Supplementary information

Table S1 Influent characteristics and operational conditions in 2007

parameters	unit	range	mean	parameters	unit	range	mean
COD[a)]	$g \cdot m^{-3}$	158–771	368	T	℃	12–26	20
BOD_5[b)]	$g \cdot m^{-3}$	79–390	182	pH	–	6.8–8.3	7.7
SS[c)]	$g \cdot m^{-3}$	60–650	188	MLSS[f)]	$kg \cdot m^{-3}$	3.9–8.9	5.9
TN[d)]	$g \cdot m^{-3}$	24–90	61	MLVSS[g)]	$kg \cdot m^{-3}$	1.0–5.2	3.4
TP[e)]	$g \cdot m^{-3}$	2.4–9.0	5.8	SRT[h)]	d	9–37	23
PO_4^{3-}-P	$g \cdot m^{-3}$	1.3–9.6	4.4	HRT_{OD}[i)]	h	6.0–9.0	7.5

Note: a) COD, chemical oxygen demand; b) BOD_5, 5 day biochemical oxygen demand; c) SS, suspended solid; d) TN, total nitrogen; e) TP, total phosphorus; f) MLSS, mixed liquor suspended solids; g) MLVSS, mixed liquor volatile suspended solids; h) SRT, solid retention time; i) HRT_{OD}, hydraulic retention time of the closed-loop bioreactor

Table S2 Average sensitivity of model parameters for ammonium, nitrate and phosphate

parameter	anaerobic	anoxic	aerobic		
	PO_4-P	PO_4-P	NH_4-N	NO_3-N	PO_4-P
DO	–	–0.051	–21.500	10.000	1.430
$K_{A,HET}$	–0.004	–0.161	0.273	0.269	–0.154
$K_{A,PAO}$	–2.270	0.253	–0.127	–0.299	0.351
K_{MAX}	0.923	–1.350	2.640	–0.720	–1.270
$K_{NH_4,AUT}$	–	–	3.580	–0.957	–0.122
$K_{NO_3,HET}$	–0.364	–0.309	1.030	0.321	–0.188
$K_{O_2,AUT}$	–	–	25.900	–5.040	–0.201
$K_{O_2,HET}$	5.830	–0.326	–0.552	–2.580	–0.647
η_{fe}	7.110	–0.151	1.180	–0.098	–0.408
$\eta_{NO_3,HET}$	5.890	0.140	–1.690	–3.120	–0.279
$\eta_{NO_3,PAO}$	3.270	–0.649	1.620	–1.730	–0.418
q_{PHA}	8.710	–0.391	0.834	0.733	–0.631
q_{PP}	5.620	–0.504	15.300	–3.250	–0.330
μ_{AUT}	–	–	–49.500	10.300	0.518
μ_{HET}	–0.538	0.547	–0.964	–0.411	0.503
μ_{PAO}	–3.950	–0.015	–12.400	2.180	0.118
Y_{PO_4}	15.400	1.530	–12.100	2.440	0.471

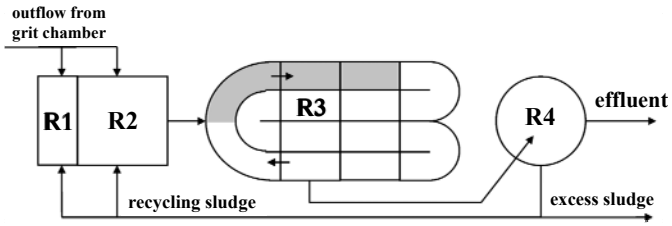


Fig. S1 Scheme of the activated sludge unit of the OD system layout. R1: selector, R2: anaerobic tank, R3: closed-loop bioreactor, R4: sedimentation tank. The vertical lines in R3 represent the location of 12 brush aerators. The shaded area is the non-aerated (anoxic) zone

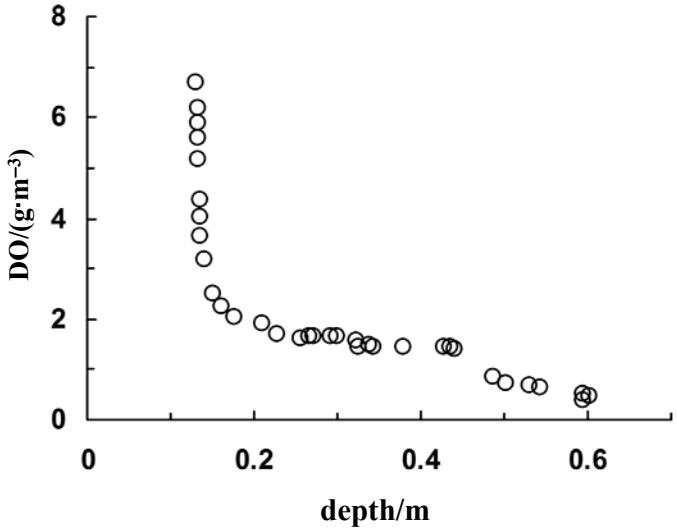
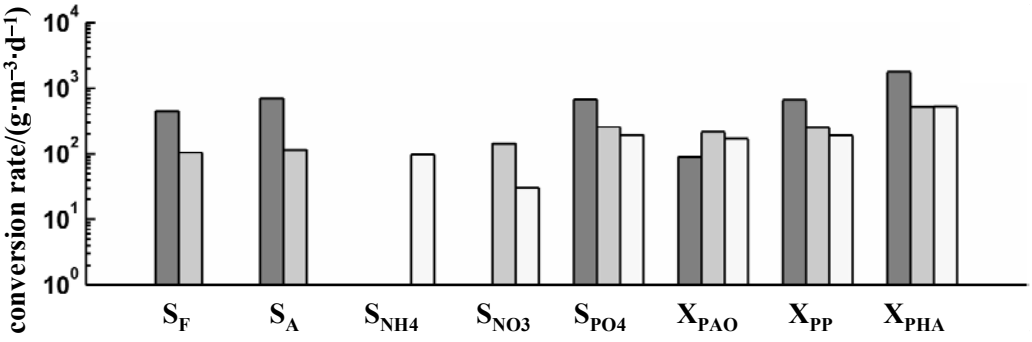
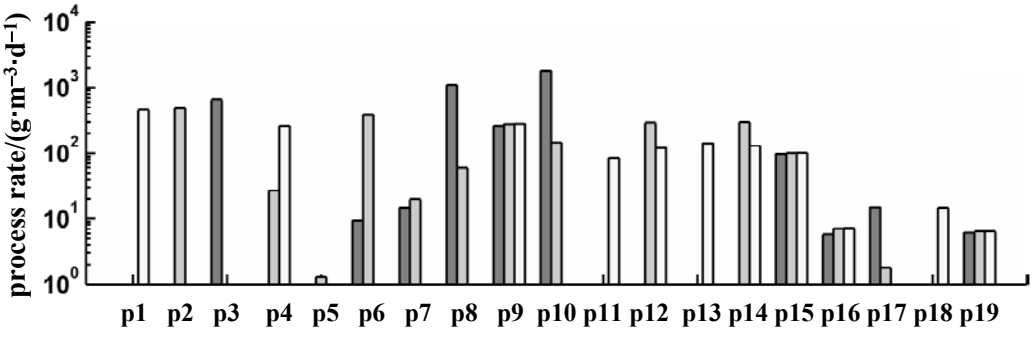


Fig. S2 Vertical distribution of DO in the aerated zone of the reactor

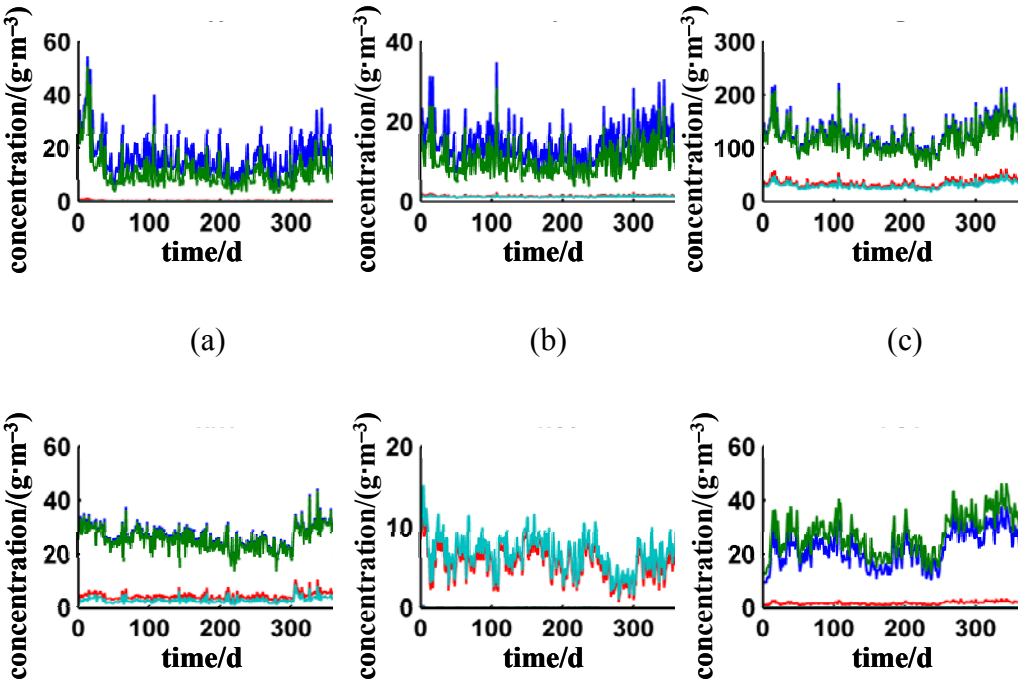


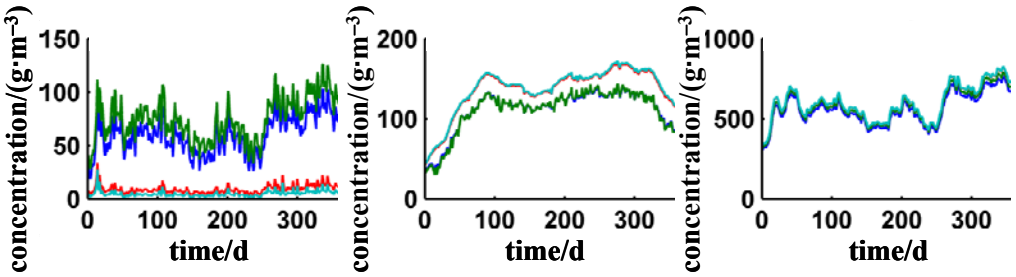
(a)



(b)

Fig. S3 Calculated (a) conversion rates of model components and (b) process rates with the calibrated model in the anaerobic (dark bars), anoxic (gray bars) and aerated (white bars) compartment. p1: aerobic hydrolysis, p2: anoxic hydrolysis, p3: anaerobic hydrolysis, p4: heterotrophic growth on fermentable substrates, p5: heterotrophic growth on VFA, p6: denitrification with fermentable substrates, p7: denitrification with VFA, p8: fermentation, p9: lysis of heterotrophic organisms, p10: storage of PHA, p11: aerobic storage of Poly-P, p12: anoxic storage of Poly-P, p13: aerobic growth of PAO, p14: anoxic growth of PAO, p15: lysis of PAO, p16: lysis of Poly-P, p17: lysis of PHA, p18: aerobic growth of autotrophic organisms, p19: lysis of autotrophic organisms





(g) (h) (i)

Fig. S4 Simulation results of model components in the compartment selector (blue lines), anaerobic (green lines), anoxic (red lines) and aerated (cyan lines) corresponding to the parameter values at the maximum of the posterior distribution resulted from Bayesian inference. (a) S_A; (b) S_F; (c) X_S; (d) S_{NH_4}; (e) S_{NO_3}; (f) S_{PO_4}; (g) X_{PHA}; (h) X_{PP}; (i) X_{PAO}