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Title A Framework Based on Finite Element Method (FEM) for Modelling and Assessing the Affection of the Local Thermal Weather Factors on the Performance of Anaerobic Lagoons for the Natural Treatment of Swine Wastewater

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Table S1 Biochemical rate coefficients (v_{ij}) and kinetic rate equations (ρ_j) for soluble components (i=1-12; j=1-19). The matrix comes from the ADM1 Bastone et al. [2]

Component→	i	1	2	3	4	5	6	7	8	9	10	11	12	Rate (ρ_j kgCOD m^{-3} d^{-1})
j	Process↓	S_{su}	S_{aa}	S_{fa}	S_{va}	S_{bu}	S_{pro}	S_{ac}	S_{h2}	S_{ch4}	S_{IC}	S_{IN}	S_I	
1	Disintegration												$f_{sl,xc}$	$k_{dis}X_c$
2	Hydrolysis of carbohydrates	1												$k_{hyd,ch}X_{ch}$
3	Hydrolysis of proteins		1											$k_{hyd,pr}X_{pr}$
4	Hydrolysis of lipids	1 - $f_{fa,li}$		$f_{fa,li}$										$k_{hyd,li}X_{li}$
5	Uptake of sugar	-1				$(1-Y_{su})f_{bu,su}$	$(1-Y_{su})f_{pro,su}$	$(1-Y_{su})f_{ac,su}$	$(1-Y_{su})f_{h2,su}$		$-\sum_{i=1-9,11-29} C_i v_{i,5}$	-$(Y_{su})N_{bac}$		$k_{m,su}\frac{S_{su}}{K_s+S_{su}}X_{su}I_1$
6	Uptake of amino acids		-1		$(1-Y_{aa})f_{va,aa}$	$(1-Y_{aa})f_{bu,aa}$	$(1-Y_{aa})f_{pro,aa}$	$(1-Y_{aa})f_{ac,aa}$	$(1-Y_{aa})f_{h2,aa}$		$-\sum_{i=1-9,11-29} C_i v_{i,6}$	N_{aa}-$(Y_{aa})N_{bac}$		$k_{m,aa}\frac{S_{aa}}{K_s+S_{aa}}X_{aa}I_1$
7	Uptake of LCFA			-1				$(1-Y_{fa})0.7$	$(1-Y_{fa})0.3$			-$(Y_{fa})N_{bac}$		$k_{m,fa}\frac{S_{fa}}{K_s+S_{fa}}X_{fa}I_2$
8	Uptake of valerate				-1		$(1-Y_{c4})0.54$	$(1-Y_{c4})0.31$	$(1-Y_{c4})0.15$			-$(Y_{c4})N_{bac}$		$k_{m,c4}\frac{S_{va}}{K_s+S_{va}}X_{c4}\frac{1}{1+S_{bu}/S_{va}}I$
9	Uptake of butyrate					-1		$(1-Y_{c4})0.8$	$(1-Y_{c4})0.2$			-$(Y_{c4})N_{bac}$		$k_{m,c4}\frac{S_{bu}}{K_s+S_{bu}}X_{c4}\frac{1}{1+S_{va}/S_{ba}}I$
10	Uptake of propionate						-1	$(1-Y_{pro})0.57$	$(1-Y_{pro})0.43$		$-\sum_{i=1-9,11-29} C_i v_{i,10}$	-$(Y_{pro})N_{bac}$		$k_{m,pr}\frac{S_{pro}}{K_s+S_{pro}}X_{pro}I_2$
11	Uptake of acetate							-1		$(1-Y_{ac})$	$-\sum_{i=1-9,11-29} C_i v_{i,11}$	-$(Y_{ac})N_{bac}$		$k_{m,ac}\frac{S_{ac}}{K_s+S_{ac}}X_{ac}I_3$
12	Uptake of hydrogen								-1	$(1-Y_{h2})$	$-\sum_{i=1-9,11-29} C_i v_{i,12}$	-$(Y_{h2})N_{bac}$		$k_{m,h2}\frac{S_{h2}}{K_s+S_{h2}}X_{h2}I_1$
13	Decay of X_{su}													$k_{dec,Xsu}X_{su}$
14	Decay of X_{aa}													$k_{dec,Xaa}X_{aa}$
15	Decay of X_{fa}													$k_{dec,Xfa}X_{fa}$
16	Decay of X_{c4}													$k_{dec,Xc4}X_{c4}$
17	Decay of X_{pro}													$k_{dec,Xpro}X_{pro}$
18	Decay of X_{ac}													$k_{dec,Xac}X_{ac}$
19	Decay of X_{h2}													$k_{dec,Xh2}X_{h2}$
		Monosaccharides (kgCOD·m^{-3})	Amino acids (kgCOD·m^{-3})	Long chain fatty acids (kgCOD·m^{-3})	Total valarate (kgCOD·m^{-3})	Total butyrate (kgCOD·m^{-3})	Total propionate (kgCOD·m^{-3})	Total acetate (kgCOD·m^{-3})	Hydrogen gas (kgCOD·m^{-3})	Methane gas (kgCOD·m^{-3})	Inorganic carbon (kmoleC·m^{-3})	Inorganic nitrogen (kmoleN·m^{-3})	Soluble inerts (kgCOD·m^{-3})	Inhibition factors: $I_1 = I_{pH}I_{IN,lim}$ $I_1 = I_{pH}I_{IN,lim}I_{h2}$ $I_1 = I_{pH}I_{IN,lim}I_{NH3,Xac}$

Table S2 Biochemical rate coefficients (v_{ij}) and kinetic rate equations (ρ_j) for particulate components (i=13-24; j=1-19). The matrix comes from the ADM1 Bastone et al. [2]

Component→	i	13	14	15	16	17	18	19	20	21	22	23	24	36	37	38	39	Rate (ρ_j kgCOD m^{-3} d^{-1})
j	Process↓	X_c	X_{ch}	X_{pr}	X_{li}	X_{su}	X_{aa}	X_{fa}	X_{c4}	X_{pro}	X_{ac}	X_{h2}	X_I	S_{lac}	$X_{lac,f}$	$X_{lac,o}$	S_{ca}	
1	Disintegration	-1	$f_{ch,xc}$	$f_{pr,xc}$	$f_{li,xc}$								$f_{xI,xc}$					$k_{dis} X_c$
2	Hydrolysis of carbohydrates		-1															$k_{hyd,ch} X_{ch}$
3	Hydrolysis of proteins			-1														$k_{hyd,pr} X_{pr}$
4	Hydrolysis of lipids				-1													$k_{hyd,li} X_{li}$
5	Uptake of sugar					Y_{su}												$k_{m,su} \frac{S_{su}}{K_s + S_{su}} X_{su} I_1$
6	Uptake of amino acids						Y_{aa}											$k_{m,aa} \frac{S_{aa}}{K_s + S_{aa}} X_{aa} I_1$
7	Uptake of LCFA							Y_{fa}										$k_{m,fa} \frac{S_{fa}}{K_s + S_{fa}} X_{fa} I_2$
8	Uptake of valerate								Y_{c4}									$k_{m,c4} \frac{S_{va}}{K_s + S_{va}} X_{c4} \frac{1}{1 + S_{bu}/S_{va}} I$
9	Uptake of butyrate								Y_{c4}									$k_{m,c4} \frac{S_{bu}}{K_s + S_{bu}} X_{c4} \frac{1}{1 + S_{va}/S_{ba}} I$
10	Uptake of propionate									Y_{pro}								$k_{m,pr} \frac{S_{pro}}{K_s + S_{pro}} X_{pro} I_2$
11	Uptake of acetate										Y_{ac}							$k_{m,ac} \frac{S_{ac}}{K_s + S_{ac}} X_{ac} I_3$
12	Uptake of hydrogen											Y_{h2}						$k_{m,h2} \frac{S_{h2}}{K_s + S_{h2}} X_{h2} I_1$
13	Decay of X_{su}	1				-1												$k_{dec,Xsu} X_{su}$
14	Decay of X_{aa}	1					-1											$k_{dec,Xaa} X_{aa}$
15	Decay of X_{fa}	1						-1										$k_{dec,Xfa} X_{fa}$
16	Decay of X_{c4}	1							-1									$k_{dec,Xc4} X_{c4}$
17	Decay of X_{pro}	1								-1								$k_{dec,Xpro} X_{pro}$
18	Decay of X_{ac}	1									-1							$k_{dec,Xac} X_{ac}$
19	Decay of X_{h2}	1										-1						$k_{dec,Xh2} X_{h2}$
		Composites (kgCOD m^{-3})	Carbohydrates (kgCOD m^{-3})	Proteins (kgCOD m^{-3})	Lipids (kgCOD m^{-3})	Sugar degraders (kgCOD m^{-3})	Amino acid degraders (kgCOD m^{-3})	LCFA degraders (kgCOD m^{-3})	Valerate and butyrate degraders (kgCOD m^{-3})	Propionate degraders (kgCOD m^{-3})	Acetate degraders (kgCOD m^{-3})	Hydrogen degraders (kgCOD m^{-3})	Particulate inerts (kgCOD m^{-3})	Total lactate (kgCOD m^{-3})	Lactate (fermentation) degraders (kgCOD m^{-3})	Lactate (oxidation) degraders (kgCOD m^{-3})	Total calcium (kmole m^{-3})	Inhibition factors: $I_1 = I_{pH} I_{IN,lim}$ $I_1 = I_{pH} I_{IN,lim} I_{h2}$ $I_1 = I_{pH} I_{IN,lim} I_{NH3,Xac}$

Table S3. Dynamic state variables included in the stoichiometry matrix (Tables A1 and A2).

Name	Description	Name	Description
X_c	composite	S_{bu}	total butyrate
X_{ch}	carbohydrates	S_{pro}	total propionate
X_{pr}	proteins	S_{ac}	total acetate
X_u	lipids	S_{h2}	hydrogen
X_1	particulate ínerts	S_{ch4}	methane
S_1	soluble inerts	S_{ic}	inorganíc carbon
S_{su}	monosacharides	S_{IN}	inorganic nitrogen
S_{aa}	amino acids	X_{su-h2}	biomass
S_{ta}	total LCFA	S_{cat}	cations
S_{va}	total valerate	S_{an}	anions