INHIBITORY EFFECT OF SULFIDE ON THE BIOLOGICAL AMMONIUM AND NITRITE OXIDATION PROCESSES

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Key words: Inhibition; nitrification; sulfide

Introduction. The biological nitrogen removal process is the most common methodology for removing ammonium from wastewaters. The first step is the nitrification process, which consists of a double process; ammonium oxidation followed by nitrite oxidation (1). Sulfide is a toxic compound frequently found in industrial wastewaters containing ammonium. Very little information is available on the inhibitory effect of sulfide on the nitrification process (2).

The objective of this study was to evaluate the inhibitory effect of different initial sulfide concentrations on the ammonium and nitrite oxidation processes.

Methods. Batch assays were performed in 160 mL serological bottles with 100 mL of a lithoautotrophic medium (2). The inoculum (50 ± 5 mg microbial protein/L) was obtained from a nitrification continuous reactor under steady-state operation. Sulfide was added from a standard solution of $Na_2S.9H_2O$. Cultures were maintained at 200 rpm and 30°C. Kinetic constants (q_{max}, K_S) were calculated by using Monod and Hanes-Woolf plots.

Results. Figures 1 and 2 show the Monod plots of ammonium and nitrite oxidation, respectively, in absence and presence of sulfide ($R^2 > 0.995$). A clear inhibitory effect of sulfide on both ammonium and nitrite oxidation processes was observed through a significant decrease of specific rates (q_{NH4+} and q_{NO2-}). Sulfide inhibited more the nitrite oxidation than the ammonium oxidation (Table 1).

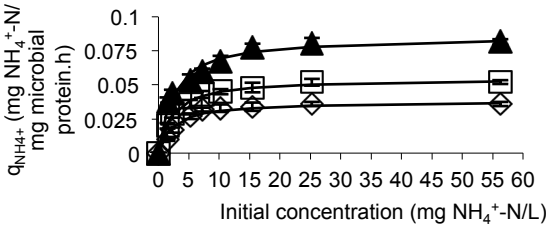

Fig. 1 Monod plots of ammonium oxidation at different initial sulfide concentrations: 0 (▲), 2.5 (□), 3.5 (◊) mg HS^--S/L.

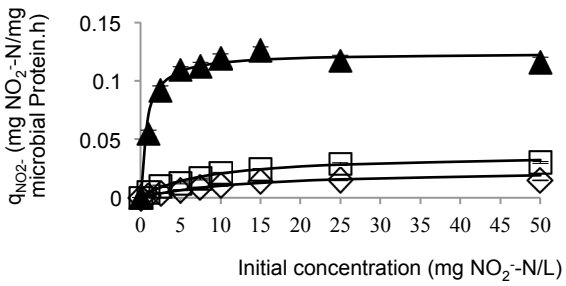

Fig. 2 Monod plots of nitrite oxidation at different initial sulfide concentrations: 0 (▲), 2.5 (□), 3.5 (◊) mg HS^--S/L.

Table 1. Kinetic constants of the ammonium and nitrite oxidation processes at different initial sulfide concentrations.

Sulfide concn. (mg HS^--S/L)	Ammonium oxidation		
	0	2.5	3.5
Ks (mg NH_4^+-N/L)	2.35 ± 0.28	2.12 ± 0.22	2.25 ± 0.22
q_{max} (mg N/mg microbial protein.h)	0.085 ± 0.010	0.054 ± 0.005	0.038 ± 0.003
Sulfide concn. (mg HS^--S/L)	Nitrite oxidation		
	0	2.5	3.5
Ks (mg NO_2^--N/L)	0.74 ± 0.09	8.14 ± 0.73	14.08 ± 1.40
q_{max} (mg N/mg microbial protein.h)	0.124 ± 0.015	0.038 ± 0.003	0.025 ± 0.002

Conclusions. Sulfide was shown to inhibit more the nitrite oxidation process than the ammonium oxidation process. The results point out sulfide as a potential factor leading to nitrite accumulation during wastewater nitrification. The presence of sulfide in nitrification systems should be minimized, by pretreatment or biological oxidation.

Acknowledgements. This work was supported by CONACYT (Grant No. SEP-CONACYT-CB-2011-01-165174).

References.

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