NITRITE AS OXIDIZING POWER FOR *p*-CRESOL REMOVAL USING A DENITRIFYING SLUDGE: KINETIC STUDY

Gonzalez-Blanco G., Beristain-Cardoso R[1]., Cuervo-López F[1]., Cervantes FJ[2] and Gómez J[1].; Universidad Autónoma
[1]Metropolitana-Iztapalapa, Department of Biotechnology, Av. San Rafael Atlixco 186, C.P. 09340. México. Tel (52 55) 58044600; Fax: +52555804, gehovan25@yahoo.com.mx

[2]División de Ciencias Ambientales, Instituto Potosino de Investigación Científica y Tecnológica (IPICyT), Camino a la Presa San José 2055, Col. Lomas 4ª. Sección, San Luis Potosí, SLP, 78216 Mexico

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Introduction. Industrial wastewaters from chemical and petrochemical plants entering a water body represent a great challenge for treatment. The major part of wastewaters polluted with *p*-cresol derives from petrochemical industry where nitrite is also found(1). Denitrification is an economical and feasible process; however, metabolic and kinetic information is required in order to know and to control the limitations involved when nitrite is present or accumulated.
The goal of this study was study the kinetic behavior of a denitrifying sludge to reduce nitrite at several *p*-cresol-C (*p*-Cr) concentrations.

Methods. The sludge used for inoculating batch reactors was obtained from a continuous denitrifying reactor in steady-state denitrification feed containing acetate (2g/L) and nitrate (1.84g/L). Batch cultures were conducted in 160 mL serological bottles containing 60 mL of liquid medium. Bioassays were conducted by duplicate, and incubated for 55 h at 30°C in a shaker at 200 rpm. All batch cultures were inoculated with 2.0 ± 0.2 g VSS/L. The pH value was of 7.0 ± 0.5. Microbial performance was evaluated in terms of consumption efficiency (E, [g of N or C consumed/g of N or C fed] × 100), production yield (Y, [g of N or C produced/g of N or C consumed]) and specific rates (q, [mg of substrate or product/g VSS h]). The specific rates were calculated by the integrated Gompertz model(2). The mineral composition of the medium used and all analytical methods were previously described in González-Blanco(3). The analytical methods present a variation coefficient of less than 10%.

Results. From 10 to 45 mg *p*-Cr/L tested, nitrite reduction was linked to *p*-Cr oxidation and the specific rate increased up to 7.02 mg NO_2^--N/g VSS h, being CO_2 and N_2 end products. At higher initial *p*-Cr concentrations an inhibition was observed, diminishing the specific rate to 1.60 mg NO_2^--N/g VSS h., being CO_2, phenol, propionate and N_2 end products (Figure 1). Electron balance showed that *p*-Cr consumption was carried out by two biological processes; denitrification and fermentation. The kinetic profile followed the Haldane model, with inhibition constant (Ki) of 35.75 mg *p*-Cr/L, affinity constant (Ks) of 20.32 mg *p*-Cr L-1 and maximum specific nitrite reduction (*qmax*) of 9.48 mg NO_2^- .N/g VSS h.

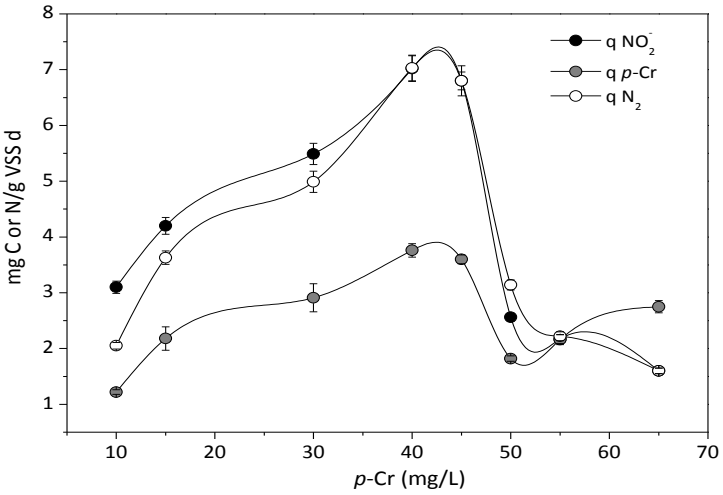

Fig 1. NO_2^--N and p-Cr consumption rates and specific molecular nitrogen production rates at several *p*-Cr concentrations evaluated in batch cultures.

Table 1. Electron balances in the batch cultures

p-Cr (mg L^{-1})	Total meq* Accepted [NO_2^--N → N_2]	Total meq* Donated [*p*-Cr → HCO_3^--C]	Observation
10	4.2 ± 0.13	4.1 ± 0.18	coupled
15	6.3 ± 0.22	5.9 ± 0.19	coupled
30	11.3 ± 0.28	12.2 ± 0.54	coupled
40	17.7 ± 0.56	17.7 ± 0.56	coupled
45	18.0 ± 0.72	18.0 ± 0.33	coupled
50	5.8 ± 0.24	11.6 ± 0.71	uncoupled
55	4.9 ± 0.24	11.3 ± 0.63	uncoupled
65	6.6 ± 0.15	11.2 ± 0.47	uncoupled

* meq= milliequivalents of electrons

Conclusions. The results suggested that *p*-cresol can be removed by denitrification and fermentation. Kinetic information should be considered for designing and operating denitrifying reactors to treat industrial wastewaters containing phenolic compounds and nitrite.

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