NITRITE POTENTIAL FOR PHENOL REMOVAL IN A CONTINOUS PACKED BED REACTOR

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Introduction. Phenol is a toxic compound and commonly found in effluents coming from petrochemical, tannery and paper industry. The removal of phenols has been accomplished using anaerobic, aerobic or anoxic (i.e. denitrification) reactors. Nowadays, several researchers have focused on the nitrification-denitrification process via nitrite, in order to optimize the process from the economic viewpoint. Nitrite can come from a nitrifying reactor, and it is used for denitrification. Nonetheless, nitrite is well known as uncoupling agent or inhibitory. In this context is necessary its study. The goal of this work was to evaluate the metabolic behavior of a microbial sludge to remove phenol and nitrite in a continuous packed bed reactor.

Method. Packed bed reactor (PBR) with working volume of 4.85 L was used. PBR was packed with polyethylene rings. Temperature was controlled by thermostat at 30 ± 0.2 °C, and experimental pH was of 7.6 ± 0.3. Reactor was fed with 200 mg NO_2^--N/L and 144 mg phenol-C/L in stoichiometric ratio. Residence time distribution (RTD) studies were carried out to analyze the hydrodynamics of the reactor by adding a pulse of inert tracer (methylene blue) to the reactor (Casablancas, 2005). RTD was evaluated at several hydraulic retention times (HRT) [5, 10 and 18 h]. PBR was inoculated with aerobic sludge coming from nitrifying reactor. El reactor was fed at two HRTs; 25 y 40 h., and the metabolic process was evaluated in terms of consumption efficiency [*E*%; (mg substrate consumed/mg substrate fed)*100] and denitrifying yield (*Y*-N_2; mg N_2 produced/mg NO_2^--N consumed).

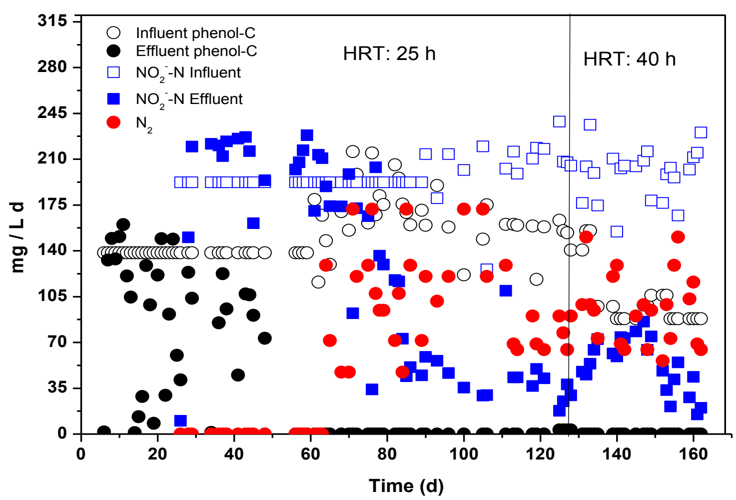
Results. Using the calculated dispersion numbers it can be concluded that the flow pattern within the reactor was intermediate between plug-flow and perfectly mixed under all the conditions tested; tending more to a mixed flow reactor (Table 1). Any deviation from ideality could have been caused by channeling of the liquid through the packed bed, or by the creation of dead spaces in the reactor. In fact the dead volumes were around 40% for all cases.

Table 1 Residence time distribution in the PBR

HRT (h)	Methylene blue (mg)	σ_{adim}^2	1/Pe (Peclet)
5	60	0.38	0.26
10	60	0.27	0.16
18	60	0.30	0.30

Fig. 1 shows the performance of PBR fed with phenol and nitrite. At the HRT of 25 h., *E*% for phenol and nitrite were 98.9±1.1% and 83±8%, respectively. Nitrite was recovered as N_2, with a *Y*-N_2 of 0.66±0.38. HRT was increased to 40 h in order to enhance nitrite removal. However, *E*% and *Y*-N_2 did not significantly change. Beristain-Cardoso et al. (2009) observed that nitrate was totally recovered as N_2 in a continuous reactor fed with phenol and nitrate in stoichiometric ratio. In the present work, nitrite was reduced to N_2 and the other fraction was used by biomass growth. In this context, results suggested that nitrite might modify the outcome of the metabolic process.

Figure 1 Profiles of nitrogen and carbon compounds in the packed bed reactor



Conclusions. The hydrodynamic study suggested that the flow pattern inside the reactor tended more to a mixed flow reactor. Microbial sludge showed the metabolic capability for oxidizing phenol using nitrite as electron acceptor. This research showed the nitrite potential to oxidize phenol in a continuous packed bed reactor.

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References

Beristain-Cardoso R., Texier A. C., Alpuche-Solís A., Gómez J and Razo-Flores E. (2009). Phenol and sulfide oxidation in a denitrifying biofilm reactor and its microbial community análisis. Process Biochemistry, 44, 23-28

Medioambientales y Tecnológicas.Ingeniería Bioquímica Francesc Gódia Casablancas y Josep López Santín., Editorial Sintesis, S.A . Primera Edición 2005, España.