SYMBOLS AND ABBREVIATIONS

1 Symbols — INTRODUCTION

N/A

1 Abbreviations — INTRODUCTION

AMX	Anammox organisms
AOO	Ammonium oxidizing organisms
CH_4	Methane
DNA	Deoxyribonucleic acid
DPAO	Denitrifying phosphorus- or polyphosphate-accumulating organisms
FISH	Fluorescence *in situ* hybridization
GAO	Glycogen-accumulating organisms
GHG	Greenhouse gas emissions
N_2O	Nitrous oxide
NO_2^-	Nitrite
NO_3^-	Nitrate
NOO	Nitrite oxidizing organisms
PAO	Phosphorus- or polyphosphate-accumulating organism
PCR	Polymerase chain reaction
RBCOD	Readily biodegradable COD also known as readily biodegradable organics
SBCOD	Slowly biodegradable COD also known as slowly biodegradable organics
SRB	Sulphate reducing bacteria or SRO - Sulphate reducing organisms

2 Symbols — ACTIVATED SLUDGE ACTIVITY TESTS

Ac	Concentrations of acetate and acetic acid, mg Ac L^{-1}
Ac_{cons}	Ac concentration consumed in a batch activity test, C-mol L^{-1} or mg C L^{-1}
Ac_{final}	Final concentration of Ac in the bulk liquid at the end of the batch activity test, C-mol L^{-1} or mg C L^{-1}
Ac_{ini}	Initial concentration of Ac in the bulk liquid at the start of the batch activity test, C-mol L^{-1} or mg C L^{-1}
b_{AOO}	Decay or endogenous respiration rate of ammonia oxidizing organisms, d^{-1}
b_{NOO}	Decay or endogenous respiration rate of ammonia oxidizing organisms, d^{-1}
BOD	Biochemical oxygen demand, mg O_2 L^{-1}
BOD_5	Biochemical oxygen demand after 5 d, mg O_2 L^{-1}
C	COD content of an organic compound or substrate, g COD mol^{-1} organic substrate or g COD g^{-1} organic substrate
C_i	Concentration of a compound or element in the gas phase or headspace of a reactor or system, ppmv
C_{CH4}	Concentration of methane in the gas phase, ppmv
C_{CO2}	Concentration of carbon dioxide in the gas phase, ppmv
C_{H2S}	Concentration of sulphide in the gas phase, ppmv
C_{N2}	Concentration of nitrogen in the gas phase, ppmv
C_{O2}	Concentration of oxygen in the gas phase, ppmv
CO_2	Carbon dioxide

COD	Chemical oxygen demand, mg COD L^{-1}
$COD_{B,cons}$	Concentration of biodegradable substrate consumed expressed as COD, mg COD L^{-1}
$COD_{Bio,prod}$	Concentration of biomass produced expressed as COD, mg COD L^{-1}
$COD_{GLY,cons}$	Concentration of glycogen consumed expressed as COD, mg COD L^{-1}
$COD_{GLY,cons}$	Concentration of glycogen consumed expressed as COD in a batch test, mg COD L^{-1}
$COD_{GLY,prod}$	Concentration of glycogen produced expressed as COD in a batch test, mg COD L^{-1}
COD_{input}	Total COD concentration that gets into a system or reactor, mg COD L^{-1}
$COD_{organics}$	COD concentration of organic compounds, mg COD L^{-1}
$COD_{organics,in}$	COD concentration of organic compounds in the inlet or influent of a reactor or system, mg COD L^{-1}
$COD_{organics,out}$	COD concentration of organic compounds flowing out of a reactor or system, mg COD L^{-1}
COD_{output}	Total COD concentration that exits a reactor or system, mg COD L^{-1}
$COD_{PHA,cons}$	Concentration of PHA consumed expressed as COD, mg COD L^{-1}
$COD_{PHA,prod}$	Concentration of PHA produced expressed as COD, mg COD L^{-1}
$COD_{sulphide}$	Concentration of sulphide expressed as COD, mg COD L^{-1}
COD_{total}	Total COD concentration, mg COD L^{-1}
DP_{SB}	Denitrification potential of the RBCOD in wastewater, mg N L^{-1}
DP_{XCB}	Denitrification potential of the SBCOD in wastewater, mg N L^{-1}
E_a	Activation energy of a bioprocess, kJ mol^{-1} K^{-1}
$E_{a,S}$	Activation energy of a bioprocess when consuming a generic substrate S, kJ mol^{-1} K^{-1}
f_{CV}	Chemical oxygen demand to volatile suspended solids ratio of an organic compound, mg COD mg VSS^{-1}
F	Flux of a gas or a compound, Mass Time $^{-1}$
F_{in}	Flux of a gas or a compound that enters into a reactor or system, mol h^{-1} or mg h^{-1}
F_{out}	Flux of a gas or a compound that flows out or leaves a reactor or system, mol h^{-1} or mg h^{-1}
F_{AMX,NHx_N2}	Maximum N_2 production flux rate in an anammox test, mmol N_2 min^{-1}
F_{N_NHx}	Ammonification flux rate, mg N min^{-1}
F_{NHx}	Ammonium oxidation flux rate, mg N min^{-1}
$F_{NHx,H2O2}$	Ammonium oxidation flux rate determined based on the H_2O_2 titration flux rate, mg N min^{-1}
$F_{NHx,NaOH}$	Ammonium oxidation flux rate determined based on the NaOH titration flux rate, mg N min^{-1}
F_{NO2}	Nitrite oxidation flux rate in a titrimetric nitrification test, mg N min^{-1}
H^+	Proton
H_2O	Water
H_2S	Sulphide
H_2S_{in}	Concentration of sulphide that enters into a reactor or system, mg S L^{-1} or mg COD L^{-1}
H_2S_{out}	Concentration of sulphide that leaves a reactor or system, mg S L^{-1} or mg COD L^{-1}
HA	Organic acid
HRT	Hydraulic retention time, d
HS^{-1}	Dissociated sulphide
$i_{N,ANO}$	Nitrogen content of autotrophic nitrifying organisms, g N g VSS^{-1} or g N g COD^{-1}
$i_{N,Bio}$	Nitrogen content of a biomass or bacterial culture, g N g VSS^{-1} or g N g COD^{-1}
$i_{N,OHO}$	Nitrogen content in ordinary heterotrophic organisms, g N g VSS^{-1} or g N g COD^{-1}
k	Sulphate-reduction rate, nmol cm^{-3} d^{-1}
ln	Natural logarithm
m	Maximum specific maintenance or endogenous rate, Mass Active Biomass $^{-1}$ Time $^{-1}$
$m_{ATP,An}$	Anaerobic ATP maintenance coefficient, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active $biomass^{-1}$ h^{-1}
$m_{ATP,Ax}$	Anoxic ATP maintenance coefficient, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active $biomass^{-1}$ h^{-1}
$m_{ATP,Ox}$	Aerobic ATP maintenance coefficient, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active $biomass^{-1}$ h^{-1}
m_{Ax}	Anoxic maintenance rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
m_{Ox}	Aerobic maintenance rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
m_{O2}	Aerobic endogenous respiration rate of a culture, mol O_2 C-mol^{-1} h^{-1} or mg O_2 mg active $biomass^{-1}$ h^{-1}
m_{NOx}	Anoxic endogenous respiration rate on NO_X of a biomass, N-mol C-mol^{-1} h^{-1} or mg NO_X mg VSS^{-1} h^{-1}
m_{NO3}	Anoxic endogenous respiration rate on NO_3 of a biomass, N-mol C-mol^{-1} h^{-1} or mg NO_3 mg VSS^{-1} h^{-1}
m_{NOx_N2}	Biomass specific endogenous denitrification rate, mg N g VSS^{-1} h^{-1}
$m_{GAO,Ax}$	Anoxic maintenance rate of GAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$m_{GAO,Ox}$	Aerobic maintenance rate of GAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$m_{GAO,NO3}$	Anoxic endogenous respiration rate of GAO on NO_3, N-mol C-mol^{-1} h^{-1} or mg NO_3 mg active $biomass^{-1}$ h^{-1}
$m_{GAO,NOx}$	Anoxic endogenous respiration rate of GAO on NO_X, N-mol C-mol^{-1} h^{-1} or mg NO_X mg active $biomass^{-1}$ h^{-1}

$m_{GAO,O2}$	Aerobic endogenous respiration rate of GAO, mol O_2 C-mol^{-1} h^{-1} or mg O_2 mg active biomass^{-1} h^{-1}
$m_{GAO,ATP,Ax}$	Anoxic ATP maintenance coefficient of GAO, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active biomass^{-1} h^{-1}
$m_{GAO,ATP,An}$	Anaerobic ATP maintenance coefficient of GAO, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active biomass^{-1}h^{-1}
$m_{GAO,ATP,Ox}$	Aerobic ATP maintenance coefficient of GAO, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active biomass^{-1} h^{-1}
$m_{PAO,Ax}$	Anoxic maintenance rate of PAO, C-mol Stor C-mol^{-1} h^{-1} or mg Stor mg active biomass^{-1} h^{-1}
$m_{PAO,Ox}$	Aerobic maintenance rate of PAO, C-mol C-mol^{-1} h^{-1} or mg C mg active biomass^{-1} h^{-1}
$m_{PAO,NO3}$	Anoxic endogenous respiration rate of PAO on NO_3, N-mol C-mol^{-1} h^{-1} or mg NO_3 mg active biomass^{-1} h^{-1}
$m_{PAO,NOx}$	Anoxic endogenous respiration rate of PAO on NO_X, N-mol C-mol^{-1} h^{-1} or mg NO_X mg active biomass^{-1} h^{-1}
$m_{PAO,O2}$	Aerobic endogenous respiration rate of PAO, mol O_2 C-mol^{-1} h^{-1} or mg O_2 mg active biomass^{-1} h^{-1}
$m_{PAO,ATP,Ax}$	Anoxic ATP maintenance coefficient of PAO, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active biomass^{-1} h^{-1}
$m_{PAO,ATP,Ox}$	Aerobic ATP maintenance coefficient of PAO, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active biomass^{-1} h^{-1}
$m_{PAO,ATP,An}$	Anaerobic ATP maintenance coefficient of PAO, mol ATP C-mol^{-1} h^{-1} or mg ATP mg active biomass^{-1} h^{-1}
$m_{PAO,PP\_PO4,An}$	Anaerobic endogenous orthophoshate release rate of PAO, P-mol C-mol^{-1} h^{-1} or mg P mg active biomass^{-1} h^{-1}
$m_{PAO,PP\_PO4,Sec,An}$	Anaerobic secondary orthophoshate release rate of PAO, P-mol C-mol^{-1} h^{-1} or mg P mg active biomass^{-1} h^{-1}
$m_{PAO,PP\_PO4,T,An}$	Anaerobic orthophoshate endogenous release rate of PAO at a temperature T, P-mol C-mol^{-1} h^{-1} or mg P mg active biomass^{-1} h^{-1}
$m_{PP\_PO4,An}$	Anaerobic endogenous orthophoshate release rate of a biomass, P-mol C-mol^{-1} h^{-1} or mg P mg active biomass^{-1} h^{-1}
$m_{PP\_PO4,Sec,An}$	Anaerobic secondary orthophoshate release rate of a biomass, P-mol C-mol^{-1} h^{-1} or mg P mg active biomass^{-1} h^{-1}
$m_{PP\_PO4,T,An}$	Anaerobic orthophoshate endogenous release rate of a biomass at a temperature T, P-mol C-mol^{-1} h^{-1} or mg P mg active biomass^{-1} h^{-1}
m, n, p	pH-dependent factors in the computation of the nitrogen to proton ratio in titration tests
M_i	Mass of a component
M_{N2}	Mass of nitrogen gas generated by denitrification in a manometric tests, N-mol or mg N
M_{NO2_N2}	Mass of nitrite converted during an anammox batch test, N-mol or mg N
$M_{NOx,ini}$	Mass of nitrate and nitrite added at the beginning of a denitrification titrimetric test, N-mol or mg N
MW	Molecular weight, g mol^{-1}
n(t)	N_2 moles present in the volume of the headspace (VHS) at time t, mol N_2
N	Nitrogen
N_2	Nitrogen gas
N_2H_4	Hydrazine
Net $P_{released}$	Net concentration of orthophosphate released into the bulk liquid after excluding the anaerobic maintenance release, P-mol L^{-1} or mg P L^{-1}
N_{req}	Concentration of nitrogen required for biomass growth or synthesis, mg N mg VSS^{-1}
N_S	Nitrogen requirements for biomass growth or synthesis, mg N mg VSS^{-1}
N_T	Concentration of the titrant solution in a denitrification tests, meq mL^{-1}
O_2	Molecular oxygen
P	Pressure, Pa or torr
P(t)	Pressure measured in the headspace at time t, atm
P_{atm}	Atmospheric pressure, atm
P_{max}	Maximum pressure in a manometric test, atm
pK_a	Dissociation constant
pK_1	Dissociation constant for carbonic acid
pK_2	Dissociation constant for bicarbonate
pK_{NH4}	Dissociation constant for ammonium
PO_4-P	Orthophosphate
Pr	Concentration of propionate and propionic acid, C-mol L^{-1}, mg Pr L^{-1}, mg COD L^{-1}
$P_{released}$	Concentration of orthophosphate released into the bulk liquid, P-mol L^{-1} or mg P L^{-1}
P_{req}	Concentration of phosphorus required for biomass growth or synthesis, mg P mg VSS^{-1}
P_S	Phosphorus requirements for biomass growth or synthesis, P-mol C-mol or mg P mg VSS^{-1}
Q	Flowrate or generic titration flowrate, mL h^{-1} or mL h^{-1}
q	Maximum specific formation or degradation rate of a compound or component, Mass Biomass^{-1} Time^{-1} or Mass Active Biomass^{-1} Time^{-1}
$q_{Ac,An}$	Maximum specific anaerobic acetate uptake rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg Ac mg VSS^{-1} h^{-1}
$q_{Ac,T,An}$	Maximum specific anaerobic acetate uptake rate at a temperature T of a biomass, C-mol C-mol^{-1} h^{-1} or mg Ac mg active biomass^{-1} h^{-1}
$q_{AMX,NH4\_N2}$	Maximum biomass specific activity of anammox bacteria, g N-N_2 g VSS^{-1} d^{-1} or g N-NH_4^+ g VSS^{-1} d^{-1}

$q_{AMX,NH4\_NO3}$	Maximum biomass specific nitrate production rate in an anammox test, mg N g VSS^{-1} h^{-1}
$q_{AMX,NO2\_N2}$	Maximum biomass specific nitrite removal rate in an anammox test, mg N g VSS^{-1} h^{-1}
$q_{AOO,NH4}$	Maximum biomass specific ammonium oxidation rate of AOO, g N g VSS^{-1} d^{-1} or in mg N g VSS^{-1} h^{-1}
$q_{Bio,Ax}$	Maximum specific anoxic biomass growth rate, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{Bio,Ox}$	Maximum specific aerobic biomass growth rate, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{Bio,Ox}$	Maximum specific aerobic biomass growth rate of a culture, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{GAO,Ac,An}$	Maximum specific anaerobic acetate uptake rate of GAO, C-mol C-mol^{-1} h^{-1} or mg Ac mg active $biomass^{-1}$ h^{-1}
$q_{GAO,Ac,T,An}$	Maximum specific anaerobic acetate uptake rate of GAO at a temperature T, C-mol C-mol^{-1} h^{-1} or mg Ac mg active $biomass^{-1}$ h^{-1}
$q_{GAO,NH4,Ox}$	Maximum specific aerobic ammonia consumption rate of GAO for biomass growth, N-mol C-mol^{-1} h^{-1} or mg N mg active $biomass^{-1}$ h^{-1}
$q_{GAO,Ox}$	Maximum specific aerobic GAO biomass growth rate, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{GAO,PHA,Ax}$	Maximum specific anoxic PHA degradation rate of GAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{GAO,PHA,Ox}$	Maximum specific aerobic PHA degradation rate of GAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{GAO,PHA\_Gly,Ax}$	Maximum specific anoxic glycogen formation rate of GAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{GAO,PHA\_Gly,Ox}$	Maximum specific aerobic glycogen formation rate of GAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{GAO,VFA,An}$	Maximum specific anaerobic volatile fatty acids uptake rate of GAO, C-mol C-mol^{-1} h^{-1} or mg VFA mg active $biomass^{-1}$ h^{-1}
q_{N_NHx}	Biomass specific ammonification rate, mg N g VSS^{-1} h^{-1}
$q_{NH4\_Bio,Ox}$	Maximum specific aerobic ammonia consumption rate for biomass growth of a biomass, N-mol C-mol^{-1} h^{-1} or mg N mg VSS^{-1} h^{-1}
$q_{NOO,NO2\_NO3}$	Maximum biomass specific nitrite oxidation rate by NOO, g N g VSS^{-1} d^{-1} or in mg N g VSS^{-1} h^{-1}
$q_{NOO,NO2\_NO3,T}$	Maximum biomass specific consumption rate of a generic substrate (S) evaluated at a certain operative temperature (T), g S g VSS^{-1} d^{-1}
q_{NOx_N2}	Maximum biomass specific denitrification rate, g N g VSS^{-1} d^{-1} or mg N g VSS^{-1} h^{-1}
$q_{NOx\_N2,SB}$	Maximum biomass specific denitrification rate on RBCOD, mg N g VSS^{-1} h^{-1}
$q_{NOx\_N2,XCB}$	Maximum biomass specific denitrification rate on SBCOD, mg N g VSS^{-1} h^{-1}
$q_{OHO,COD,Ox}$	Maximum specific aerobic organic matter removal rate expressed in COD by ordinary heterotrophic organisms, mg COD mg VSS^{-1} h^{-1}
$q_{OHO,NH4,Ox}$	Maximum specific aerobic ammonia consumption rate of OHO for biomass growth, N-mol C-mol^{-1} h^{-1} or mg N mg VSS^{-1} h^{-1}
$q_{PAO,Ac,An}$	Maximum specific anaerobic acetate uptake rate of PAO, C-mol C-mol^{-1} h^{-1} or mg Ac mg active $biomass^{-1}$ h^{-1}
$q_{PAO,Ac,T,An}$	Maximum specific anaerobic acetate uptake rate of PAO at a temperature T, C-mol C-mol^{-1} h^{-1} or mg Ac mg active $biomass^{-1}$ h^{-1}
$q_{PAO,Ax}$	Maximum specific anoxic PAO biomass growth rate, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{PAO,NH4,Ox}$	Maximum specific aerobic ammonia consumption rate of PAO for biomass growth, N-mol C-mol^{-1} h^{-1} or mg N mg active $biomass^{-1}$ h^{-1}
$q_{PAO,Ox}$	Maximum specific aerobic PAO biomass growth rate, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{PAO,PHA,Ax}$	Maximum specific anoxic PHA degradation rate of PAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{PAO,PHA,Ox}$	Maximum specific aerobic PHA degradation rate of PAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{PAO,PHA\_Gly,Ax}$	Maximum specific anoxic glycogen formation rate of PAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{PAO,PHA\_Gly,Ox}$	Maximum specific aerobic glycogen formation rate of PAO, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{PAO,PO4\_PP,Ax}$	Maximum specific anoxic poly-P formation rate of PAO, P-mol C-mol^{-1} h^{-1} or mg P mg active $biomass^{-1}$ h^{-1}
$q_{PAO,PO4\_PP,Ox}$	Maximum specific aerobic orthophosphate uptake or poly-P formation rate of PAO, P-mol C-mol^{-1} h^{-1} or mg P mg active $biomass^{-1}$ h^{-1}
$q_{PAO,PP\_PO4,An}$	Maximum specific anaerobic orthophosphate release rate of PAO, P-mol C-mol^{-1} h^{-1} or mg P mg active $biomass^{-1}$ h^{-1}
$q_{PAO,Pr,An}$	Maximum specific anaerobic propionate uptake rate of PAO, C-mol C-mol^{-1} h^{-1} or mg Pr mg active $biomass^{-1}$ h^{-1}
$q_{PAO,VFA,An}$	Maximum specific anaerobic volatile fatty acids uptake rate of PAO, C-mol C-mol^{-1} h^{-1} or mg VFA mg active $biomass^{-1}$ h^{-1}
$q_{PHA,Ax}$	Maximum specific anoxic PHA degradation rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg C mg VSS $^{-1}$ h^{-1}
$q_{PHA,Ox}$	Maximum specific aerobic PHA degradation rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg C mg active $biomass^{-1}$ h^{-1}
$q_{PHA\_Gly,Ax}$	Maximum specific anoxic glycogen formation rate of a culture, C-mol C-mol^{-1} h^{-1} or mg C mg VSS^{-1} h^{-1}
$q_{PHA\_Gly,Ox}$	Maximum specific aerobic glycogen formation rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg C mg VSS^{-1} h^{-1}
$q_{PO4\_PP,Ax}$	Maximum specific anoxic poly-P formation rate of a biomass , P-mol C-mol^{-1} h^{-1} or mg P mg VSS^{-1} h^{-1}

$q_{PO4\_PP,Ox}$	Maximum specific aerobic orthophosphate uptake or poly-P formation rate of a biomass, P-mol C-mol^{-1} h^{-1} or mg P mg VSS^{-1} h^{-1}
$q_{PP\_PO4,An}$	Maximum specific anaerobic orthophosphate release rate of a biomass, P-mol C-mol^{-1} h^{-1} or mg P mg VSS^{-1} h^{-1}
$q_{Pr,An}$	Maximum specific anaerobic propionate uptake rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg Pr mg VSS^{-1} h^{-1}
$q_{SRB,SO4,An}$	Maximum specific anaerobic sulphate reduction rate by sulphate reducing organisms, S-mol C-mol^{-1} h^{-1} or mg S mg VSS^{-1} h^{-1}
$q_{SRB,VFA,An}$	Maximum specific anaerobic volatile fatty acids consumption rate by sulphate reducing organisms, C-mol C-mol^{-1} h^{-1} or mg VFA mg VSS^{-1} h^{-1}
$q_{VFA,An}$	Maximum specific anaerobic volatile fatty acids uptake rate, C-mol C-mol^{-1} h^{-1} or mg VFA mg active biomass^{-1} h^{-1}
$q_{VFA,An}$	Maximum specific anaerobic volatile fatty acids uptake rate of a biomass, C-mol C-mol^{-1} h^{-1} or mg VFA mg VSS^{-1} h^{-1}
$q_{VFA\_PHA,An}$	Maximum specific anaerobic PHA production rate, C-mol C-mol^{-1} h^{-1} or mg PHA mg active biomass^{-1} h^{-1}
Q_{in}	Influent flowrate that enters into a reactor or system, L d^{-1}, m^3 d^{-1}, mL min^{-1}
Q_{H2O2}	Titration flowrate of the oxygenated titrant, mL min^{-1}
$Q_{H2O2,final}$	Final background titration flowrate of the oxygenated titrant, mL min^{-1}
$Q_{H2O2,ini}$	Initial or background titration flowrate of the oxygenated titrant, mL min^{-1}
$Q_{H2O2,NH4}$	Titration flowrate of the oxygenated titrant during ammonium oxidation, mL min^{-1}
$Q_{H2O2,NO2}$	Titration flowrate of the oxygenated titrant during nitrite oxidation, mL min^{-1}
Q_{NaOH}	Titration rate of the NaOH titrant, mL min^{-1}
$Q_{NaOH,final}$	Final background titration rate of the NaOH titrant, mL min^{-1}
$Q_{NaOH,ini}$	Initial or background titration rate of the NaOH titrant, mL min^{-1}
$Q_{NaOH,NH4}$	Titration rate of the NaOH titrant during ammonium oxidation, mL min^{-1}
Q_{tit}	Acid titration flow rate during a denitrification test, mL min^{-1}
r	Maximum volumetric production or consumption rate of a compound or element, Mass Volume^{-1} Time^{-1}
$r_{Ac,An}$	Maximum volumetric anaerobic acetate uptake rate of a biomass, C-mol L^{-1} h^{-1} or mg Ac L^{-1} h^{-1}
$r_{AMX,NH4}$	Maximum volumetric ammonium consumption rate in an anammox test, mg N L^{-1} h^{-1}
$r_{AMX,NH4\_NO3}$	Maximum volumetric nitrate production rate in an anammox test, mg N L^{-1} h^{-1}
$r_{AMX,NO2}$	Maximum volumetric nitrite consumption rate in an anammox test, mg N L^{-1} h^{-1}
$r_{ANO,O2}$	Maximum volumetric oxygen uptake rate by autotrophic nitrifying organisms, mg O_2 L^{-1} h^{-1}
$r_{AOO,O2}$	Maximum volumetric oxygen uptake rate by ammonium oxidazing organisms, mg O_2 L^{-1} h^{-1}
$r_{B,Ox}$	Maximum volumetric aerobic organic matter removal rate expressed as COD of a biomass, mg COD L^{-1} h^{-1}
r_{COD}	Maximum volumetric COD consumption rate, mg COD L^{-1} min^{-1}
$r_{GAO,Ac,An}$	Maximum volumetric anaerobic acetate uptake rate of a GAO culture, C-mol L^{-1} h^{-1} or mg Ac L^{-1} h^{-1}
$r_{NH4\_Bio,Ox}$	Maximum volumetric aerobic ammonia consumption rate for biomass growth, N-mol L^{-1} h^{-1} or mg N L^{-1} h^{-1}
r_{NO3}	Maximum volumetric nitrate removal or uptake rate, mg N L^{-1} h^{-1}
r_{NO3_N2}	Maximum volumetric nitrate removal or uptake rate for denitrification to N_2, mg N L^{-1} h^{-1}
$r_{NOO,O2}$	Maximum volumetric oxygen uptake rate by nitrite oxidazing organisms, mg O_2 L^{-1} h^{-1}
$r_{NOx\_N2,endo}$	Maximum volumetric endogenous denitrification rate, mg N L^{-1} min^{-1}
$r_{NOx\_N2,exo}$	Maximum volumetric exogenous denitrification rate, mg N L^{-1} min^{-1}
$r_{NOx\_N2,SB}$	Maximum volumetric denitrification rate on readily biodegradable organics (RBCOD), mg N L^{-1} min^{-1}
$r_{NOx\_N2,XCB}$	Maximum volumetric denitrification rate on slowly biodegradable organics (SBCOD), mg N L^{-1} min^{-1}
$r_{O2,endo}$	Maximum volumetric endogenous oxygen uptake rate, mg O_2 L^{-1} min^{-1}
$r_{O2,exo}$	Maximum volumetric exogenous oxygen uptake rate, mg O_2 L^{-1} min^{-1}
$r_{OHO,COD,Ox}$	Maximum volumetric aerobic organic matter removal rate of ordinary heterotrophic organisms, mg COD L^{-1} h^{-1}
r_P	Pressure increase rate during a manometric test, atm min^{-1} or in atm h^{-1}
$r_{PAO,Ac,An}$	Maximum volumetric anaerobic acetate uptake rate of a PAO culture, C-mol L^{-1} h^{-1} or mg Ac mg L^{-1} h^{-1}
$r_{PO4\_PP,Ax}$	Maximum volumetric anoxic orthophosphate uptake (or poly-P formation) rate, P-mol L^{-1} h^{-1} or mg P L^{-1} h^{-1}
$r_{PO4\_PP,Ox}$	Maximum volumetric aerobic orthophosphate uptake (or poly-P formation) rate, P-mol L^{-1} h^{-1} or mg P L^{-1} h^{-1}
$r_{PP\_PO4,An}$	Maximum volumetric anaerobic orthophosphate release rate, P-mol L^{-1} h^{-1} or mg P L^{-1} h^{-1}
$r_{PP\_PO4,Sec,An}$	Anaerobic volumetric secondary orthophosphate release rate, C-mol L^{-1} h^{-1} or mg C L^{-1} h^{-1}
$r_{SO4,An}$	Maximum volumetric anaerobic sulphate reduction rate, S-mol L^{-1} h^{-1} or mg S L^{-1} h^{-1}
$r_{VFA,An}$	Maximum volumetric anaerobic volatile fatty acids uptake rate, C-mol L^{-1} h^{-1} or mg VFA L^{-1} h^{-1}
R	Ideal (or universal) gas constant, 8.314 J K^{-1} mol^{-1}
$RBCOD_{removed}$	Concentration of readily biodegradable organic matter removed in a batch activity test, C-mol L^{-1} or mg COD L^{-1}
S_i	Concentration of a component in a liquid or in the water phase, Mass Volume^{-1}

$S_{Ac,COD}$	Acetate concentration in COD units, mg COD L^{-1}
S_{ALK}	Alkalinity concentration, mmol L^{-1}
S_B	Concentration of readily biodegradable organics (as COD), mg COD L^{-1}
S_{CO2}	Concentration of carbon dioxide in the bulk liquid, C-mol L^{-1}
S_{H2O2}	Concentration of the H_2O_2 titrant, mmol O_2 mL^{-1}
S_{H2S}	Sulphide concentration in the liquid phase, mg S L^{-1} or mg COD L^{-1}
$S_{H2S,in}$	Concentration of sulphide in the inlet or that enters into a reactor or system, S-mol L^{-1} or mg S L^{-1}
$S_{H2S,out}$	Concentration of sulphide that flows out or leaves a reactor or system, S-mol L^{-1} or mg S L^{-1}
S_{IC}	Inorganic carbon, mol L^{-1}
S_{N2}	Dissolved nitrogen gas concentration, mg N L^{-1}
S_{NaOH}	Concentration of the NaOH titrant, meq mL^{-1}
S_{NH3}	Ammonia concentration, N-mol L^{-1} or mg N L^{-1}
S_{NH4}	Ammonium concentration, N-mol L^{-1} or mg N L^{-1}
S_{NHx}	Ammonium and ammonia concentration, N-mol L^{-1} or mg N L^{-1}
S_{NO2}	Nitrite concentration, N-mol L^{-1} or mg N L^{-1}
$S_{NO2,Ax}$	Nitrite concentration in a denitrification test, N-mol L^{-1} or mg N L^{-1}
$S_{NO2,ini}$	Initial nitrite concentration, N-mol L^{-1} or mg N L^{-1}
S_{NO3}	Nitrate concentration, N-mol L^{-1} or mg N L^{-1}
$S_{NO3,Ax}$	Nitrate concentration in a denitrification test, N-mol L^{-1} or mg N L^{-1}
$S_{NO3,Eq}$	Oxidized equivalents of nitrogen in a denitrification test, N-mol L^{-1} or mg N L^{-1}
$S_{NO3/SB,eq}$	Amount on nitrate equivalents that are consumed on RBCOD, N-mol L^{-1} or mg N L^{-1}
$S_{NO3/XCB,eq}$	Amount on nitrate equivalents that are consumed on SBCOD, N-mol L^{-1} or mg N L^{-1}
$S_{NO3\_N2,Ax}$	Concentration of nitrate converted into nitrogen gas by denitrification in a manometric test, N-mol L^{-1} or mg N L^{-1}
S_{NOx}	Nitrate or nitrite concentration, N-mol L^{-1} or mg N L^{-1}
S_{O2}	Dissolved oxygen (DO) concentration, mg O_2 L^{-1}
$S_{O2,in}$	Dissolved oxygen concentration in the influent, mgO_2 L^{-1}
$S_{O2,ini}$	Initial concentration of dissolved oxygen in the bulk liquid, mgO_2 L^{-1}
SO_4	Sulphate
$SO_{4,final}$	Final concentration of sulphate in the bulk liquid at the end of the batch activity test, S-mol L^{-1} or mg S L^{-1}
$SO_{4,ini}$	Initial concentration of sulphate in the bulk liquid at the beginning of the batch activity test, S-mol L^{-1} or mg S L^{-1}
$S_{SO4,in}$	Concentration of sulphate in the inlet or that enters into a reactor or system, S-mol L^{-1} or mg S L^{-1}
$S_{SO4,out}$	Concentration of sulphate that flows out or leaves a reactor or system, S-mol L^{-1} or mg S L^{-1}
$S_{PO4,final}$	Final orthophosphate concentration in the bulk liquid at the end of the batch activity test, P-mol L^{-1} or mg P L^{-1}
$S_{PO4,ini}$	Initial orthophosphate concentration in the bulk liquid at the start of the batch activity test, P-mol L^{-1} or mg P L^{-1}
SRT	Solids retention time, d
Stor	Intracellular storage compound, C-mol or P-mol, mg C or mg P
T	Temperature, ºC or K
T_C	Operative temperature in Celsius degrees, °C
T_K	Operative temperature in Kelvin degrees, K
T_{ref}	Reference absolute temperature, K
V	Volume of a system, reactor or closed system, L or mL
V_G	Gas volume, L
$V_G(t)$	Gas volume at time t, L
V_{H2O2}	Volume of the oxygenated titrant, mL
V_{HS}	Headspace volume in a manometric test, L or mL
V_L	Volume of liquid in a reactor or system, L or mL
V_{ML}	Volume of a mixed liquor sample, L
V_{NaOH}	Volume of NaOH titrant, mL
V_T	Total volume of acid titrant added during a denitrification test, mL
V_{tit}	Volume of acid titrant during a denitrification test, mL
V_{WW}	Volume of wastewater, L
x	Number of carbon moles per mole of organic substrate
X_{ANO}	Concentration of autotrophic nitrifying organisms, mg VSS L^{-1} or mg COD L^{-1}
X_{AOA}	Concentration of ammonia-oxidizing archaea, mg VSS L^{-1} or mg COD L^{-1}
X_{AOO}	Concentration of ammonia oxidizing organisms, mg VSS L^{-1} or mg COD L^{-1}
X_{AOO}	Concentration of ammonia oxidizing organisms, mg VSS L^{-1} or mg COD L^{-1}

X_{Bio}	Biomass concentration, mg VSS L^{-1} or mg COD L^{-1}
$X_{Bio,COD}$	Biomass concentration in COD units, mg COD L^{-1}
XC_B	Concentration of slowly biodegradable organics, mg COD L^{-1}
X_{final}	Final concentration of a particulate compound, mg L^{-1}
X_{ini}	Initial concentration of a particulate compound, mg L^{-1}
X_{NOO}	Concentration of nitrite oxidizing organisms, mg VSS L^{-1} or mg COD L^{-1}
X_{NOO}	Concentration of nitrite oxidizing organisms, mg VSS L^{-1} or mg COD L^{-1}
X_{OHO}	Concentration of ordinary heterotrophic organisms, mg VSS L^{-1} or mg COD L^{-1}
X_{TSS}	Mixed liquor suspended solids concentration, g SS L^{-1}
X_{VSS}	Mixed liquor volatile suspended solids concentration, g VSS L^{-1}
Y	Stoichiometric yield ratio, Mass $Mass^{-1}$
Y_A	Growth yield of autotrophic nitrifying organisms, g COD g N^{-1}
$Y_{Ac\_PH2MV,An}$	Anaerobic PH_2MV formation to acetate uptake ratio, C-mol C-mol^{-1} or mg C mg Ac^{-1}
$Y_{Ac\_PHA,An}$	Anaerobic PHA formation to acetate uptake ratio, C-mol C-mol^{-1} or mg C mg Ac^{-1}
$Y_{Ac\_PHB,An}$	Anaerobic PHB formation to acetate uptake ratio, C-mol C-mol^{-1} or mg C mg Ac^{-1}
$Y_{Ac\_PHV,An}$	Anaerobic PHV formation to acetate uptake ratio, C-mol C-mol^{-1} or mg C mg Ac^{-1}
$Y_{Ac\_PO4,An}$	Anaerobic orthophosphate released to acetate uptake ratio, P-mol C-mol^{-1} or mg P mg Ac^{-1}
$Y_{AMX,NH4}$	Growth yield of anammox bacteria on ammonium consumption, C-mol N-mol^{-1}
Y_{ANO}	Growth yield of autotrophic nitrifying organisms, g COD g N^{-1}
Y_{AOO}	Growth yield of ammonia oxidizing organisms, g COD g N^{-1}
$Y_{C\_PO4,An}$	Anaerobic orthophosphate released to carbon uptake ratio, P-mol C-mol^{-1} or mg P mg Ac^{-1}
Y_{CO2}	Yield of CO_2 per substrate consumed, C-mol C-mol^{-1}
Y_{Gly}	Aerobic glycogen formation to oxygen consumption ratio, C-mol mol O_2^{-1} or mg C mg O_2^{-1}
$Y_{Gly,GAO}$	Aerobic glycogen formation to oxygen consumption ratio of GAO, C-mol mol O_2^{-1} or mg C mg O_2^{-1}
$Y_{Gly,PAO}$	Aerobic glycogen formation to oxygen consumption ratio of PAO, C-mol mol O_2^{-1} or mg C mg O_2^{-1}
$Y_{Gly/Ac,An}$	Anaerobic glycogen utilization to acetate uptake ratio, C-mol C-mol^{-1} or mg C mg Ac^{-1}
$Y_{Gly/Pr,An}$	Anaerobic glycogen utilization to propionate uptake ratio, C-mol C-mol^{-1} or mg C mg Pr^{-1}
$Y_{Gly/VFA,An}$	Anaerobic glycogen utilization to volatile fatty acids uptake ratio, C-mol C-mol^{-1} or mg C mg VFA^{-1}
$Y_{NH4/O2\_NO2}$	Ratio between ammonium oxidation and oxygen consumption for ammonium oxidation to nitrite, g N g O_2^{-1}
$Y_{NH4/O2\_NO3}$	Ratio between ammonium oxidation and oxygen consumption for ammonium oxidation to nitrate, g N g O_2^{-1}
Y_{NH4_H+}	Ratio between ammonium oxidation and proton production, mol Protons g N^{-1}
$Y_{NH4\_NO3,AMX}$	Ratio between nitrate production and ammonium consumption in anammox metabolism, g N g N^{-1} or N-mol N-mol^{-1}
$Y_{NO2/NH4,AMX}$	Ratio between nitrite and ammonium consumption in anammox metabolism, g N g N^{-1} or N-mol N-mol^{-1}
$Y_{NO2/O2\_NO3}$	Ratio between nitrite oxidation and oxygen consumption for nitrite oxidation to nitrate, g N g O_2^{-1}
Y_{NO2_H+}	Ratio between nitrite consumption and proton removed, mol Protons g N^{-1}
$Y_{NO3\_Bio,Ax}$	Anoxic biomass growth to NO_3 consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
$Y_{NO3\_Gly,Ax}$	Anoxic glycogen formation to NO_3 consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
Y_{NO3_H+}	Ratio between nitrate consumption and proton removed, mol $Protons^{-1}$ g N
$Y_{NO3\_H+,Ax}$	Ratio between nitrate consumption and proton removed in denitrification, mol $Protons^{-1}$ g N
$Y_{NO3\_PAO,Ax}$	Anoxic PAO biomass growth to NO_3 consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
$Y_{NO3\_PHA,Ax}$	Anoxic PHA degradation to NO_3 consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
$Y_{NO3\_PP,Ax}$	Anoxic poly-P formation to NO_3 consumption ratio, P-mol N-mol^{-1} or mg P mg N^{-1}
Y_{NOO}	Growth yield of nitrite oxidizing organisms, g COD g N^{-1}
$Y_{NOx\_Bio,Ax}$	Anoxic biomass growth to NO_X consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
$Y_{NOx\_Gly,Ax}$	Anoxic glycogen formation to NO_X consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
$Y_{NOx\_PAO,Ax}$	Anoxic PAO biomass growth to NO_X consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
$Y_{NOx\_PHA,Ax}$	Anoxic PHA degradation to NO_X consumption ratio, C-mol N-mol^{-1} or mg C mg N^{-1}
$Y_{NOx\_PP,Ax}$	Anoxic poly-P formation to NO_X consumption ratio, P-mol N-mol^{-1} or mg P mg N^{-1}
Y_{OHO}	Growth yield of heterotrophic microorganisms under aerobic conditions, mg VSS COD^{-1} or g COD g COD^{-1}
$Y_{OHO,Ax}$	Growth yield of heterotrophic microorganisms under anoxic conditions, mg VSS COD^{-1} or g COD g COD^{-1}
Y_{PAO}	Aerobic PAO biomass growth to oxygen consumption ratio, C-mol mol O_2^{-1} or mg C mg O_2^{-1}
Y_{PHA}	Aerobic PHA degradation to oxygen consumption ratio, C-mol mol O_2^{-1} or mg C mg O_2^{-1}
$Y_{PHA,GAO}$	Aerobic PHA degradation to oxygen consumption ratio of GAO, C-mol mol O_2^{-1} or mg C mg O_2^{-1}
$Y_{PHA,PAO}$	Aerobic PHA degradation to oxygen consumption ratio of PAO, C-mol mol O_2^{-1} or mg C mg O_2^{-1}
$Y_{PHA\_Bio,Ax}$	Anoxic biomass growth to PHA consumption ratio, C-mol C-mol^{-1} or mg C^{-1}

$Y_{PHA\_Bio,Ox}$	Aerobic biomass growth to PHA consumption ratio, C-mol C-mol^{-1} or mg C mg C^{-1}
$Y_{PHA\_Gly,Ax}$	Anoxic glycogen formation to PHA consumption ratio, C-mol C-mol^{-1} or mg C mg C^{-1}
$Y_{PHA\_Gly,Ox}$	Aerobic glycogen formation to PHA consumption ratio, C-mol C-mol^{-1} or mg C mg C^{-1}
$Y_{PHA\_PAO,Ax}$	Anoxic PAO biomass growth to PHA consumption ratio, C-mol C-mol^{-1} or mg C^{-1}
$Y_{PHA\_PAO,Ox}$	Aerobic PAO biomass growth to PHA consumption ratio, C-mol C-mol^{-1} or mg C mg C^{-1}
$Y_{PHA\_PP,Ax}$	Anoxic poly-P formation to PHA consumption ratio, P-mol C-mol^{-1} or mg P mg C^{-1}
$Y_{PHA\_PP,Ox}$	Aerobic poly-P formation to PHA consumption ratio, P-mol C-mol^{-1} or mg P mg C^{-1}
$Y_{PHV/PHB,An}$	Anaerobic PHV formation to PHB formation ratio, C-mol C-mol^{-1} or mg C mg C^{-1}
$Y_{PO4\_PP,Ax}$	Anoxic poly-P formation to orthophoshate uptake ratio, P-mol P-mol^{-1} or mg P mg P^{-1}
$Y_{PO4\_PP,Ox}$	Aerobic poly-P formation to orthophoshate uptake ratio, P-mol P-mol^{-1} or mg P mg P^{-1}
Y_{PP}	Aerobic poly-P formation to oxygen consumption ratio, P-mol mol O_2^{-1} or mg P mg O_2^{-1}
$Y_{Pr\_PH2MV,An}$	Anaerobic PH_2MV formation to propionate uptake ratio, C-mol C-mol^{-1} or mg C mg Pr^{-1}
$Y_{Pr\_PHA,An}$	Anaerobic PHA formation to propionate uptake ratio, C-mol C-mol^{-1} or mg C mg Pr^{-1}
$Y_{Pr\_PHB,An}$	Anaerobic PHB formation to propionate uptake ratio, C-mol C-mol^{-1} or mg C mg Pr^{-1}
$Y_{Pr\_PHV,An}$	Anaerobic PHV formation to propionate uptake ratio, C-mol C-mol^{-1} or mg C mg Pr^{-1}
$Y_{Pr\_PO4,An}$	Anaerobic orthophosphate released to propionate uptake ratio, P-mol C-mol^{-1} or mg P mg Pr^{-1}
$Y_{SO4/VFA,An}$	Anaerobic sulphate reduction to VFA consumption ratio, S-mol C-mol^{-1} or mg S mg Ac^{-1}
$Y_{VFA\_H2S,An}$	Anaerobic reduction of sulphate to H_2S to volatile fatty acids consumption ratio, S-mol C-mol^{-1} or mg S mg VFA^{-1}
$Y_{VFA\_PH2MV,An}$	Anaerobic PH_2MV formation to volatile fatty acids uptake ratio, C-mol C-mol^{-1} or mg C mg VFA^{-1}
$Y_{VFA\_PHA,An}$	Anaerobic PHA formation to volatile fatty acids uptake ratio, C-mol C-mol^{-1} or mg C mg VFA^{-1}
$Y_{VFA\_PHB,An}$	Anaerobic PHB formation to volatile fatty acids uptake ratio, C-mol C-mol^{-1} or mg C mg VFA^{-1}
$Y_{VFA\_PHV,An}$	Anaerobic PHV formation to volatile fatty acids uptake ratio, C-mol C-mol^{-1} or mg C mg VFA^{-1}
$Y_{VFA\_PO4,An}$	Anaerobic orthophosphate released to volatile fatty acids uptake ratio, P-mol C-mol^{-1} or mg P mg VFA^{-1}
Y_{XBio}	Biomass growth yield, C-mol C-mol^{-1} or mg VSS g COD^{-1}
Net $P_{released}$	Net concentration of orthophosphate released into the bulk liquid only due to Ac uptake, mg P L^{-1}
α	Dimensionless distribution coefficient for H_2S liquid-gas phases equilibrium
β	Oxygen equivalent of oxydized nitrogen
δ-ratio	ATP produced per O_2 consumed under aerobic conditions, mol ATP mol O_2^{-1}
η	Oxygen equivalents of nitrate, mg O_2 mg N^{-1} or mg COD mg N^{-1}
μ	Specific growth rate of biomass, Mass Time^{-1} Volume^{-1}
μ_{OHO}	Maximum specific biomass growth rate of ordinary heterotrophic organisms under aerobic conditions, h^{-1} or d^{-1}
$\mu_{OHO,Ax}$	Maximum specific biomass growth rate of ordinary heterotrophic organisms under anoxic conditions, h^{-1} or d^{-1}
μ_{AOO}	Maximum specific biomass growth rate of ammonia oxidizing organisms, d^{-1}
μ_{NOO}	Maximum specific biomass growth rate of nitrite oxidizing organisms, d^{-1}
ρ	Density, g L^{-1} or g mL^{-1}
ΔCOD(%)	COD balance, %
ΔCOD_{cons}	Total concentration of COD consumed in a reactor or system, mg COD L^{-1}
$\Delta G°'$	Gibb's free energy, kJ mol^{-1}
$\Delta O_{2,cons}$	Total concentration of oxygen consumed, mg COD L^{-1}
$\Delta t_{SB,Ax}$	Duration of the anoxic denitrification phase that uses RBCOD as electron donor, min
$\Delta t_{XCB,Ax}$	Duration of the anoxic denitrification phase that uses SBCOD as electron donor, min

2 Abbreviations

ACTIVATED SLUDGE ACTIVITY TESTS

A/O	Anaerobic-oxic (aerobic) system
A^2	Anaerobic-anoxic system
A^2O	Anaerobic-anoxic-aerobic system
AB	Active biomass
AC	Acetogens or acetogenic bacteria
AMO	Ammonia monooxygenase
AMP	Adenosine monophosphate

ANAMMOX	Anaerobic ammonium oxidation
ANO	Autotrophic nitrifying organisms
ANS	Anaerobic Sludge
ANS	Anaerobic sludge system
AOA	Ammonium oxidizing archaea
AOO	Ammonia oxidizing organisms
APS	Adenosine phosphosulphate
ASM	Activated sludge model
ATP	Adenosin triphosphate
BIODENIPHO	Biological denitrification and phosphorus removal system
BNR	Biological nutrient removal
CAS	Conventional activated sludge
CSTR	Continuous stirred tank reactor
DGGE	Denaturing gradient gel electrophoresis
DPAO	Denitrifying phosphorus- or polyphosphate-accumulating organisms
EBPR	Enhanced biological phosphorus removal
FISH	Fluorescence *in situ* hybridization
FNA	Free nitrous acid
GAO	Glycogen-accumulating organisms
HAO	Hydroxylamine oxidoreductase
HDH	Hydrazine dehydrogenase
HPLC	High-performance liquid chromatography
HZS	Hydrazine synthase enzyme
MBR	Membrane bioreactor
MET	Methanogenic bacteria
MLSS	Mixed liquor suspended solids
MLVSS	Mixed liquor volatile suspended solids
Modified UCT	Modified University of Cape Town system
NADH	Nicotinamide adenine dinucleotide
NAR	Nitrate reductase
Nir	Nitrite oxidoreductase
NO	Nitrous oxide
NOO	Nitrite oxidizing organisms
NOR (or NXR)	Nitrite oxido reductase
NOS	Nitrous oxide reductase
OHO	Ordinary heterotrophic organisms
OUR	Oxygen uptake rate
PAO	Phosphorus- or polyphosphate-accumulating organisms
PH_2MV	Poly-β-hydroxy-2-methyl-valerate
PHA	Poly-β-hydroxy-alkanoates
PHB	Poly-β-hydroxy-butyrate
PHV	Poly-β-hydroxy-valerate
Phoredox	Phosphorus reduction oxidation system
PhoStrip	Phosphorus stripping system
PN	Partial nitritation process
PNA	Partial nitritation-anammox process
Poly-P	Polyphosphate
PPi	Pyrophosphate
RBC	Rotating biological contactor
RBCOD	Readily biodegradable organic matter measured as COD
rDNA	Ribosomal DNA
SAA	Specific anammox activity
SANI®	Sulphate-reduction, autotrophic denitrification and nitrification integrated process
SBCOD	Slowly biodegradable organic matter measured as COD
SBR	Sequencing batch reactor
SRB	Sulphate reducing bacteria

TOC	Total organic carbon
TUDelft	Delft University of Technology
UASB	Upflow anaerobic sludge blanket
UCT	University of Cape Town
VSS	Volatile suspended solids
WWTP	Wastewater treatment plant

3 RESPIROMETRY

Symbols

[CHO]	Any carbohydrate
μ_{OHO}	Maximum specific biomass growth rate of ordinary heterotrophic organisms under aerobic conditions, h^{-1} or d^{-1}
μ_{ANO}	Maximum specific biomass growth rate of autotrophic nitrifying organisms, d^{-1}
Ac	Concentrations of acetate and acetic acid, mg Ac L^{-1}
ASM1	Activated sludge model No. 1
AUR	Ammonia utilization or uptake rate, mg N L^{-1} h^{-1}
BOD	Biochemical oxygen demand, mg O_2 L^{-1}
BOD_5	Biochemical oxygen demand after 5 d, mg O_2 L^{-1}
$BOD\infty$	Ultimate biochemical oxygen demand, mg O_2 L^{-1}
BOD^{i}_{st}	Short-term biochemical oxygen demand attributed to a specific organic matter present in wastewater, mg O_2 L^{-1}
BOD_{st}	Short-term biochemical oxygen demand, mg O_2 L^{-1}
BOD^{st}_{sample}	Short-term biochemical oxygen demand of a sample, mg O_2 L^{-1}
BOD_t	Oxygen uptake measured at time t, mg O_2 L^{-1}
BOD_U	Ultimate biochemical oxygen demand, mg O_2 L^{-1}
CBOD	Carbonaceous biochemical oxygen demand, mg O_2 L^{-1}
CH_4	Methane
C_i	Concentration of a compound or element in the gas phase or headspace of a reactor or system, ppmv
CN^{-1}	Cyanide, mg L^{-1}
CO_2	Carbon dioxide
C_{O2}	Concentration of oxygen in the gas phase, ppmv
$C_{O2,in}$	Concentration of oxygen in the flux of a gas that enters into a reactor or system, ppmv
COD	Chemical oxygen demand, mg COD L^{-1}
COD_{Ac}	Concentration of acetate and acetic acid expressed as COD, mg COD L^{-1}
$COD^{Degraded}$	Concentration of degraded biodegradable substrate, mg COD L^{-1}
$COD_{substrate}$	Concentration of substrate expressed as COD, mg COD L^{-1}
DO	Dissolved oxygen
F_{in}	Flux of a gas or a compound that enters into a reactor or system, mol h^{-1} or mg h^{-1}
F_{out}	Flux of a gas or a compound that flows out or leaves a reactor or system, mol h^{-1} or mg h^{-1}
H	Henry's proportionality constant for the solubility of a gas, mol m3 $^{-1}$ Pa^{-1}
H_2	Hydrogen
H_2S	Sulphide
HCO_3	Bicarbonate or alkalinity
IC_{50}	Concentration that produces 50% inhibition of the respiration process, mg L^{-1}
$i_{N,Bio}$	Nitrogen content of a biomass or bacterial culture, g N g VSS^{-1} or g N g COD^{-1}
k	First order oxygen uptake rate coefficient for the ultimate biochemical oxygen demand determination, d^{-1}
kLa	Volumetric mass transfer coefficient, d^{-1}
MLSS	Mixed liquor suspended solids, mg SS L^{-1}
MLVSS	Mixed liquor volatile suspended solids, mg VSS L^{-1}
n	Moles of a gas present in the volume of a headspace, mol
N_2	Nitrogen gas
NBOD	Nitrogenous biochemical oxygen demand, mg O_2 L^{-1}
NH_4	Ammonium
N_{Nit}	Concentration of nitrogen available for nitrification, mg N L^{-1}
NO_3	Nitrate

NO_x^-	Nitrate and nitrite
NUR	Nitrate uptake rate (r_{NO3}), N-mol L^{-1} h^{-1} or mg N L^{-1} h^{-1}
NUR	Nitrate utilization or uptake rate, mg N L^{-1} h^{-1}
O_2	Oxygen
OUR	Oxygen uptake rate (r_{O2}), mol O_2 L^{-1} h^{-1} or mg O_2 L^{-1} h^{-1}
OUR	Oxygen utilization or uptake rate, mg O_2 L^{-1} h^{-1}
P	Pressure, Pa or torr
Q_{in}	Influent flowrate that enters into a reactor or system, L d^{-1}, m^3 d^{-1}, mL min^{-1}
Q_{out}	Flowrate that leaves a reactor or system, L d^{-1}, m^3 d^{-1}, mL min^{-1}
Q_{ww}	Wastewater flowrate that enters into a reactor or system, L d^{-1}, m^3 d^{-1}, mL min^{-1}
r_{NO2_NO3}	Aerobic oxidation rate of nitrite to nitrate, mg N L^{-1} h^{-1}
R	Ideal (or universal) gas constant, 8.314 J K^{-1} mol^{-1}
$r_{ANO,O2}$	Exogenous respiration rate of autotrophic nitrifying organisms, mg O_2 L^{-1} h^{-1}
$r_{AOO,O2}$	Respiration rate of ammonia oxidation organisms, mg O_2 L^{-1} h^{-1}
$r^{i}_{O2,exo}(t)$	Time series of exogenous respiration rates associated to the oxidation of a specific component present in wastewater, mg O_2 L^{-1} h^{-1}
$r^{max}_{O2,exo}$(after)	Maximum volumetric exogenous oxygen uptake rate after the addition of a toxic compound, mg O_2 L^{-1} min^{-1}
$r^{max}_{O2,exo}$(before)	Maximum volumetric exogenous oxygen uptake rate before the addition of a toxic compound, mg O_2 L^{-1} min^{-1}
r_{NH4_NO2}	Aerobic oxidation rate of ammonia to nitrite, mg N L^{-1} h^{-1}
$r^{Nit}_{O2,exo}$	Exogenous respiration rate due to nitrification, mg O_2 L^{-1} h^{-1}
$r^{Nit}_{O2,exo}(t)$	Time series of exogenous respiration rates due to nitrification ($r^{Nit}_{O2,exo}$), mg O_2 L^{-1} h^{-1}
r_{NO3}	Volumetric nitrate uptake rate, mg N L^{-1} min^{-1}
$r_{NO3,exo}$	Volumetric exogenous nitrate uptake rate, mg N L^{-1} min^{-1}
$r_{NOO,O2}$	Respiration rate of nitrite oxidation organisms, mg O_2 L^{-1} h^{-1}
r_{O2}	Maximum volumetric oxygen uptake rate, mg O_2 L^{-1} min^{-1}
r_{O2}	Oxygen uptake rate, mg O_2 L^{-1} h^{-1}
$r_{O2,endo}$	Volumetric endogenous oxygen uptake rate, mg O_2 L^{-1} min^{-1}
$r_{O2,exo}$	Volumetric exogenous oxygen uptake rate, mg O_2 L^{-1} min^{-1}
$r_{O2,exo}(t)$	Time series of exogenous respiration rates $r_{O2,exo,}$ mg O_2 L^{-1} h^{-1}
$r_{O2,NH4,exo}$	Exogenous respiration rate associated to the oxidation of ammonia, mg O_2 L^{-1} h^{-1}
$r_{O2,NO2,exo}$	Exogenous respiration rate associated to the oxidation of nitrite, mg O_2 L^{-1} h^{-1}
$r_{O2,tot}$	Total oxygen uptake rate of biomass, mg O_2 L^{-1} min^{-1}
$r^{SB}_{NOx,exo}$	Exogenous nitrate uptake rate associated to denitrification using readily biodegradable organics, mg N L^{-1} h^{-1}
$r^{SB}_{NOx,exo}(t)$	Time series of exogenous nitrate uptake rate associated to denitrification using readily biodegradable organics, mg N L^{-1} h^{-1}
$r^{SB}_{O2,exo}$	Exogenous respiration rate associated to the oxidation of readily biodegradable organics, mg O_2 L^{-1} h^{-1}
$r^{SB}_{O2,exo}(t)$	Time series of exogenous respiration rates associated to the oxidation of readily biodegradable organics, mg O_2 L^{-1} h^{-1}
$r^{XCB}_{NOx,exo}$	Exogenous nitrate uptake rate associated to denitrification using slowly biodegradable organics, mg N L^{-1} h^{-1}
$r^{XCB}_{NOx,exo}(t)$	Time series of exogenous nitrate uptake rate associated to denitrification using slowly biodegradable organics, mg N L^{-1} h^{-1}
$r^{XCB}_{O2,exo}$	Exogenous respiration rate associated to the oxidation of slowly biodegradable organics, mg O_2 L^{-1} h^{-1}
S^*_{O2}	Saturation concentration of dissolved oxygen in the bulk liquid at local conditions, mg O_2 L^{-1}
$S^*_{O2,endo}$	Saturation concentration of dissolved oxygen in the bulk liquid under endogenous conditions, mg O_2 L^{-1}
SAUR	Specific ammonia utilization or uptake rate, mg N g VSS^{-1} h^{-1}
S_B	Concentration of readily biodegradable organics (as COD), mg COD L^{-1}
$S_B(0)$	Initial concentration of readily biodegradable organics (as COD), mg COD L^{-1}
$S_{B,N}$	Concentration of nitrogen associated to the soluble biodegradable organics, N-mol L^{-1} or mg N L^{-1}
S_{NHx}	Ammonium and ammonia concentration, N-mol L^{-1} or mg N L^{-1}
S_{NOx}	Nitrate or nitrite concentration, N-mol L^{-1} or mg N L^{-1}
SNUR	Specific nitrate utilization or uptake rate, mg N g VSS h^{-1}
S_O	Initial substrate concentration, mg L^{-1}
S_{O2}	Dissolved oxygen (DO) concentration, mg O_2 L^{-1}
S_{O2}	Dissolved oxygen (DO) concentration, mg O_2 L^{-1}
$S_{O2,in}$	Dissolved oxygen concentration in the influent, mgO_2 L^{-1}
SOUR	Specific oxygen utilization or uptake rate, mg O_2 g VSS h^{-1}

STP	Standard temperature and pressure, 273.15 K and 1013.25 bar
T	Temperature, ºC or K
t_{final}	Time required to return to the endogenous respiration rate after sample addition, min or h
TOC	Total organic carbon, C-mol L^{-1} or mg C L^{-1}
t_{pulse}	Time of pulse addition of the sample, min or h
TSS	Concentration of total suspended solids, mg TSS L^{-1}
UBOD	Ultimate biochemical oxygen demand, mg O_2 L^{-1}
V	Volume of a system, reactor or closed system, L or mL
V_G	Gas volume, L
V_L	Volume of liquid in a reactor or system, L or mL
V_{react}	Volume of a system, reactor or closed system, L or mL
VS	Volatile solids, mg VS L-1
V_{sample}	Volume of the sample added to the test vessel, L
V_{sludge}	Volume of the sludge in the test vessel prior to the sample addition, L
VSS	Concentration of volatile suspended solids, mg VSS L^{-1}
VSS	Volatile suspended solids, mg VSS L-1
$VSS_{inoculum}$	Concentration of volatile suspended solids present in the inoculum, mg VSS L^{-1}
X_{ANO}	Concentration of autotrophic nitrifying organisms, mg VSS L^{-1} or mg COD L^{-1}
XC_B	Concentration of slowly biodegradable organics, mg COD L^{-1}
$XC_{B,N}$	Concentration of nitrogen associated to the slowly biodegradable organics, N-mol L^{-1} or mg N L^{-1}
X_O	Initial biomass concentration, mg L^{-1}
X_{OHO}	Concentration of ordinary heterotrophic organisms, mg VSS L^{-1} or mg COD L^{-1}
Y	Stoichiometric growth yield ratio, Mass $Mass^{-1}$
Y_{ANO}	Growth yield of autotrophic nitrifying organisms, g COD g N^{-1}
Y_{AOO}	Growth yield of ammonia oxidizing organisms, g COD g N^{-1} or g VSS N^{-1}
Y_{NOO}	Growth yield of nitrite oxidizing organisms, g COD g N^{-1} or g VSS N^{-1}
Y_{OHO}	Growth yield of heterotrophic microorganisms under aerobic conditions, mg VSS COD^{-1} or g COD g COD^{-1}
$Y_{OHO,Ax}$	Growth yield of heterotrophic microorganisms under anoxic conditions, mg VSS COD^{-1} or g COD g COD^{-1}
η	Oxygen equivalents of nitrate, mg O_2 mg N^{-1} or mg COD mg N^{-1}
ΔNO_X	Difference in nitrate uptake rates associated to the denitrification rates on readily or slowly biodegradable organics, mg N L^{-1} min^{-1}
$\Delta r_{O2,tot}$	Difference in oxygen uptake rates before and after the continuous addition of wastewater, mg O_2 L^{-1} min^{-1}

3

Abbreviations

RESPIROMETRY

Ar	Argon
ARIKA	Automated respiration inhibition kinetics analysis
ATP	Adenosin triphosphate
ATU	Allylthiourea
BMP	Biomethane potential
EBPR	Enhanced biological phosphorus removal
G	Gas
GFF	Flowing gas, flowing liquid
GFS	Flowing gas, static liquid
GSF	Static gas, flowing liquid
GSS	Static gas, static liquid
IAWQ	International Association on Water Quality
L	Liquid
LFF	Flowing gas, flowing liquid
LFS	Flowing gas, static liquid
LSF	Static gas, flowing liquid
LSS	Liquid phase, static gas, static liquid

MFC	Mass flow controller
NaOH	Sodium hydroxide
PAO	Polyphosphate-accumulating organisms
SMA	Specific methanogenic activity
TCMP	2-chloro-6-(trichloromethyl)pyridine
UV	Ultraviolet light
VFA	Volatile fatty acids

4 OFF-GAS EMISSION TESTS

Symbols

A	Cross-sectional area of the surface emission isolation flux chamber, m^2
a1, a2, a3, a4, a5	Gas stripping parameters determined through batch tests and parameter estimation or linear regression for the description of the gas concentrations in a stripping method
Alk	Alkalinity, mg eq L-1 or mg $CaCO_3$ L^{-1}
BOD_5	Biochemical oxygen demand determined after 5 days, mg O_2 L^{-1}
C	Gas concentration, M, mol L^{-1}, mg L^{-1}, g L^{-1} or kg $m^{3\ -1}$
CH_4	Methane, ppmv, % or mg COD L^{-1}
CO_2	Carbon dioxide, ppmv, %, C-mol L^{-1} or mg C L^{-1}
$cBOD_{5,filtered}$	Carbonaceous biochemical oxygen demand determined after 5 days in a sample subject to filtration, mg O_2 L^{-1}
$cBOD_{5,total}$	Carbonaceous biochemical oxygen demand determined after 5 days in a raw non-filtered sample, mg O_2 L^{-1}
COD	Chemical oxygen demand, mg COD L^{-1}
$COD_{filt,floc}$	Chemical oxygen demand determined in a sample that has been subject to coagulation-flocculation and filtration, mg COD L^{-1}
$COD_{soluble}$	Chemical oxygen demand determined in a sample subject to filtration, mg COD L^{-1}
$C_{helium\text{-}FC}$	Helium concentration in the off-gas from the flux chamber, ppmv or %
$C_{helium\text{-}GC}$	Helium concentration measured in the gas chromatograph, ppmv or %
$C_{helium\text{-}tracer}$	Helium concentration in the tracer gas, ppmv or %
$C_{G,2}(t)$	Concentration of gas in the headspace of subsystem 2 in the stripping method as a function of time, ppmv or %
C_G^{in}	Gas concentration in the gas flow supplied to stripping device, ppmv or %
$C_G^{in,R}$	Gas concentration entering into the stripping flask, ppmv or %
$C_L(t)$	Concentration of gas in subsystem 1 in the stripping method as a function of time, ppmv, % or mg L^{-1}
$C_L^{in,R}$	Concentration of gas in the inflow to the reactor, mg L^{-1}
$C^R_{G,1}(t)$	Concentration of gas in the reactor as a function of time, ppmv or %
$C^R_{G,2}(t)$	Concentration of gas in the gas outflow as a function of time, ppmv or %
$C^R_L(t)$	Concentration of gas present in the liquid phase in the reactor as a function ot time, mg L^{-1}, ppmv or %
D_L	Liquid dilution rate, L L^{-1} h^{-1} or m^3 $m3^{-1}$ d^{-1}
DO	Dissolved oxygen, mol O_2 L^{-1} or mg O_2 L^{-1}
f_{sample}	Frequency of sampling
H_2SO_4	Sulphuric acid, mol L^{-1} or %
He	Helium, ppmv or %
K	Sensitivity of a stripping device
MLSS	Concentration of mixed liquor suspended solids, mg SS L^{-1}
MLVSS	Concentration of mixed liquor volatile suspended solids, mg VSS L^{-1}
n	Amount of methane in the expanded headspace of the serum bottle, mol
N_2	Dinitrogen gas, ppmv, %, N-mol L^{-1} or mg N L^{-1}
N_2in	Nitrogen gas supplied into a gas stripping device, ppmv
N_2O	Nitrous oxide, ppmv, %, N-mol L^{-1} or mg N L^{-1}
NaCl	Sodium chloride or common salt, mg, % or mg L^{-1}
NH_3	Ammonia, N-mol L^{-1} or mg N L^{-1}
NH_3-N	Concentration of ammonia and ammonium as nitrogen, N-mol L^{-1} or mg N L^{-1}
NH_4^+	Ammonium, N-mol L^{-1} or mg N L^{-1}
NO_2^-	Nitrite, N-mol L^{-1} or mg N L^{-1}

NO_2-N	Nitrite concentration as nitrogen, N-mol L^{-1} or mg N L^{-1}
NO_3^-	Nitrate, N-mol L^{-1} or mg N L^{-1}
NO_3-N	Nitrate concentration as nitrogen, N-mol L^{-1} or mg N L^{-1}
NO_X	Concentration of nitrate and nitrite, N-mol L^{-1} or mg N L^{-1}
O_2	Oxygen, ppmv, %, O-mol L^{-1} or mg O_2 L^{-1}
ORP	Oxidation-reduction or redox potential, mV
P	Atmospheric pressure, Pa
Q	Flowrate, mL min^{-1}, L h^{-1} or m^3 d^{-1}
Q_1	Florate at the point of reference 1, mL min^{-1}, L h^{-1} or m^3 d^{-1}
$Q_{A/S}$	Flowrate supplied to the activated sludge mixed liquor system, m^3 d^{-1}
$Q_{emission}$	Advective gas flowrate through the flux-chamber, m^3 d^{-1}
Q_{flux}	Flowrate of gas leaving the surface emission isolation flux chamber, m^3 d^{-1}
Q_G	Stripping gas flowrate, mL min^{-1}, L h^{-1} or m^3 d^{-1}
$Q_{G,1}(t)$	Gas flowrate stripped out of subsystem 1 as a function of time, mL min^{-1}, L h^{-1} or m^3 d^{-1}
$Q_G^{in,R}$	Gas flowrate supplied to the reactor, mL min^{-1}, L h^{-1} or m^3 d^{-1}
$Q_R^G(t)$	Gas inflow into the reactor as a function of time, mL min^{-1}, L h^{-1} or m^3 d^{-1}
Q_L	Liquid inflow into a stripping flask, mL min^{-1}, L h^{-1} or m^3 d^{-1}
Q_L	Constant flow rate of a liquid sample from the reactor to a stripping flask, mL min^{-1}, L h^{-1} or m^3 d^{-1}
$Q^R_L(t)$	Liquid influent flowrate into the reactor as a function of time, mL min^{-1}, L h^{-1} or m^3 d^{-1}
Q_n	Flowrate at the sampling point or point of reference n, mL min^{-1}, L h^{-1} or m^3 d^{-1}
Q^R_G	Gas outflow, mL min^{-1}, L h^{-1} or m^3 d^{-1}
Q^R_L	Liquid outflow, mL min-1, L h^{-1} or m^3 d^{-1}
$Q^R_L(t)$	Liquid outflow as a function of time, mL min^{-1}, L h^{-1} or m^3 d^{-1}
Q_{sweep}	Flowrate of sweep or carrier gas entering into the surface emission isolation flux chamber, m^3 d^{-1}
Q_{tracer}	Tracer gas flowrate introduced into the flux-chamber, m^3 d^{-1}
R	Ideal gas constant, 8.314 m^3 Pa mol^{-1} K^{-1}
RAS	Return of activated sludge, m^3 d^{-1}
R^R_V	Volume of the reactor, L or m^3
R_V	Volume of liquid in subsystem 1 in the stripping method, L or m^3
$R_V(t)$	Volume of liquid in subsystem 1 in the stripping method as a function of time, L or m^3
SRT	Solids retention time, d^{-1}
t	Time, h or d
T	Temperature, ºC or K
TKN	Total Kjeldahl nitrogen, N-mol L^{-1} or mg N L^{-1}
$TKN_{soluble}$	Total Kjeldahl nitrogen determined in a sample subject to filtration, N-mol L^{-1} or mg N L^{-1}
TP	Total phosphorus, P-mol L^{-1} or mg P L^{-1}
TSS	Total suspended solids, mg TSS L^{-1}
V	Expanded volume of the headspace in the end of the test, L or m^3
V_1	Headspace volume in the syringe at the end of the test, mL or L
VFA	Volatile suspended solids, C-mol L^{-1}, mg COD L^{-1} or mg VFA L^{-1}
$V_{G,1}$	Volume of gas in subsystem 1 in the stripping method, L or m^3
$V_{G,2}$	Volume of headspace in subsystem 2 in the stripping method, L or m^3
V_{HS}	Headspace of the serum bottle before expansion, L or m^3
V_L	Constant liquid volume in the stripping flask, L or m^3
V_O	Initial volume of the headspace of the sampling syringe, mL or L
$V^R_{G,1}$	Volume of the reactor, L or m^3
$V^R_{G,2}$	Headspace volume, L or m^3
V^R_L	Volume of liquid in the reactor, L or m^3
V_S	Volume expansion in the sampling syringe due to the pressure build-up in the serum bottle, mL or L
V_{sample}	Volume of the sample, L
V_{sample}	Volume of the sample, mL or L
VSS	Volatile suspended solids, mg VSS L^{-1}
WAS	Waste activated sludge, m^3 d^{-1}
W_1	Weight of the bottle after filling up the bottle with clean water up to the mark of the stopper, mL or L
W_O	Weight of the bottle after the addition of the initial water volume, mL or L
ρ	Density, g L^{-1}

4 OFF-GAS EMISSION TESTS

Abbreviations

ASTM	American Society for Testing and Materials
BNR	Biological nutrient removal
C	Continuously collected sample
DAS	Data acquisition software
EPA	Environmental Protection Agency
FTIR	Fourier transform infrared spectroscopy
GC	Gas chromatograph
GCFID	Gas chromatograph equipped with flux injector detector
GC-TCD	Gas chromatograph equipped with a thermal conductivity detector
GHG	Greenhouse gas
I	Intermittent collected sample
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared light
ISE	Ion selective electrode
NA	Not applicable
PE	Person equivalent
SCADA	Supervisory control and data acquisition
SCAQMD	South Coast Air Quality Management District
SEIFC	Surface emission isolation flux chamber
SEIFC	Surface emission isolation flux chamber
SHARON	Single reactor high activity ammonia removal over nitrite
TCD	Thermal conductivity detector
US	United States
USEPA	United States Environmental Protection Agency
WWTP	Wastewater treatment plant

5 DATA HANDLING AND PARAMETER ESTIMATION

Symbols

$\mathrm{cov}(\hat{\theta})$	Covariance matrix of estimators
$\hat{F}$	Probability distribution of residuals, $\hat{\varepsilon}$
$t_{N-p}^{\alpha/2}$	Upper α/2 percentile of the t-distribution with N-p degrees of freedom
$\hat{\theta}$	Parameter estimators
σ	Standard deviation (of a normal distribution function)
θ	Parameter vector of a dynamic model
σ_{+}	Standard deviation of parameter estimates
$\theta^{\Sigma}{}_{(t)}$	Parameter vector estimated using data set $D^{S}(i)$
μ	Specific growth rate of biomass, Mass Time^{-1} Volume^{-1}
$\mu_{max}{}^{AOO}$	Maximum growth rate of AOO, d^{-1}
$\mu_{max}{}^{NOO}$	Maximum growth rate of NOO, d^{-1}
b_{AOO}	Decay rate of AOO biomass, d^{-1}
b_{NOO}	Decay rate of NOO biomass, d^{-1}
CH_2O	Reduced carbon source as substrate, C-mol
C_i	Component i, Mass Volume^{-1}
CO_2	Carbon dioxide, C-mol
cov(y)	Covariance matrix of model predictions
D(0)	Original data set with N data points
diag	Diagonal elements of a matrix

$D^S(i)$	i^{th} synthetic data set
E	Conservation matrix
E()	Expected value of a vector of random variable, y
F.	Jacobian matrix
H_2O	Water
iid	Independent and identically distributed
kLa	Volumetric mass transfer coefficient, d^{-1}
$K_{o,AOO}$	Oxygen affinity of AOO, mg O_2 L^{-1}
$K_{o,NOO}$	Oxygen affinity of NOO, mg O_2 L^{-1}
$K_{s,AOO}$	Substrate (NH_4) affinity of AOO, mg N L^{-1}
$K_{s,NOO}$	Substrate (NO_2) affinity of NOO, mg N L^{-1}
M_i	Monod term for component i
NH_3	Ammonia as nitrogen source for growth, N-mol
O_2	Molecular oxygen, O-mol
P_1	Product, C-mol
q_i	Volumetric conversion/production rate of component i, Mass i $Volume^{-1}$ $Time^{-1}$
q_m	Measured set of volumetric rates
q_u	Unmeasured set of volumetric rates
r_i	Rate of mass of component i per unit time per unit weight of biomass, Mass i $Time^{-1}$ $Mass\ biomass^{-1}$
R_{ij}	Pairwise linear correlation between parameter estimators
$S(y,\theta)$	Cost (or objective) function
s^2	Unbiased estimation of variance of residuals
Sa	Vector of absolute sensitivity function
S_{NH}	Concentration of ammonium nitrogen, mg N L^{-1}
S_{NO2}	Concentration of nitrite nitrogen, mg N L^{-1}
S_{NO3}	Concentration of nitrate nitrogen, mg N L^{-1}
S_O	Oxygen concentration, mg O_2 L^{-1}
So^{sat}	Oxygen saturation concentration, mg O_2 L^{-1}
Sr	Vector of relative sensitivity function
u	Input vector of a dynamic model
var()	Variance of a vector of random variable, y
v_{ij}	Stoichiometric coefficient of component i in process j
X	Biomass, C-mol
x	State variables in a dynamic model
X_{AOO}	Biomass concentration of AOO, mg COD L^{-1}
X_{NOO}	Biomass concentration of NOO, mg COD L^{-1}
y	Vector of outputs of a dynamic model
y*	The bootstrap sample
Y_{AOO}	Biomass (AOO) yield over substrate (NH_4), mg COD mg N^{-1}
Y_{ji}	Yield of component i per component
Y_{NOO}	Biomass (NOO) yield over substrate (NO_2), mg COD mg N^{-1}
Y_{SC}	Yield of CO_2 per unit substrate, C-mol $C\text{-}mol^{-1}$
Y_{SN}	Yield of nitrogen per unit substrate, N-mol $C\text{-}mol^{-1}$
Y_{SO}	Yield of oxygen per unit substrate, O-mol $C\text{-}mol^{-1}$
Y_{SP1}	Yield of intermediate product P_1 per substrate, C-mol $C\text{-}mol^{-1}$
Y_{SW}	Yield of water per unit of substrate, H-mol $C\text{-}mol^{-1}$
Y_{SX}	Yield of biomass per unit substrate, C-mol $C\text{-}mol^{-1}$
α	Confidence level
γ_g	Degree of reduction of glucose, mol e- $C\text{-}mol^{-1}$
γ_i	Degree of reduction of component i, mol e- mol^{1-}
γ_K	Collinearity index of a parameter subset K
γ_{O2}	Degree of reduction of oxygen, mol e- $O\text{-}mol^{-1}$
γ_x	Degree of reduction of biomass, mol e- $C\text{-}mol^{-1}$
δ^{msqr}	Delta mean square based sensitivity measure
Δx	Perturbation of the model inputs around their nominal values, x^0

ε	Measurement errors
λ_K	Eigen values of normalized sensitivity matrix for parameter subset K
$\sigma(f)$	Standard deviation of the Monte Carlo integration error

5 Abbreviations

DATA HANDLING AND PARAMETER ESTIMATION

AOO	Ammonium oxidizing organisms
ASM	Activated sludge model
COD	Chemical oxygen demand
MCMC	Markov-Chain Monte-Carlo
MLE	Maximum likelihood estimation
MW	Molecular weight
NOO	Nitrite oxidising organisms
OAT	One factor at a time
ODE	Ordinary differential equations
WWTP	Wastewater treatment plants

6 Symbols

SETTLING TESTS

m_{H_2O}	Mass of water in completely filled pyknometer, g
m'_{H_2O}	Mass of water added to pycnometer with solids sample, g
μ_w	Dynamic viscosity water, kg m^{-1} s^{-1}
ν_w	Kinematic viscosity water, m^2 s^{-1}
C_d	Continuum, intermediate
d_p	Particle diameter, m
DSS	Dispersed suspended solids concentration, mg L^{-1}
DSS_i	Dispersed suspended solids concentration at the inlet of the clarifier, mg L^{-1}
DSS_o	Dispersed suspended solids concentration at the effluent weir of the clarifier, mg L^{-1}
DSVI	Diluted sludge volume index, mL g^{-1}
E	Percentage of mass balance error, %
ESS	Effluent suspended solids concentration, mg L^{-1}
$f(v_s)$	Mass fraction of particles with a settling velocity smaller than v_s, %
FSS	Flocculated suspended solids concentration, mg L^{-1}
f_{sv}	Fraction of the settling column occupied by the settled sludge after 30 minutes of settling
g	Gravitational constant, m s^{-2}
H	Height of the ViCAs column, m
K	Particle-liquid constant
M(t)	ICumulated mass of particles settled to the bottom of the ViCAs column between t=0 and t, mg
m_0	Mass of empty pycnometer, g
M_{fin}	Final mass in the ViCAs column, mg
M_{ini}	Initial mass in the ViCAs column, mg
m_s	Mass of solid sample, g
M_{set}	Sum of the settled mass recovered in the cups at the bottom of the ViCAs column, mg
m_T	Mass of pycnometer filled with water, g
m_{TS}	Mass of pyknometer filled with solids sample and water, g
Re_p	Particle Reynolds number
r_V	Settling parameter, L g^{-1}
S(t)	Mass of particles settled in the ViCAs column between t=0 and t that have a settling velocity above H/t, mg
SSVI	Stirred specific volume index, mL g^{-1}
SV_{30}	Volume of settling column occupied by sludge after 30 min. of settling, mL L^{-1}

SVI	Sludge volume index, mL g^{-1}
V'_{H_2O}	Volume of water added to pycnometer with solids sample, L
V_0	Maximum settling velocity, m h^{-1}
v_{hs}	Hindered settling velocity, m h^{-1}
v_s	Sedimentation velocity of a single particle, m s^{-1}
V_s	Volume of solid sample, L
v_{zs}	Zone settling velocity, m h^{-1}
X_{TSS}	Total suspended solids concentration, g L^{-1}
ρ_p	Density of particle, kg m^{-3}
ρ_s	Density of solids sample, g L^{-1}
ρ_w	Density of fluid, kg m^{-3}

6 Abbreviations

SETTLING TESTS

ViCAs Vitesse de chute en assainissement (settling velocity in sanitation, in French)

7 Symbols

MICROSCOPY

d	Resolution of a microscope
N	Refractive index of the immersion medium used below the objective lens
α	One-half of the objective's opening angle, degree
λ	Light wavelength, m
λem	Emission light wavelength, m
λex	Excitation light wavelength, m

7 Abbreviations

MICROSCOPY

BF	Bright-field
Card-FISH	Catalyzed reporter deposition for fluorescence *in situ* hybridization
CCD	Charge coupled device
CLSM	Confocal laser scanning microscopy
CTC	5-cyano-2,3-ditolyl tetrazolium chloride
CTF	Fluorescent formazan
DAPI	4',6-diamidino-2-phenylindole dihydrochloride/dilactate
dH_2O	Distilled water
DMF	Dimethylformamide
DO	Dissolved oxygen
DOPE-FISH	Double labeling of oligonucleotide probes for fluorescence *in situ* hybridization
dsDNA	Doublestranded DNA
EBPR	Enhanced biological phosphate removal
EDTA	Ethylenediaminetetraacetic acid
EPS	Extracellular polymeric substances
EtOH	Ethanol
FA	Formamide
FI	Filament Index
FISH	Fluorescence *in situ* hybridization
GAO	Glycogen-accumulating organism

HI	Hexidium iodide
MLSS	Mixed liquor suspended solids
NA	Numerical aperture
PAO	Polyphosphate-accumulating organism
PBS	Phosphate-buffered saline
PFA	Paraformaldehyde
PHA	Poly-β-hydroxy-alkanoates
Ph	Phase contrast
poly-P	Poly-phosphate
RI	Refractive index (RI)
SDS	Sodium dodecylsulfate
TE	Tris-EDTA
WWTP	Wastewater treatment plant

Symbols

C_q	Quantification cycle in qPCR experiments
C or c	Concentration
g	g-force, G
V	Volume

Abbreviations

A260/230	Light absorbance ratio at 260 nm and 280 nm
A260/280	Light absorbance ratio at 260 nm and 280 nm
AOB	Ammonia-oxidizing bacteria
BHQ-1	Black hole quencher-1
bp	Base pairs
Cluster PF	Sequencing clusters passing filter
DGGE	Denaturing gradient gel electrophoresis
DN	Denitrifying bacteria
dsDNA	Double-stranded DNA
eDNA	Extracellular DNA
FAM	6-carboxyfluorescein
FIL	Filamentous bacteria
FISH	Fluorescence *in situ* hybridization
FRET	Fluorescence resonance energy transfer
GAO	Glycogen-accumulating organisms
HET	Heterotrophic bacteria
HPLC	High performance liquid chromatography
LCA	Least common ancestor
MIQE	Minimal information for publication of quantitative real-time PCR experiments
MRSA	Methicillin-resistant *Staphylococcus aureus*
MW	Molecular weight
NAC	No amplification control
NOB	Nitrite-oxidizing bacteria
NTC	No template control
OTU	Operational taxonomic unit
PAO	Polyphosphate-accumulating organisms

PCA	Principle component analysis
PCR	Polymerase chain reaction
PE	Paired-end
PEG	Polyethylene glycol
PPE	Personal protection equipment
Q10, Q20, Q30	Sequencing quality scores
qPCR	Real-time quantitative polymerase chain reaction
ROX	Reference dye used for qPCR
rpm	Revolutions (or rotations) per minute
rRNA	Ribosomal RNA
RT-qPCR	Reverse transcription real-time quantitative polymerase chain reaction
SDS	Sodium dodecyl sulfate
SPRI	Solid phase reversible immobilization
SS	Suspended solids
ssDNA	Single-stranded DNA
TAMRA	Tetramethylrhodamine
TE	Tris EDTA
TS	Total solids
UDG	Uracil-DNA glycosylase
UV-vis	Ultraviolet–visible
V1-V9	rRNA variable region 1 to 9
VRE	Vancomycin-resistant enterococci
WWTP	Wastewater treatment plant