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POLY (Ɛ-CAPROLACTONE) AS BIOFILM SUPPORT AND CARBON SOURCE FOR GROUNDWATER DENITRIFICATION

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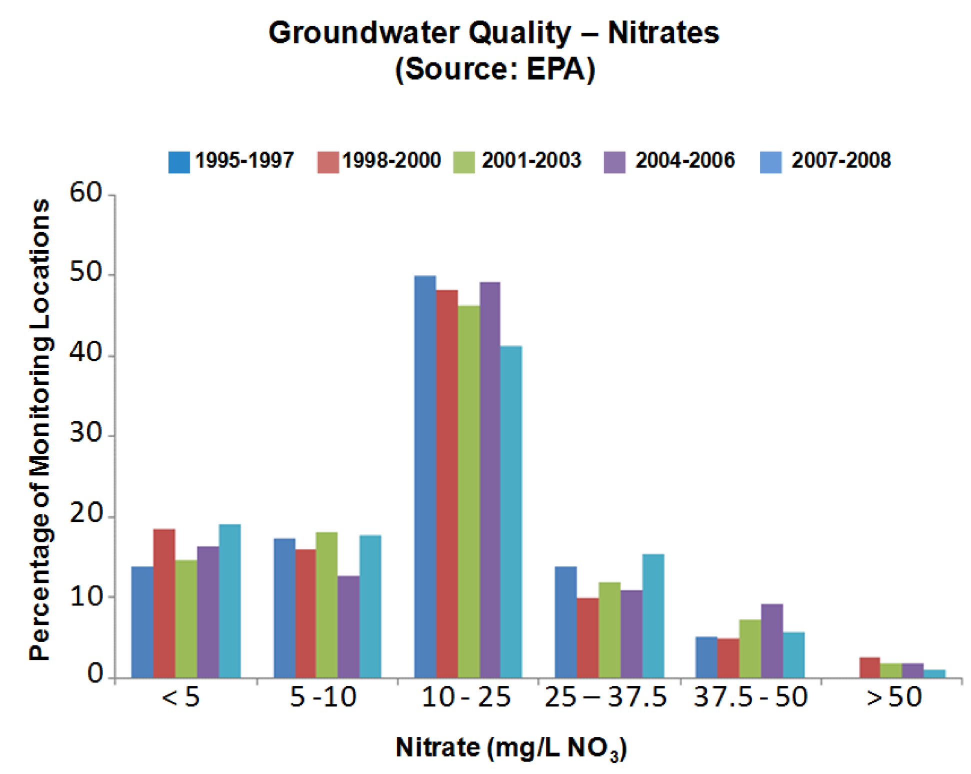
Introduction

Groundwater is widely used as a drinking water source in most countries of the world. However, groundwater nitrate contamination has steadily been increasing over the years as a consequence of anthropogenic activities. Elevated nitrate concentrations in drinking water sources can cause diseases such as methahemoglobinemia and stomach cancer (Wolfe & Patz, 2002).

Typically, contaminated groundwater with nitrate is severely limited in organic carbon and the addition of an external soluble carbon source is the usual procedure to achieve nitrogen removal (Rivett *et al.*, 2008). Nevertheless, the costs associated and the risk of additional contamination of the environment involved in this procedure demand the development of innovative treatment strategies. In this context, a promising strategy for nitrogen removal consists on the utilization of biodegradable polymers that support the growth of a denitrifying biofilm and serve as a source of organic carbon.

Aim: To evaluate the feasibility and efficiency of nitrate removal by denitrification from groundwater using poly (ε-caprolactone) as a carbon source.



Methods

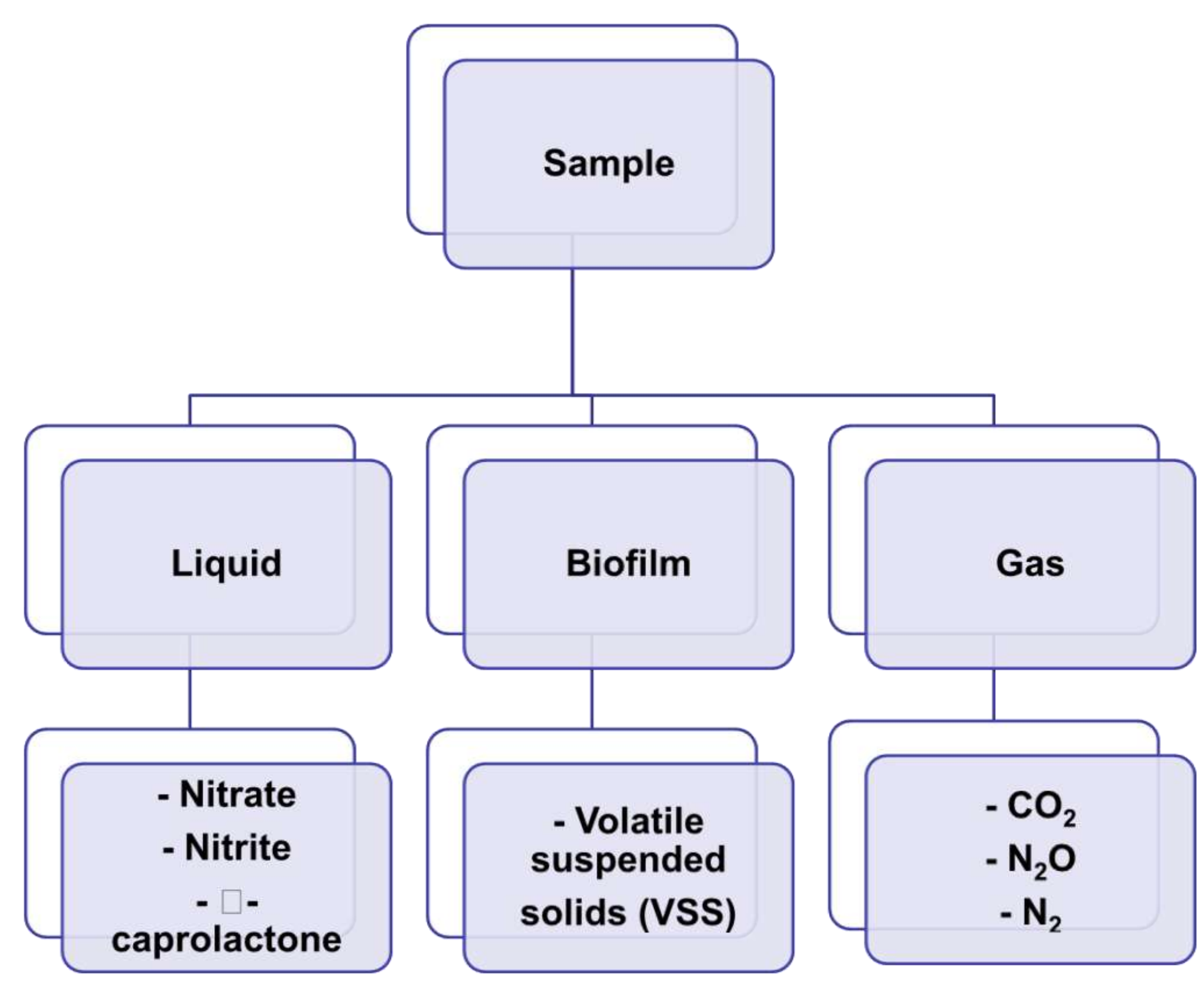
Experimental set up

Supports of PCL

- a column was filled with supports of PCL
- fed with simulated groundwater
- increasing concentrations of nitrate
- (10, 20, 30, 40 and 50 mg/L N-NO_3)
- pH was adjusted to 7.0
- a mixed culture was used as inoculum

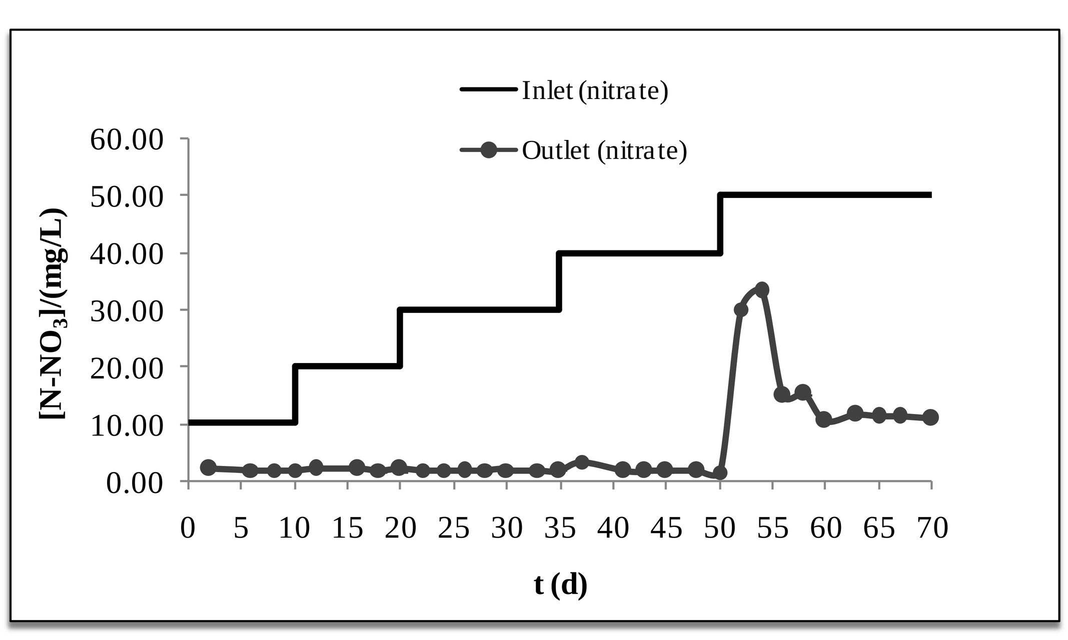
- velocity of 0.08 m/h
- flow rate of 1.83 mL/min
- temperature at 20 °C
- anoxic conditions

Analysis



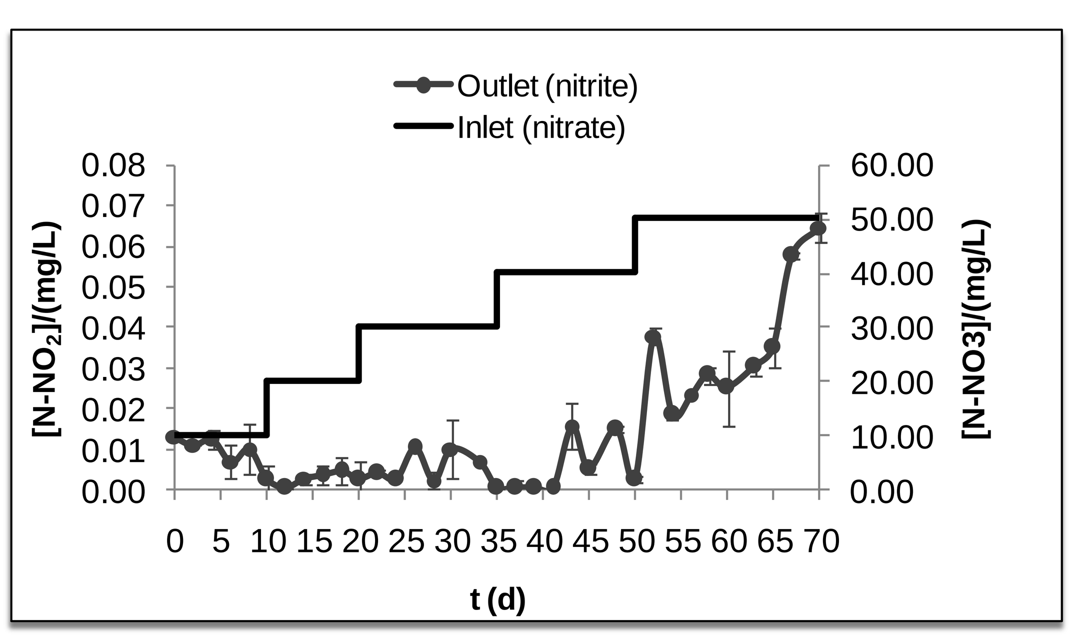
Results and discussion

Inlet and outlet nitrate concentrations



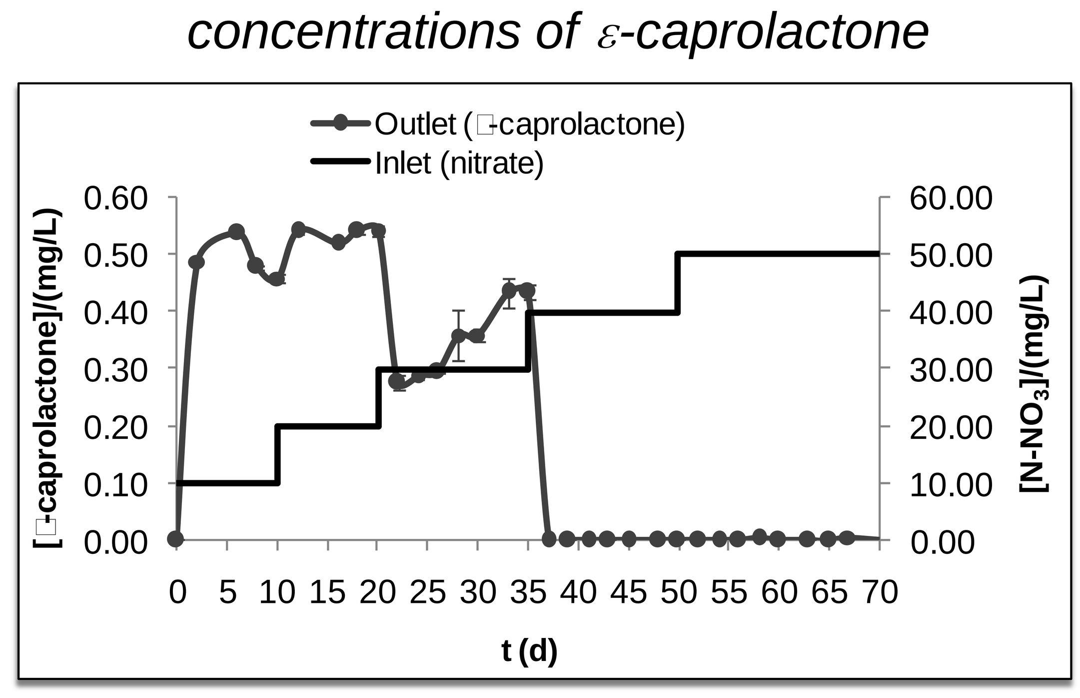
- ✓ Complete nitrate removal for inlet concentrations (10-40 mg/L N-NO_3).
- ✓ The maximum nitrate removal was 4.38 mg/L.h N-NO_3.

Inlet concentrations of nitrate and outlet concentrations of nitrite



- ✓ Outlet nitrite concentrations were very low.

Inlet concentrations of nitrate and outlet concentrations of ε-caprolactone



- ✓ Outlet ε-caprolactone concentrations were in all cases below to 0.54 mg/L.

Volatile suspended solids (VSS)

- Values increased from the beginning (0.08 g/L) to the end (0.15 g/L) of the experimental work

Gas composition

- values of N_2O were below 1.9 % for concentrations of nitrate between 10 and 40 mg/L N-NO_3 in the inlet, and 5.8 % for 50 mg/L N-NO_3

Conclusions

A maximum denitrification rate of 4.38 mg/L.h N-NO_3 was achieved at 20 °C and pH 7.0.

Denitrification was limited by nitrate for inlet concentrations lower than 40 mg/L N-NO_3 and limited by carbon for higher nitrate concentrations.

References

Wolfe, A.H. and Patz, J.A. (2002). Reactive nitrogen and human health: acute and long-term implications. AMBIO: A Journal of the Human Environment 31 (2), 120-125.

Rivett, M.O., Buss, S.R., Morgan, P., Smith, J.W.N. and Bemment C.D. (2008). Nitrate attenuation in groundwater: A review of biogeochemical controlling processes. Water Res. 42, 4215-4232.

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