Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Table S1. Anaerobic sludge bed-primary BioAX aerobic-MBS aerobic fluidized bed nitrification bioreactor- MBS expended bed denitrification bioreactor-secondary BioAX aerobic reactor (A1-O1-M1-M2-O2) system

Phase	Anaerobic sludge bed (A_1)	primary BioAX aerobic (O_1)	MBS aerobic fluidized bed nitrification bioreactor Aerobic (M_1)	MBS expended bed denitrification bioreactor (M_2)	secondary BioAX aerobic reactor (O_2)
inoculated sludge (inoculation amount)	Digested sludge (40%)	Activated sludge (100%)	MBS (15-20%)	MBS (60-70%)	Activated sludge (100%)
V（L）	13.6	17.6	17.6	9.6	17.6
HRT(days)	5→1.5	3→2	4h	6h	4h
Temperature(°C)	35	27	27	27	27
FUNCTION	Removal of COD and total phenols	Remove COD and total phenols	Remove NH_4^+-N	0.63 g methyl alcohol per liter water was added as carbon source to remove NO_3^--N	Remove excess carbon source

S2 Intermittent test of ammonia nitrogen removal in MBS aerobic fluidized bed nitrification bioreactor

The main aim of this test is to discuss the optimum HRT of ammonia nitrogen removal in Reactor M1. The wastewater used in this test takes Reactor O1 effluent (ammonia nitrogen 40 mg/L, COD < 300mg/L, total phenols < 30mg/L). Inoculated sludge (750ml entrapped bacteria (15% effective volume) was added into the Reactor M1 (aerobic) (5L effective volume), and then wastewater was feed in the reactor. Aeration was started to kept the MBS well mixed and aerated. After every two hours water samples were taken. After 12 hours of aeration, the test was stop and was restarted with fresh wastewater

Fig S2 (a) shows the concentration changes of three nitrogen (NH_4^+-N, NO_3^--N, NO_2^--N) in intermittent test of ammonia nitrogen removal of MBS.After treatment from Reactor O1, ammonia nitrogen of aerobic effluent can be reduced to less than 40mg/L. Domesticated MBS can remove ammonia nitrogen in a short period of time, in current results, lower than 10mg/L within 8 hours. Meanwhile, NO_3^--N rises from 74mg/L to 114mg/L, and NO_2^--N rises from 2mg/L to 20mg/L and then decrease to 0.45mg/L. This means, removed NH_4^+-N is converted into NO_3^--N via NO_2^--N.

Intermittent test of NO_3^--N removal in MBS expended bed denitrification bioreactor

The main aim of this test is to discuss the optimum HRT of NO_3^--N removal in Reactor M2. The trial wastewater takes the effluent of Reactor M1. NO_3^--N was close to 120mg/L, NH_4^+-N < 3 mg/L, COD < 300mg/L, total phenols < 30mg/L. 500ml entrapped bacteria (10% effective volume) MBS are added into the Reactor M2 (effective volume 5L). Wastewater was added and 4ml methyl alcohol (0.8 ml methyl alcohol/L H_2O), and stirring device was started to make MBS flow circularly and also uniformly. . After every four hours water

samples were taken. After 24 hours of stirring, the test was stop and was restarted with new trial wastewater

Fig S2 (b) shows the concentration changes of three nitrogen in intermittent test of MBS denitrification. The results of the test indicate that, after 16 hours, NO_3^--N decreases from 117 mg/L to 3.98 mg/L, NH_4^+-N decreases from 2.65 mg/L to 0.77 mg/L, and NO_2^--N decreases from 5.1 mg/L to 0.36 mg/L. This means, MBS can achieve the efficacy of denitrification within 16 hours.

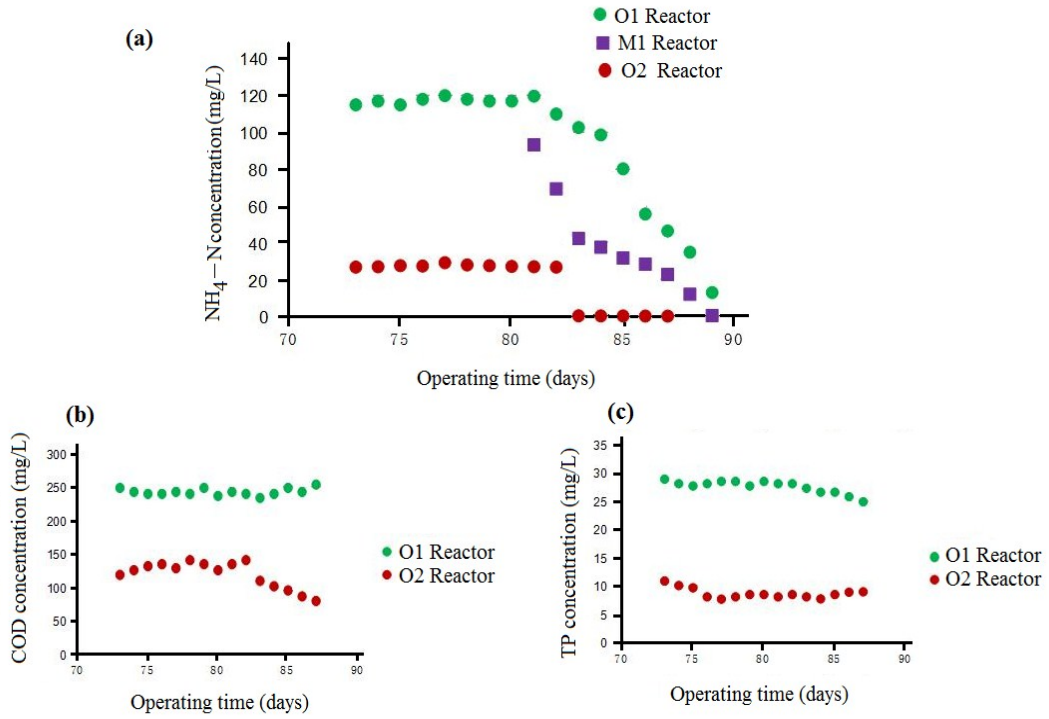

Figure S1. Variation in (a) NH_4-N (b) COD (c) Total phenol in primary BioAX aerobic O1 - MBS fluidized bed nitrification bioreactor M1-secondary BioAX aerobic reactor O2 of (A1-O1-M1-M2-O2) system

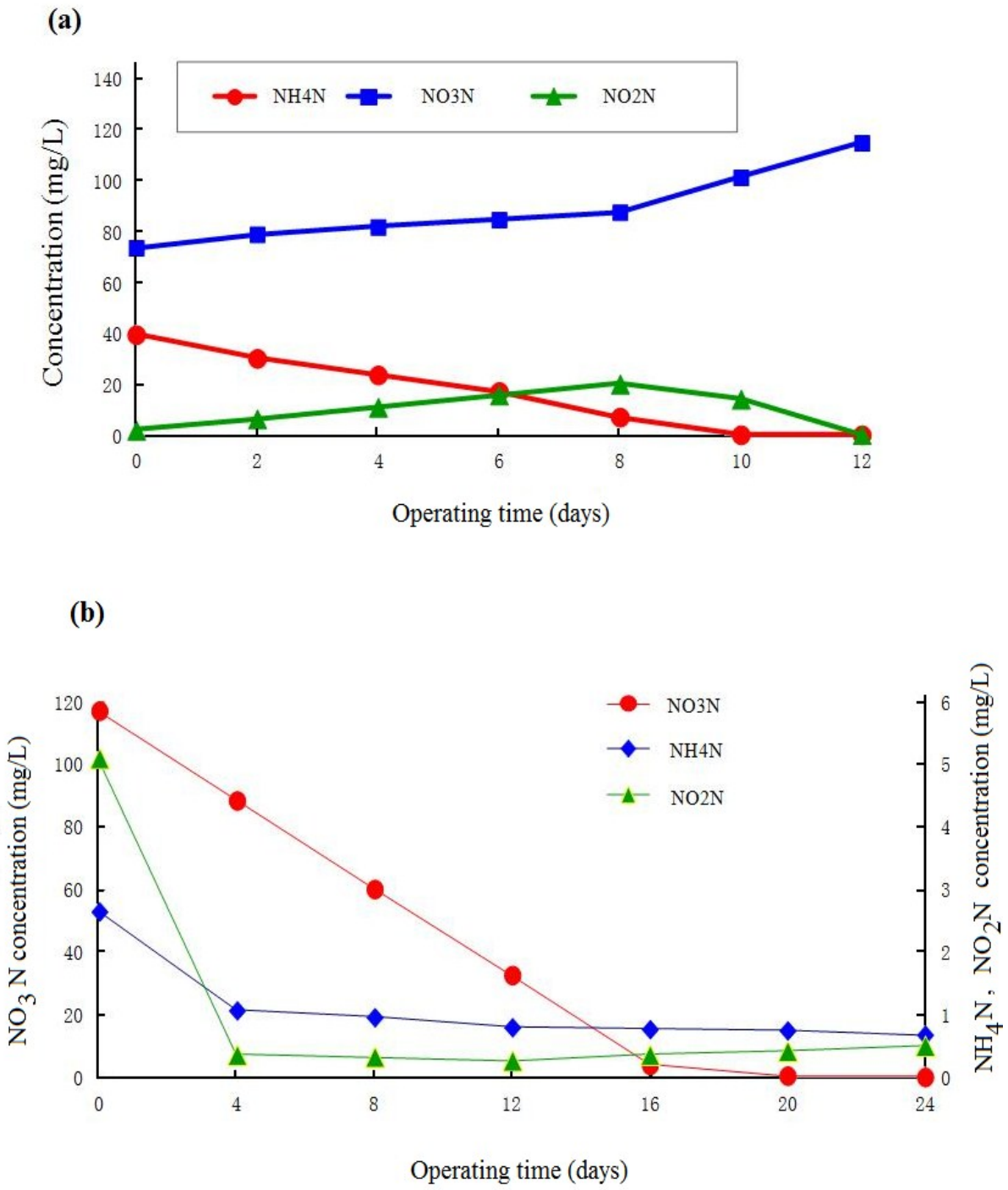

Figure S2. Concentration changes of ammonia nitrogen, nitrate and nitrite in intermittent test (a) of ammonia nitrogen removal in MBS aerobic fluidized bed nitrification bioreactor M1; (b) of NO_3^--N removal in MBS expended bed denitrification bioreactor M2.