2904 FLUIDIZED BED BIOREACTORS COUPLED TO ZERO-VALENT IRON FILTERS FOR REMOVAL OF HIGH CONCENTRATIONS OF PERCHLOROETHYLENE

Poggi-Varaldo H.M.[1], Herrera-López D.[1], García-Mena J.[2], Ríos-Leal E.[1]
[1] Environmental Biotechnology and Renewable Energies R&D Group, Dept. Biotechnology & Bioengineering, Centro de Investigación y de Estudios Avanzados del I.P.N., P.O. Box 14-740, México D.F. 07000, México. Tel: 5747 3800 x 4324 and 4321; Fax : 5747 3313; E-mail: hectorpoggi2001@gmail.com. [2] Dept. of Genetics and Molecular Biology, Centro de Investigación y de Estudios Avanzados del I.P.N. MEXICO.

The aim of this work was to evaluate the effect of coupling continuous bioreactors with zero-valent iron filters on removal of PCE. Two types of reactors with simultaneous electron acceptors were used: partially aerated methanogenic (PAM) and methanogenic-denitrifying (M-D). Lab-scale fluidized-bed reactors (FBBR) were operated as follows: PAM at λ = 135 g COD/g O_2 and M-D at λ = 9 g COD/g N-NO_3^- with 80 mg/L of PCE in the influent. It is worth highlighting that this PCE concentration is very near the saturation concentration of PCE at 35 ºC (90 mg/L). Two periods of operation were run, namely Period 1 and Period 2, where the only difference consisted of the coupling of bioreactors to zero-valent iron filters fitted in the recirculation line. Both reactors were fed with 1 g COD methanol/L as carbon source in the two periods. Bioreactors were operated at 1-day hydraulic retention time and 35 ºC. Each reactor was fitted with an activated carbon trap in the biogas exit line in order to capture and determine volatilized CACs. Average performances of both bioreactors were very close, and no significant differences were found between periods. PCE removal was high and similar in both reactors (99.58 and 99.69 for PAM and M-D respectively) and both Periods. COD removal averaged between periods was slightly higher in M-D (92.3%) than in PAM (89.9%). Trichloethylene (TCE) concentration in effluents was low in both reactors in both Periods and concentrations of dichloroethylene (DCE) and vinyl chloride (VC) in influent were below levels of detection of the method. Traces of ethylene were found in biogas. Concentrations of PCE, TCE, DCE and VC were periodically determined in bed bioparticles as well as in the activated carbon of a biogas trap and were found to be very low; abiotic removal of PCE and intermediates was negligible compared to the overall removal, strongly suggesting biological degradation as the main driving force in our FBBRs. It can be concluded that there were no significant differences between biochemical performances of the two systems between periods. In fact, removal efficiencies of PCE without ZVI were already so high that there was little room for improvement by the addition of the ZVI filters. Fitting ZVI filters to our simultaneous electron acceptor bioreactors should be conceived more as a safety factor for dealing with negative transients caused PCE surges or hydraulic rate shocks rather than an improvement of their background performance.

2909 BIOLOGICAL TREATMENT SYSTEMS APPLIED TO THE DEGRADATION OF CHLORINATED ORGANIC COMPOUNDS: REVIEW OF ADVANCES AND PERSPECTIVES

Bárcenas-Torres J.D.[1], Garibay-Orijel C.[1], Macarie H.[3], García-Mena J.[2], Poggi-Varaldo H.M.[1]
[1] Environmental Biotechnology and Renewable Energies R&D Group, Dept. Biotechnology & Bioengineering, CINVESTAV del I.P.N. P.O. Box 14-740, 07000, México D.F., México Tel: 5255 50613800 x 4324. Fax: 5255 50613313, E-mail: hectorpoggi2001@gmail.com.; [2] Depto. Genética y Biología Molecular; CINVESTAV del I.P.N. México D.F., MEXICO.
[3] IRD, IMEP, Marseille, FRANCE. E-mail: herve.macarie@ird.fr.

Biological treatment of municipal and industrial wastewater it is a field well developed, very well known technologies, and of great application for control of water contamination. Biological treatment of wastewater has been carried out mainly by sole aerobic and anaerobic treatment. Nevertheless, the chlorinated organics compounds usually are recalcitrant to the degradation in biorreactores with a single acceptor of electrons: O_2 in aerobic, CO_2 in methanogenic, NO_3^- in denitrifying systems, and $SO_4^=$ in sulfate-reducing systems. In the last 15 years a particular approach to biological wastewater treatment has attracted considerable attention: bioreactors possessing several electron acceptors in the same vessel (simultaneous electron acceptors, SEA). The objective of this work is to review the state of the art on the biological treatment of chlorinated compounds with dominant environmental (aerobic, anaerobic, combinative systems in series) and SEA bioreactors. Aerobic bioreactors are efficient for the removal of chlorinated compounds with low and intermediate levels of chlorination (for example Dichlorophenols and Chlorophenols), whereas studies reporting the application of these systems to higher substituted chlorine organic substances are scarce and discouraging. Anaerobic biological treatment has been widely used for removal of chlorinated xenobiotics and highly persistent pollutants. Particularly, for chlorophenols, they mainly emphasize the use of bioreactors of immobilized biomass, such as the Upflow Anaerobic Sludge Bioreactors (UASB), anaerobic filters (packed beds) and more recently anaerobic fluidized bed bioreactors (FBBR). Anaerobic treatment of chlorinated compounds such as chlorophenols, has been shown to be very efficient for the dechlorination and degradation of halogenated organics with high degree of chlorine substitution in the aromatic ring. Yet, very often there exists accumulation of compounds with lower levels of chlorination. This becomes a serious disadvantage as far as the fulfillment of discharge regulations and treatment cost. Methanogenic-Aerobic Systems (MAS), where simultaneous aerobic and anaerobic metabolisms coexist in the bioreactor, can be easily accomplished in immobilized biomass bioreactors. In effect, microbial aggregates distribution like bioparticles in FBBR, allows for oxygen consumption by facultative bacteria at the outer layers of the biofilm, whereas strict anaerobic bacteria and methanogenic archaea can grow under anaerobic conditions in the inner layers of biofilm. Several works have shown the tolerance of methanogenic consortia to O_2. MAS has several advantages over sole anaerobic or aerobic treatment systems, e.g. (i) it can have both aerobic and anaerobic degradative pathways, (ii) slow biomass growth like in anaerobic reactors may be achieved with related savings in sludge disposal, (iii) since we have two metabolisms in the same vessel, operational costs are reduced compared to 2-stage series biological processes. Without any doubt, the evolution of methanogenic reactors to SEA bioreactors, is a consequence of the success and wide acceptance of the anaerobic digestion as a wastewater treatment option. Finally, MAS is a promising alternative for the efficient removal of toxic and persistent substances in wastewater and polluted groundwater, particularly for the class of xenobiotics that cannot be degraded, or they are only degraded of incomplete form in bioreactors with one electron acceptor.

3IMEBE

21·25 September 2008
Palma de Mallorca. Spain

THE THIRD INTERNATIONAL MEETING ON ENVIRONMENTAL BIOTECHNOLOGY AND ENGINEERING

Edited by:

Isabel Sastre Conde, Hervé Macarie, Gerardo López López, Ana Mª Ibáñez Burgos
Carme Garau, Joana María Luna, Joan March, Antoni Martorell
Margalida Colombas, Jaume Vadell, Jeroni Vera
Jose Luis Sanz

Members of the 3IMEBE Organization

Design of the Draws by: Macarena Moreno Moreno

GOVERN de les ILLES BALEARS
www.illesbalears.cat
Conselleria d'Agricultura i Pesca

Published by: Govern de les Illes Balears
Conselleria d'Agricultura i Pesca
Eusebio Estada, 145. Palma de Mallorca. Balearic Island. SPAIN

Edited by:
Isabel Sastre Conde, Hervé Macarie, Gerardo López López, Ana Mª Ibáñez Burgos
Carme Garau, Joana María Luna, Joan March, Antoni Martorell
Margalida Colombas, Jaume Vadell, Jeroni Vera
Jose Luis Sanz

Members of the 3IMEBE Organization

Design of the Draws by: Macarena Moreno Moreno
III Campus Universitario. 28300 Aranjuez. Madrid. SPAIN

Design and printing: Gràfiques Terrasa

ISBN: 978-84-692-4948-2
Deposito Legal: PM-1549-2009