Parameter	Definition	Units
Biomass and substrate components		
X_H	Concentration of heterotrophic bacteria	gCOD m^{-3}
X_A	Concentration of ammonium-oxidizing bacteria (AOB)	gCOD m^{-3}
X_N	Concentration of nitrite-oxidizing bacteria (NOB)	gCOD m^{-3}
X_I	Concentration of inert solids	gTS m^{-3}
S_O	Concentration of dissolved oxygen	gO_2 m^{-3}
S_N	Concentration of nitrite	gN m^{-3}
S_A	Concentration of ammonium	gN m^{-3}
S_C	Concentration of soluble, readily biodegradable organics	gCOD m^{-3}
Kinetic and stoichiometric coefficients		
μ_{Hmax}	Maximum growth rate of heterotrophs	d^{-1}
b_H	Aerobic endogenous respiration rate constant for heterotrophs	d^{-1}
K_{OH}	Affinity constant for oxygen of heterotrophs	gO_2 m^{-3}
K_C	Affinity constant for organics of heterotrophs	gCOD m^{-3}
Y_H	Yield coefficient for heterotrophs growing aerobically	$gCOD_{XH}$ $g^{-1}COD_{SC}$
μ_{Amax}	Maximum growth rate of AOB	d^{-1}
b_A	Aerobic endogenous respiration rate constant for AOB	d^{-1}
K_{OA}	Affinity constant for oxygen of AOB	gO_2 m^{-3}
K_A	Affinity constant for ammonium of AOB	gN m^{-3}
Y_A	Yield coefficient for AOB	$gCOD_{XA}$ $g^{-1}NH_4$-N
μ_{Nmax}	Maximum growth rate of NOB	d^{-1}
b_N	Aerobic endogenous respiration rate constant for NOB	d^{-1}
K_{ON}	Affinity constant for oxygen of NOB	gO_2 m^{-3}
K_N	Affinity constant for NO_2^- of NOB	gN m^{-3}
Y_N	Yield coefficient for NOB	$gCOD_{XN}$ $g^{-1}NO_2$-N
f_{XI}	Fraction live biomass being convert to inert material during endogenous respiration	
i_{NX}	Nitrogen content in biomass	gNH_4-N g^{-1}COD
Physical parameters		
D_{W_O}	Diffusion coefficient of oxygen in water	m^2 s^{-1}
D_{W_N}	Diffusion coefficient of nitrite in water	m^2 s^{-1}
D_{W_A}	Diffusion coefficient of ammonium in water	m^2 s^{-1}
D_{W_C}	Diffusion coefficient of organic carbon in water	m^2 s^{-1}
D_e	Effective diffusion coefficient, i.e. diffusion coefficient in biofilm	m^2 s^{-1}
f_{VS}	Fraction of the total solids that is live, active bacteria	
fX_H	Fraction of the live bacteria that is aerobic heterotrophs	
fX_A	Fraction of the live bacteria that is AOB	
fX_N	Fraction of the live bacteria that is NOB	
$S_{O,bulk}$	Concentration dissolved oxygen in bulk liquid	gO_2 m^{-3}
$S_{N,bulk}$	Concentration nitrite in bulk liquid	gN m^{-3}
$S_{A,bulk}$	Concentration ammonium in bulk liquid	gN m^{-3}

$S_{C,bulk}$	Concentration organic carbon in bulk liquid	gCOD m^{-3}
L	Biofilm thickness	m
Δx	Thickness of layer in biofilm	m
X_{TS}	Biofilm density	gTS m^{-3}
δ_{BL}	Bulk liquid-biofilm diffusion boundary layer thickness	M