SUPPLEMENTARY MATERIAL

High rate domestic wastewater treatment at 15ºC using anaerobic reactors inoculated with cold-adapted sediments/soils – shaping robust methanogenic communities

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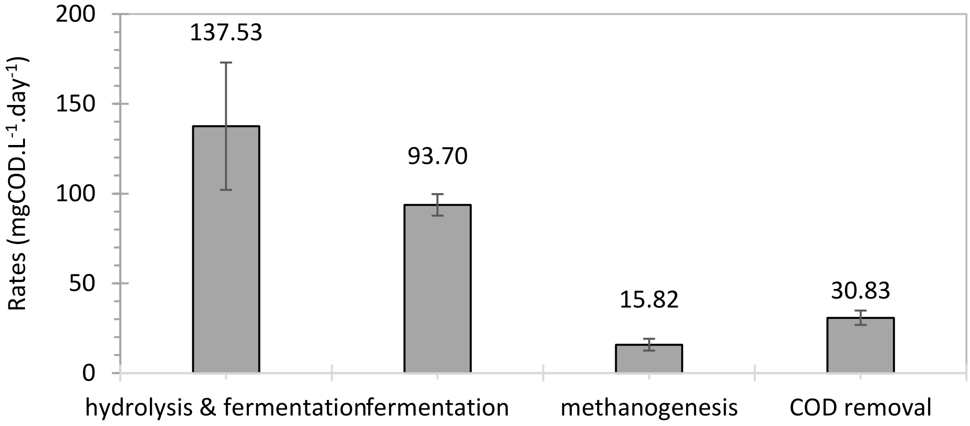
Figure S1 = Bio-conversion rates of wastewater using the specific cold-adapted inoculum; from left to right: COD to sCOD+COD_{CH4}; COD to COD_{VFA}+COD_{CH4}; COD to CH_4; COD removal (for hydrolysis, fermentation, methanogenesis and COD removal respectively.



*The difference between 'hydrolysis/fermentation' and 'fermentation' is the fact that the first takes into account all the COD that became sCOD, whilst the second only considers the VFA generation excluding soluble longer chain acids.

- Abstracting fermentation from 'hydrolysis & fermentation' can give a rough estimation of the rate of hydrolysis = 43.8 $mgCOD.L^{-1}.day^{-1}$.

- Similarly, abstracting the methanogenesis ratefrom the COD removal rate can provide with an estimation of other removal mechanisms such as sulphate reduction = 15.0 $mgCOD.L^{-1}.day^{-1}$.

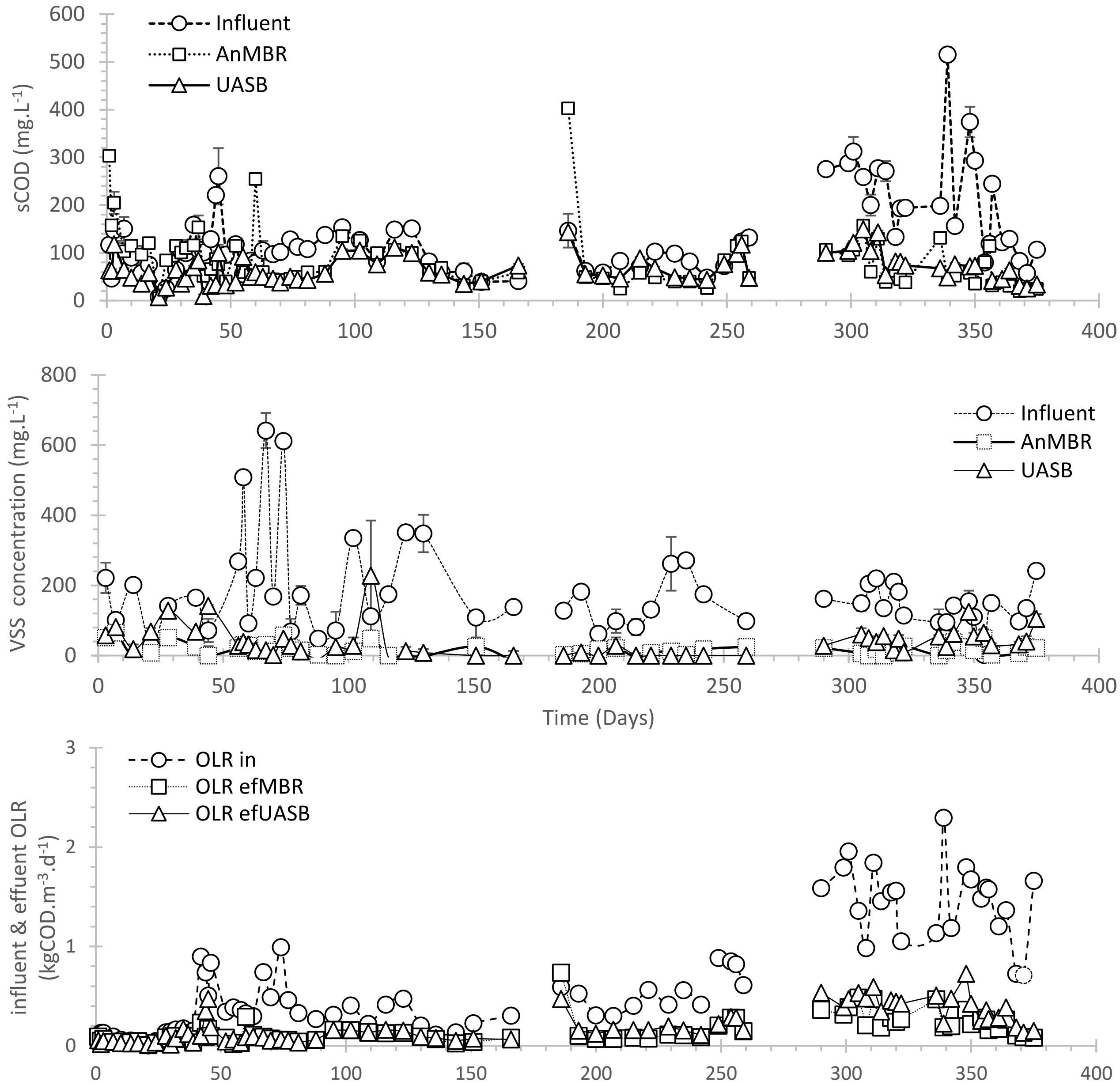


Figure S2 – Concentration(s) of (top to bottom): soluble COD (sCOD); volatile suspended solids (VSS); in the influent and effluent for both the AnMBR and UASB; influent and effluent OLR for the two systems. Error bars stands for standard error (n=2).

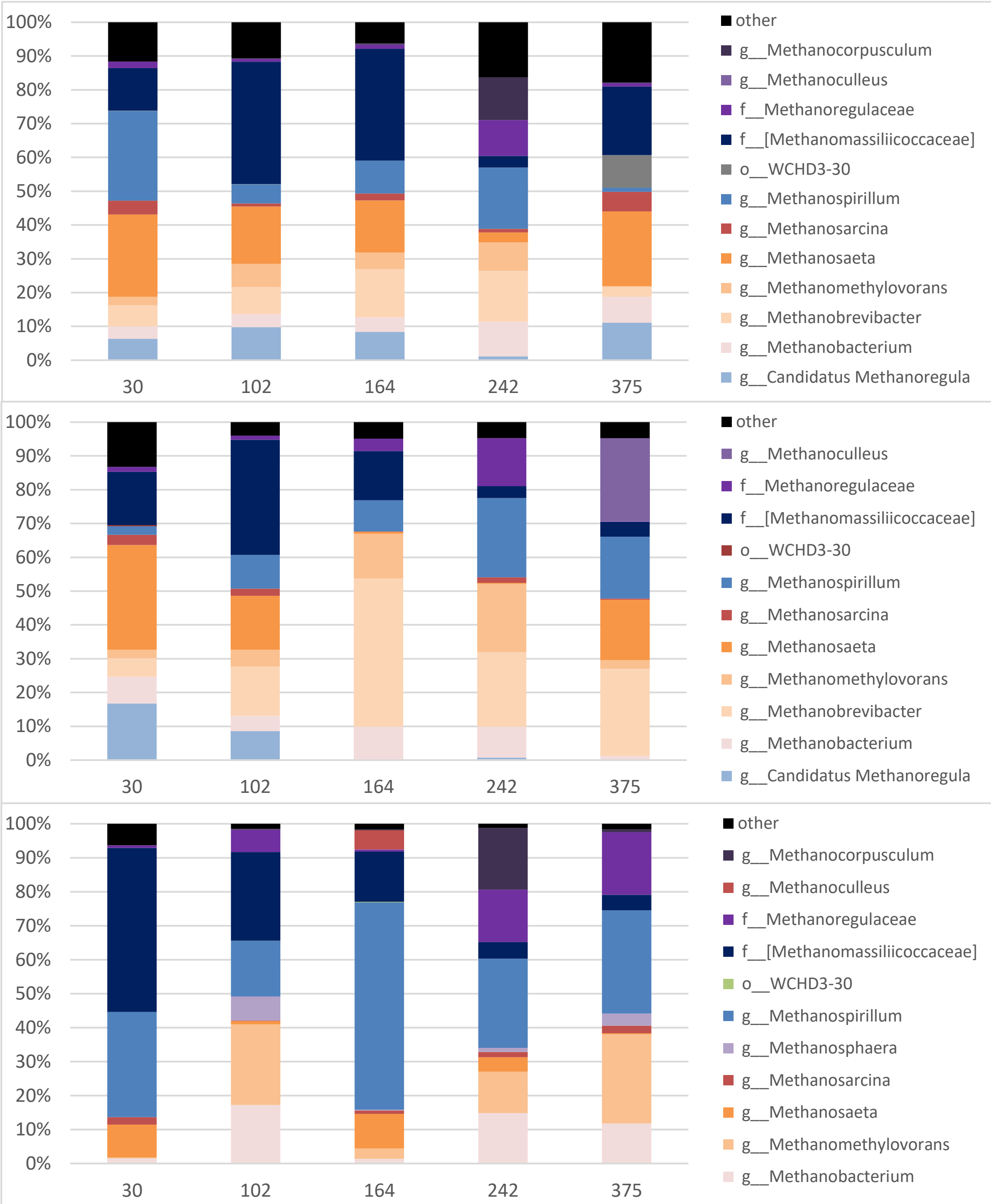


Figure S3 – Evolution of the archaeal genuses from the (top to bottom) AnMBR, the UASB and the biofilm at 5 experimental days (30, 102, 164, 242 and 375)

Figure S4 – Evolution of bacterial phyla from the (top to bottom) AnMBR, UASB and membrane biofilm at 5 experimental days (30, 102, 164, 242 and 375).

Figure S5 – Specific methanogenic activity as per the activity trials with and without the activity from the un-amended controls. Activity expressed in mmolsCH_4.gSS^{-1}.day^{-1} for better understanding of the treatment capacity of the inoculum at direct intermediates (error bars stand for standard error, n = 4).

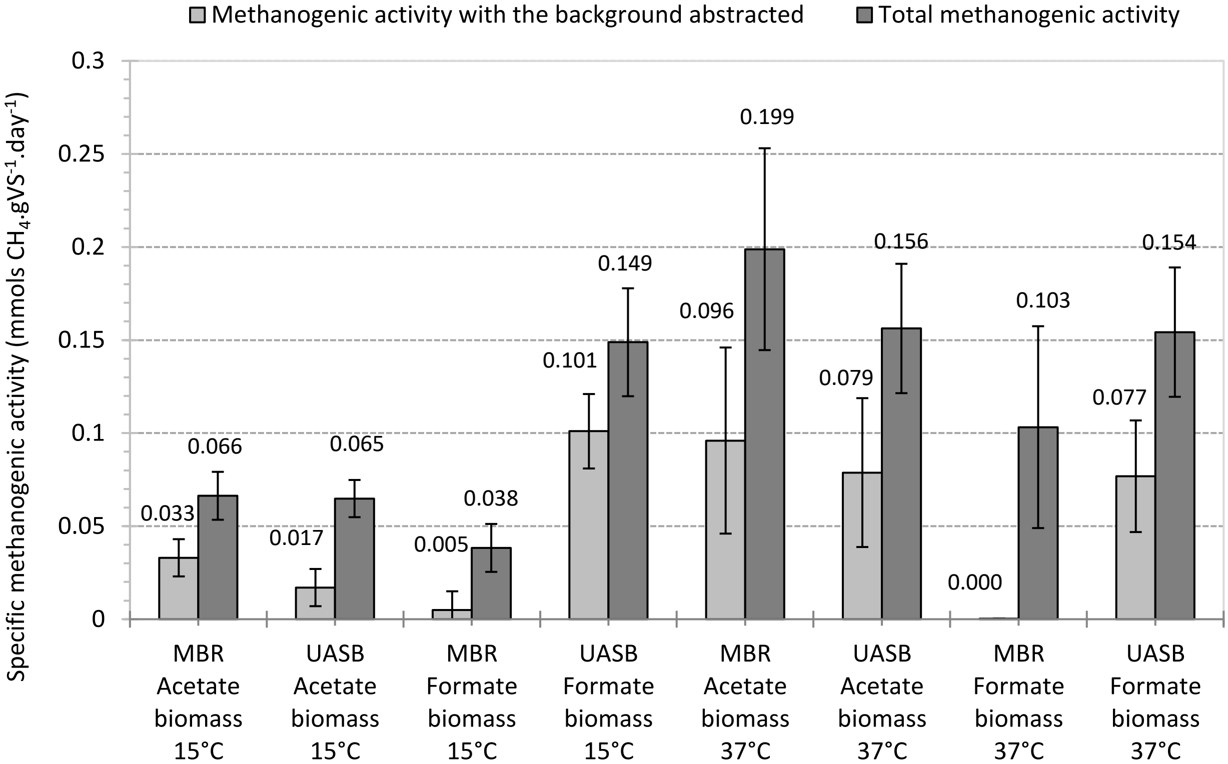


Table S1 – Net energy consumption and production from the methane produced at the AnMBR and the UASB during the methane peak operational periods (9-11).

General				
	Peak period:	9, 10, 11		
	Days:	291-375		
	Observations (n):	22		
Energy production				
	Reactor ID:	MBR	UASB	
	mmol $CH_4.HRT^{-1}$ (or mmol.$L_{wastewater}^{-1}$)	1.27	0.88	Reactor volume of 1 L
	mmol $CH_4.m^3_{wastewater}{}^{-1}$	1273.28	880.92	
	mol $CH_4.m^3_{wastewater}{}^{-1}$	1.27	0.88	
	m^3CH_4/m^3 WW	0.03	0.02	Normalized at STP
	$KWh.m^{-3}$	0.31	0.21	1.0 m^3 CH_4:10.0 kWh
	Actual $KW.m^{-3}$	0.189	0.131	61.8% CHP efficiency (*Li et al.,2011*)
Energy use				Reference
	Minimum membrane operation ($kWh.m^{-3}$)	0.30	0.00	*Judd, 2010*
	Pumping wastewater ($kWh.m^{-3}$)	0.02	0.02	*Bodik and Kubaska, 2013*
	Mixing via pumping ($kWh.m^{-3}$)	0.02	0.02	*Bodik and Kubaska, 2013*
	Fouling mitigation via effluent pumping ($kWh.m^{-3}$)	0.02	0.00	*Bodik and Kubaska, 2013*
	Dissolved CH_4 strip ($kWh.m^{-3}$)	0.05	0.05	*McCarty et al., 2011*
	Total energy demand ($kWh.m^{-3}$)	0.410	0.090	
Net energy				
	Energy net ($kWh.m^{-3}$)	-0.2211	0.0407	

* Standard error for the gas production at normal operation regime (SO_4 reduction in) of 0.108 and 0.09 mmol $CH_4.HRT^{-1}$ for AnMBR and UASB respectively

** In the absence of SO_4 the methane rate was 2.17±0.38 and 1.38±0.12 mmol $CH_4.HRT^{-1}$ corresponding to -0.1756±0.041 and 0.059±0.013 $kW.m^{-3}$ for the AnMBR and the UASB respectively

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Observation S1.

We are convinced that the accumulated solids on day 375 do not comprise cellular material as the potential concentration cells would have been considerably lower (e.g. methanogenic mass based on the $qPCR_{mcrA}$ equal to 0.017±0.003 and 0.006±0.002 $gVSS.L^{-1}$ (AnMBR and UASB respectively - assuming that one cells weighs 10^{-12}gVS (Rittman and McCarty, 2001)).

Rittman, B.E., McCarty, P.L., 2001, Environmental Biotechnology; McGraw-Hill, Singapore, 2001.