O-17 - ACCELERATION OF ANAEROBIC REACTIONS BY CONDUCTIVE CARBON NANOMATERIALS

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Abstract

Anaerobic processes are environmentally friendly solutions for the decontamination of a wide range of recalcitrant compounds, while generating energy through the production of methane, a renewable energy source. The rates of anaerobic biotransformations are often slow, but the amendment with carbon-based conductive materials (CBCM) has been reported to accelerate the microbial conversions. For example, methane production from organic compounds could be accelerated in the presence of CBCM, which has been often justified by the occurrence of direct interspecies electron transfer (DIET), between anaerobic bacteria and methanogens, over the typical electron exchange via hydrogen or formate. However, in these studies the effect of conductive materials towards individual microbial species was never determined and therefore it is difficult to conclude whether it influences the entire microbial community and changes the electron transfer mechanism between distinct microbial groups, or whether it only stimulates the activity of specific groups of microorganisms. In our laboratory, we have been investigating the effect of CBCM in two main research areas: in the anaerobic biodegradation of organic pollutants, and in the activity of pure cultures of methanogens and in syntrophic co-cultures.

Method

Different CBCM (activated carbon, carbon xerogels, carbon nanotubes (CNT) and magnetic nanomaterials (CNT@2%Fe)) were tested as catalysts during anaerobic biodegradation of azo dyes and aromatic amines, in batch assays and in continuous bioreactors. Increasing concentrations of multi-walled CNT were added to pure cultures of hydrogenotrophic or acetoclastic methanogens, and also to a syntrophic co-culture converting butyrate to methane. The rates of azo dyes reduction and methane production were determined in the presence and in the absence of CBCM.

Results and Conclusions

CBCM increased significantly the reduction rates of azo dyes and aromatic amines in both biotic and abiotic anaerobic conditions, by acting as electron shuttles. Best results were obtained with CNT@2%Fe which improved the rates of azo dyes reduction up to 79-fold [1]. Moreover, this material can be easily recycled and used as catalyst in successive cycles due to its magnetic properties. Methanogenic activity of pure cultures of methanogens was considerably enhanced in the presence of CNT [2]. Particularly, methane production rate of M. formicicum increased 17 times in the presence of CNT, showing that CBCM can directly stimulate methanogenic microorganisms. Application of CBCM revealed to be an efficient strategy to improve the anaerobic treatment of different types of wastewater.

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