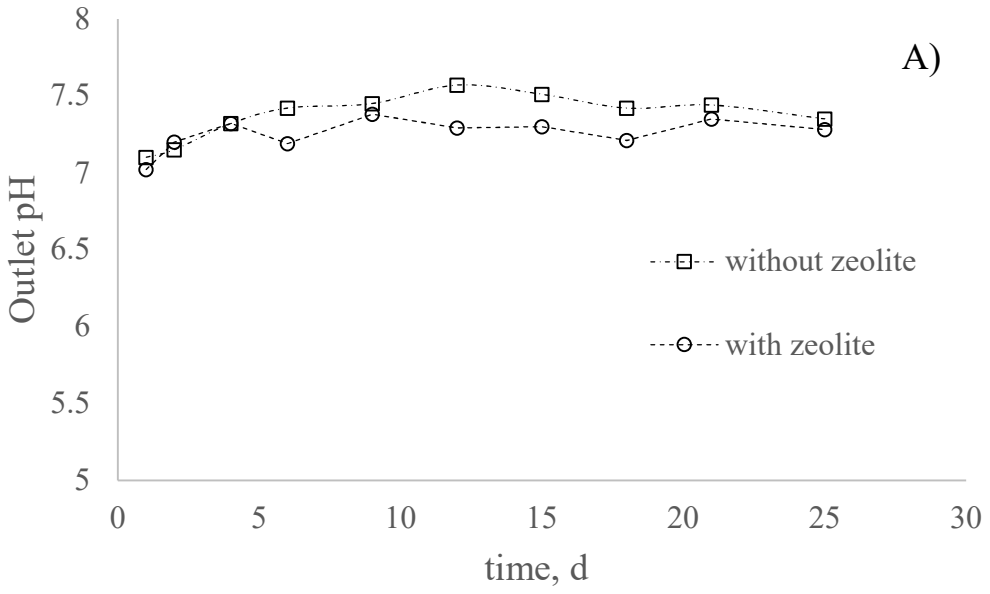
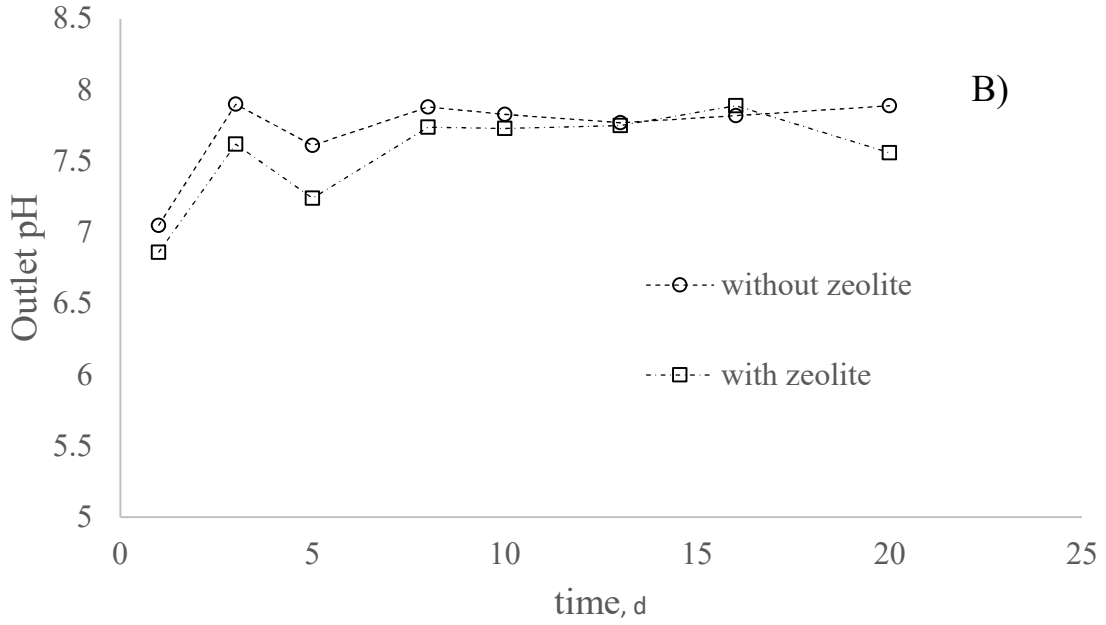
Supplementary data





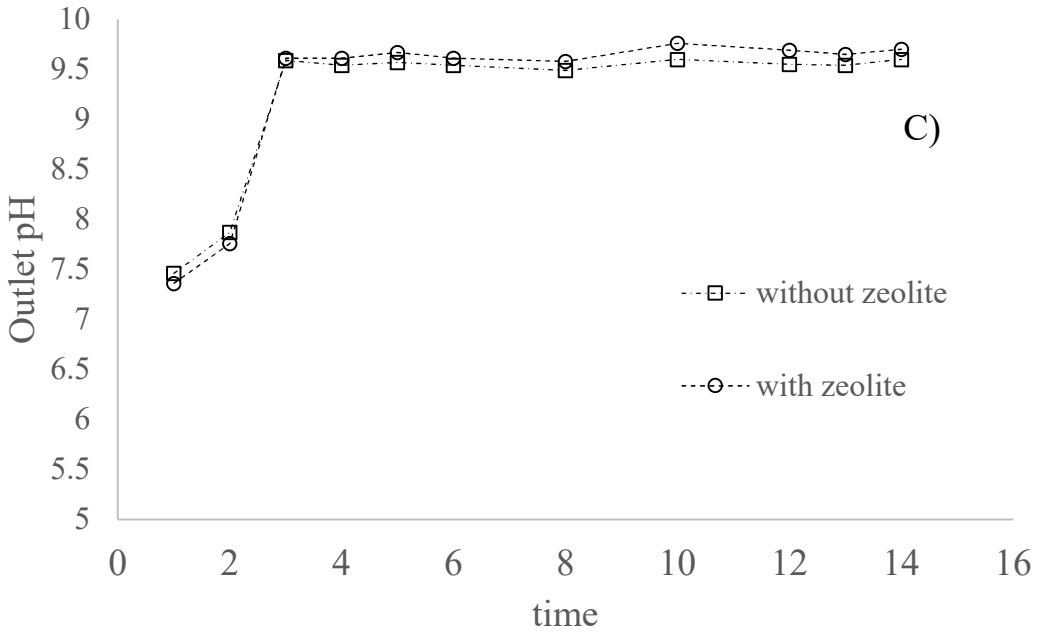


Figure S1: Outlet pH values of both systems at different conditions. A) Without sulfide and organic matter; B) At HS^- = 5 mg/L and 0.1 vvm; C) At HS^- = 10 mg/L and 0.5 vvm.

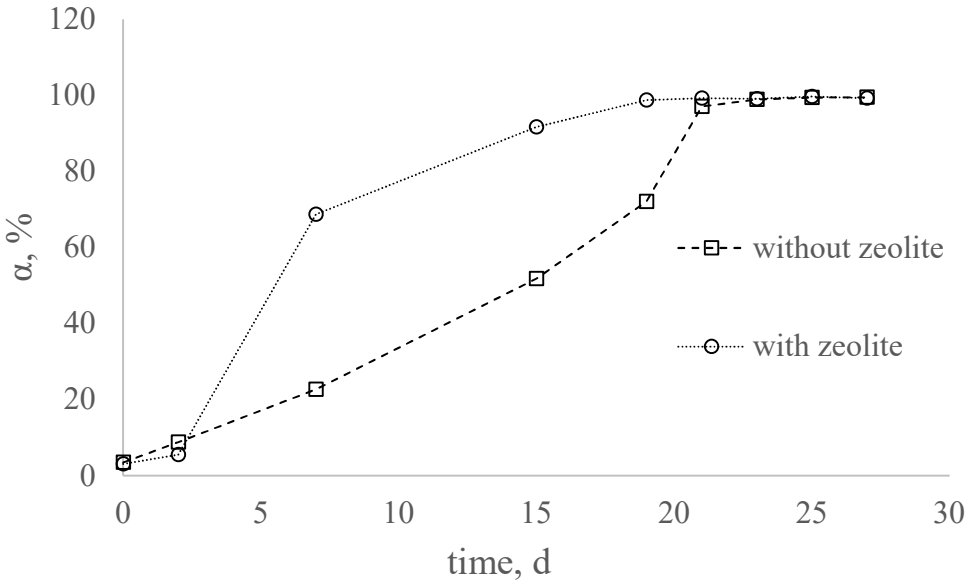


Figure S2: TAN efficiency (%) of both systems during the recovery of nitrifying activity step.

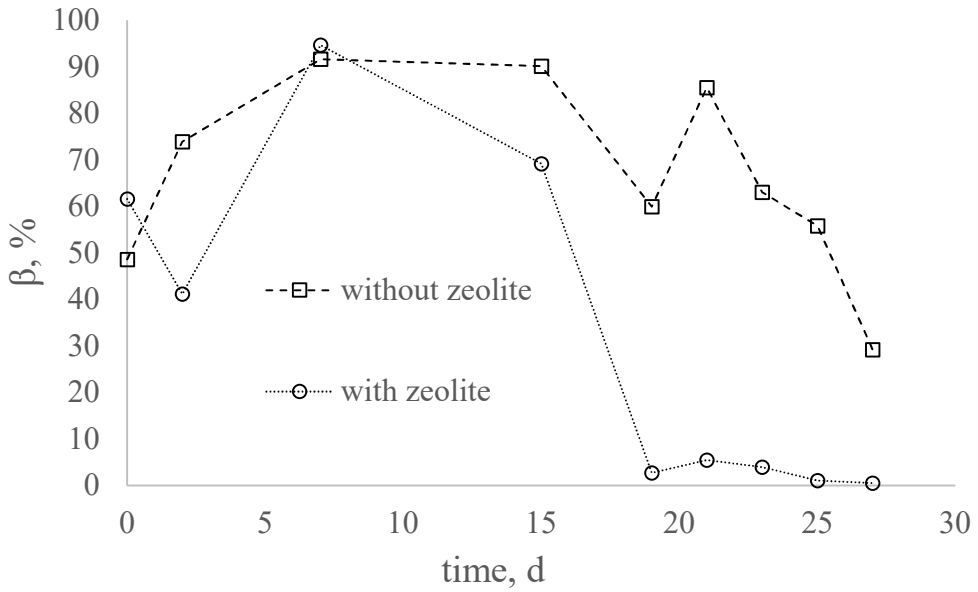


Figure S3: Nitrite accumulation (%) in both systems during the recovery of nitrifying activity step.

Table S1: Characterization of inoculum from an industrial aerobic activated sludge reactor (Huilinir et al., 2020).

Parameters	**Value**
Total Ammonia Nitrogen (TAN), mg N/L	8.83 ± 0.44
NO_3^--N, mg N/L	0.47 ± 0.02
NO_2^--N, mg N/L	Not detected
S^{2-}, mg S/L	4.99 ± 0.25
SO_4^{2-}, mg S/L	138.67 ± 6.93
VSS, g/L	4.48 ± 0.22
TSS, g/L	5.25 ± 0.26
Soluble COD, mg/L	38.90 ± 2.94
Total COD, mg/L	4944 ± 273.60
pH	6.64 ± 0.2

Table S2: Chemical and mineral composition of the zeolites used in all the assays.

Chemical composition (%)		Mineral composition (%)	
SiO_2	64.19	Clinoptilolite	35
TiO_2	0.51	Mordenite	15
Al_2O_2	11.65	Montmorillonite	30
Fe_2O_3	2.53	Other minerals	20
MnO_2	0.03		
MgO_2	0.66		
CaO	3.42		
Na_2O	0.75		
K_2O_2	1.60		
P_2O_5	0.03		

Table S3: TAN, nitrite and nitrate concentrations obtained in the system with and without zeolite (without sulfide and organic matter)

	Reactor without zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	194.8	54.7	94.34	51.66
2	246	102	77.3	65.7
4	206	66.5	90.2	45.8
6	312	97.3	95.4	117.2
9	248	80.5	90.9	70.1
12	252	68.4	90.9	91.5
15	285	83.6	89.6	111
18	245	67.1	92.2	84.2
21	210	59.8	88.5	60.7
25	215	61.4	84.7	66.3

	Reactor with zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	208	0.831	69.246	122.554
2	189.6	4.35	65.132	122.868
4	193.8	1.54	93.677	96.323
6	312	22.45	145.424	131.576

9	202	15.4	91.49	82.91
12	198	5.8	110.2	79.8
15	223	3.8	129.2	88.8
18	203	4.8	116.6	80.6
21	198	7.6	110.2	79.8
25	205	4.3	114.9	82.1

Table S4: Mass balance in the partial nitrification process without zeolite.

Time, d	TAN inlet [mg/h]	TAN outlet [mg/h]	N-NO_2^- outlet [mg/h]	NO_3^-, outlet [mg/h]	Total N outlet, [mg/h]	Difference inlet-outlet, %
1.00	11.45	3.22	5.55	3.04	11.80	-3.03
2.00	14.46	6.00	4.55	3.86	14.41	0.41
4.00	12.11	3.91	5.30	2.69	11.91	1.70
6.00	18.35	5.72	5.61	6.89	18.22	0.67
9.00	14.58	4.73	5.34	4.12	14.20	2.62
12.00	14.82	4.02	5.34	5.38	14.75	0.48
15.00	16.76	4.92	5.27	6.53	16.71	0.28
18.00	14.41	3.95	5.42	4.95	14.32	0.61
21.00	12.35	3.52	5.20	3.57	12.29	0.48
25.00	12.64	3.61	4.98	3.90	12.49	1.21

Table S5: Mass balance in the partial nitrification process with zeolite.

Time, d	TAN inlet [mg/h]	TAN outlet [mg/h]	N-NO_2^- outlet [mg/h]	NO_3^-, outlet [mg/h]	Total N outlet, [mg/h]	Difference inlet-outlet, %
1.00	12.23	0.05	4.07	7.21	11.33	7.39
2.00	11.15	0.26	3.83	7.22	11.31	-1.45
4.00	11.40	0.09	5.51	5.66	11.26	1.17
6.00	18.35	1.32	8.55	7.74	17.61	4.02
9.00	11.88	0.91	5.38	4.88	11.16	6.04
12.00	11.64	0.34	6.48	4.69	11.51	1.11
15.00	13.11	0.22	7.60	5.22	13.04	0.54
18.00	11.94	0.28	6.86	4.74	11.88	0.49
21.00	11.64	0.45	6.48	4.69	11.62	0.20
25.00	12.05	0.25	6.76	4.83	11.84	1.80

Table S6: TAN, nitrite and nitrate concentrations obtained in the systems with and without zeolite at 0.1 vvm and HS^- = 5 mg/L

	Reactor without zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	193.4	66.9	130.6	15.4
3	210.2	107.4	102	4
5	274	160.1	78.6	18
8	204	97.79	91.26	8.74
10	208.8	100.5	101.6	7
13	222.7	99.8	120.2	7.8
16	215.4	110.3	86.8	17
20	225.2	100.5	119.8	7.4
	Reactor with zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	183.8	21.1	152.4	15.6
3	202	70.3	125	5.6
5	236.4	104.2	113.4	9.4
8	214	95.2	94.86	21.14
10	215.6	99.5	102.6	23.6
13	218.2	100.2	99	14.8
16	220.5	98.4	114	10.8
20	215.8	87.8	115.2	12.4

Table S7: Mass balance in the systems with zeolite at 0.1 vvm, HS^- = 5 mg/L and cycles with 12 h/12 h aerobic/anoxic.

Time, d	TAN inlet [mg/h]	TAN outlet [mg/h]	N-NO_2^- outlet [mg/h]	NO_3^-, outlet [mg/h]	Total N outlet, [mg/h]	Difference inlet-outlet, %
1	11.37	3.93	7.68	0.91	12.52	-10.08
3	12.36	6.32	6.00	0.24	12.55	-1.52
5	16.11	9.41	4.62	1.06	15.09	6.31
8	12.00	5.75	5.37	0.51	11.63	3.04
10	12.28	5.91	5.97	0.41	12.30	-0.14
13	13.09	5.87	7.07	0.46	13.39	-2.29
16	12.67	6.49	5.10	1.00	12.59	0.60
20	13.24	5.91	7.04	0.44	13.39	-1.11

Table S8: Mass balance in the systems with zeolite at 0.1 vvm, HS^- = 5 mg/L and cycles with 12 h/12 h aerobic/anoxic.

Time, d	TAN inlet [mg/h]	TAN outlet [mg/h]	N-NO_2^- outlet [mg/h]	NO_3^-, outlet [mg/h]	Total N outlet, [mg/h]	Difference inlet-outlet, %
1	10.81	1.24	8.96	0.92	11.12	-2.88
3	11.88	4.13	7.35	0.33	11.81	0.54
5	13.90	6.13	6.67	0.55	13.35	3.98
8	12.58	5.60	5.58	1.24	12.42	1.31
10	12.68	5.85	6.03	1.39	13.27	-4.68
13	12.83	5.89	5.82	0.87	12.58	1.92
16	12.97	5.79	6.70	0.64	13.12	-1.22
20	12.69	5.16	6.77	0.73	12.67	0.19

Table S9: TAN, nitrite and nitrate concentrations obtained in the systems with and without zeolite at 0.5 vvm and HS^- = 10 mg/L

	Reactor without zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	187.8	26.3	162	6.4
2	196	188	7.4	0
3	223.2	195.6	26	3
4	234	194	35.2	4.8
5	205	187.2	15.84	0.66
6	190	170	22.12	0.96
8	205	201.4	3.9	0.04
10	200	194.6	4.08	0.04
12	199	192.4	4.52	0.98
13	198	193.2	4.98	0.38
14	202	195	5.04	0.323
	Reactor with zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	190.4	1.66	23.24	161.76
2	193	191.4	0.78	1.22
3	204.4	168.6	6.88	25.92
4	207.2	122	81.36	7.84
5	218	124.4	84.98	0.24
6	203.6	111.6	84.6	0.04
8	202	155.6	45.34	4.72
10	198	188.9	9.44	0.8
12	205	200.5	4.52	0.3
13	195	189.6	5.22	0.7
14	201	194.8	5.18	0.43

Table S10: TAN, nitrite and nitrate concentrations obtained in the systems with and without zeolite at 0.5 vvm, COD = 350 mg/L and HS^- = 5 mg/L.

	Reactor without zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	183.2	131	6.86	50.99
3	190	181.8	6.06	2.17
5	214	185	20.88	8.41
7	212	176.4	30.38	4.01
8	208	188.6	17.0585	2.23
9	214	186	27.1725	1.47
11	202	178	22.751	1.59
13	201	183.6	16.9472	0.16
15	214.4	208.8	3.788	1.45
17	198.4	192.7	4.3436	1.29
19	211.2	206.6	3.558	1.12
21	198.4	194.2	3.15	1.08

	Reactor with zeolite			
Time, d	Initial TAN, mg/L	Final TAN, mg/L	Final nitrite, mg/L	Final nitrate, mg/L
1	193.6	145	5.29	43.24
3	208	192	3.214	13.45
5	194.4	178.4	8.84	7.11
7	210	182.4	19.7	8.22
8	214	182.2	22.0095	9.2
9	202	185.6	13.964	2.07
11	210	192.8	16.162	1.13
13	204	193.2	9.492	1.35
15	205.2	193.2	11.49	0.4
17	207.2	196.6	9.4112	1.26
19	203	192.3	10.085	0.39
21	205	193.4	11.151	0.5