	9.155

*: * Data supplied by the Mapocho/Trebal WWTP

Table S2.2: Energy requirement of Boiler

	Value
Sludge Mass (Kg)	150.000
Assuming $C_{p\text{sludge}} = C_{p\text{water}}$ (KJ/Kg °C)	4
Temperature of the sludge before pre-treatment (°C)	22
Temperature of the sludge after pre-treatment (°C)	35
Heat requirement (KJ)	8.162.700
Saturated steam enthalpy (12 Bar) (KJ/Kg)	2.783
Steam requirement by each reactor (Kg)	2.933
Number of reactors working per day	8
Steam requirement by both lines (Kg)	23.464
Steam rated output by the boiler (Kg/h)*	6.000
Boiler Power (KW)	4.638
Total time (h)	4

*: Data supplied by the Mapocho/Trebal WWTP

Table S2.3: Energy requirement of Blower

Airation (VVM)	0.35
Pre-treatment reactor (m ³)	200
Effective Volume (m ³)	150
Airation Rate (m ³ /h)	3.150
Blower* Power (kW)	12

*: Blower model: Repicky R 2.5, 3400 RPM ($\Delta P=100$ mBar)

Table S1.4: Energy requirement of feeding pump

Component	Value
Solid content of the sludge (g/L)	40
Volume to pre-treat (m3)	1.200
Reactor volume (m3)	200
Reactor effective volume (m3)	150
Number of reactors per line	8
Number of lines	2
Number of reactors	16
Capacity of feeding pumps (m ³ /h)*	45
Time to feed each reactor	3.33333333

*: Data supplied by the Mapocho/Trebal WWTP

Supplementary data S3: Energy Requirements Analysis for thermal pre-treatment

Table S3.1: General analysis including all the components required

	Power (KW)	Working Hours (h)	Equipment working per day	Hours per year (h)	Energy requirement per year (MWh/year)
Centrifuge	37*	3.0*	2	2.190	81
Recirculation Pumps	8*	10.2	2	7.463	56
Feeding pumps	8*	1.3	4	1.830	14
Boiler	4.638	4.0	1	1.445	6.701
				Total (MW/year)	6.852

*: Data supplied by the Mapocho/Trebal WWTP

Table S3.2: Energy requirement of Boiler

	Value
Temperature of the sludge in the pulper (°C)	95
Temperature of the sludge in the reactor (°C)	165
Assuming $C_{p\text{sludge}}=C_{p\text{water}}$ (KJ/Kg*°C)	4
Sludge Mass (Kg)	7.500
Heat requirement (KJ)	2.197.650
Saturated steam enthalpy (12 Bar) (KJ/Kg)	2.783
Steam requirement by each reactor (Kg)	790
Steam requirement In Line A (Kg)	2.369
Steam requirement in both lines (Kg)	4.738
Steam rated output by the boiler (Kg/h)	6.000
Boiler Rating (KW)	4.638
Time in each cycle (h)	1
Number of cycles needed	5
Total time(h)	4
Consumption of live steam in each line (kg/h)	599

*: Data supplied by the Mapocho/Trebal WWTP

Table S3.3: Energy requirement of recirculation pump

Fill Reactor with 7.5 m ³ (min)	15
Inject Steam in the Reactor (min)	47
Hold temperature of reactor at 165°C (min)	30
Release Steam to the pulper (min)*	15
Transfer sludge to flash tank by pressure release (min)*	15
Number of cycles needed	5
Total time (h)	10
Number of pumps per line	1
Number of lines	2
Total number of recirculation pumps	2

* Data supplied by the Mapocho/Trebal WWTP

Table S3.4: Energy requirement of feeding pump

Components	Value
Solid content of the sludge (g/L)	160
Volume of sludge to digestion each day (m ³)	300
Volume of sludge to digestion processed by each line (m ³)	150
Dilution Factor due steam addition (%)*	33
Volume of hydrolyzed undiluted sludge (m ³)	113
Reactor capacity (m ³)	8
Reactor in each line	3
Volume of sludge processed by one cycle (m ³)	23
Number of cycles	5
Capacity of feeding pumps (m ³ /h)*	45
Number of feeding pumps per line	2
Number of lines	2
Total number of feeding pumps	4
Feeding time per cycle (h)	0.3
Feeding time (h)	1

*: Data supplied by the Mapocho/Trebal WWTP

Supplementary data S4: Figures

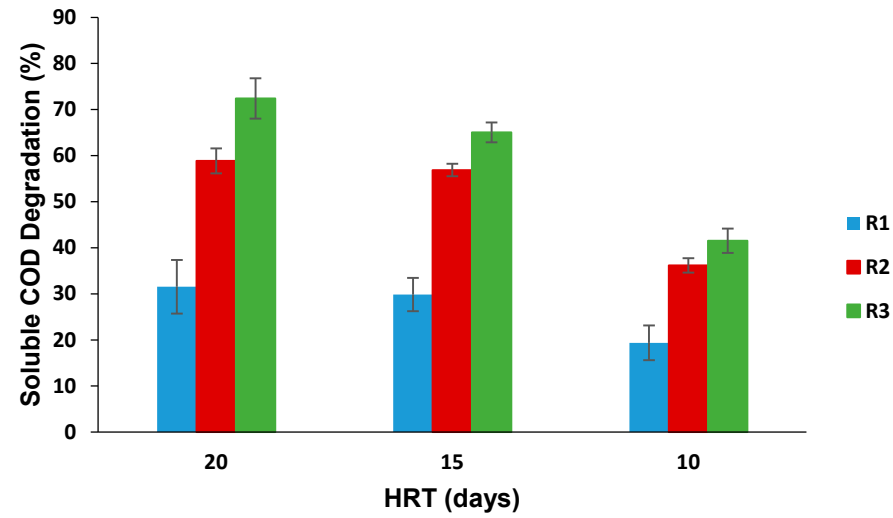


Figure S1: Values at steady state of sCOD degradation for the R1 (control), R2 (thermal pre-treatment) and R3 (micro-aerobic pre-treatment) digesters at 20, 15 and 10 days of HRT.

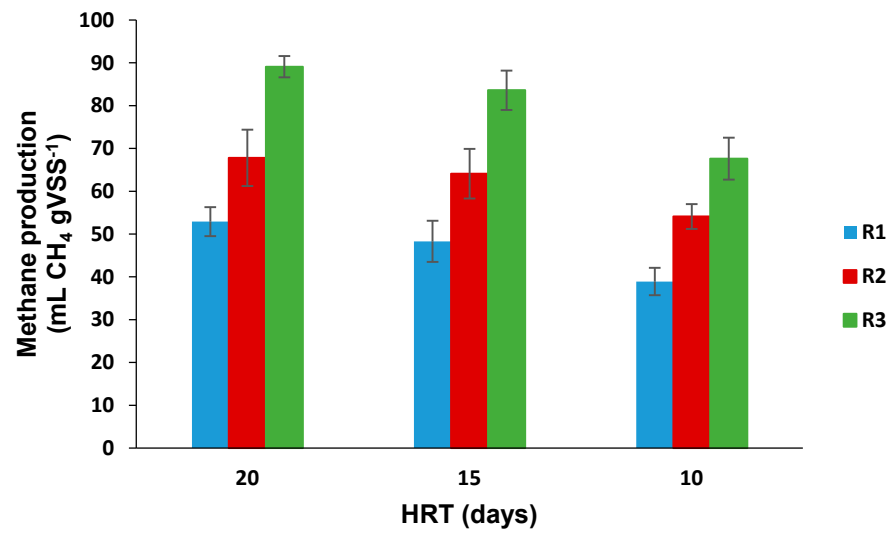


Figure S2: Average volume at steady state of methane production for the R1 (control), R2 (thermal pre-treatment), and R3 (micro-aerobic pre-treatment) digesters at 20, 15 and 10 days of HRT.