Remediation of azo dyes by natural manganese oxides

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In the present work, the degradation of azo dyes (60 mg/L) and aromatic amines (60 mg/L) in the presence of natural Mn oxides was investigated in batch experiments. A 1/10 (w/v) solid/solution ratio was used.

Discussion

Dyes Acid Orange 7 and Acid Yellow 36 were decolourised by the manganese oxide (natural pH of 8-9), indicating that they were either being degraded or adsorbed onto the mineral surface[1]. As no sterilised Mn oxide samples were used, the possibility of the reactions being solely biologically mediated cannot be discounted. Experiments performed in the absence and presence of nutrients also gave different results.

The biological activity of these systems was assessed by using molecular biological techniques such as DNA extraction followed by Polymerase Chain Reaction (PCR) [2]. Results indicate the presence of microorganisms in all samples analysed.

Conclusions

The ability of natural ‘waste’ Mn oxide compounds to undergo oxidation and reduction reactions makes them suitable to be used as redox mediators (electron shuttles) in the degradation of azo dyes and aromatic amines in natural environments. It is not clear from these experiments whether this process is either a chemically and/or a biologically mediated processes.

References

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Biogeochemical and mineralogical characteristics of the acid mine drainage system in Aljustrel and S. Domingos mines, Iberian Pyrite Belt

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Aljustrel and S. Domingos are important mines of the Iberian Pyrite Belt, the former currently active and the latter closed since the sixties. Both systems were sampled and analysed. Samples included old and recent mine taillings, stream sediments, surface waters, and biological material (algae). Acid drainage is very similar in both areas but acid waters in Aljustrel have 7 to 8 times higher metal concentrations than in S. Domingos. However, in S. Domingos the system is much more contained.

Aljustrel: Água Forte stream drains the major taillings. This stream receives domestic waste-waters 2 Km away, which act as a neutralizing agent to the acid waters (pH 2). Waste-waters pH is ≈8, and drops to values near 4 upon mixing with the acid waters. In Summer, acid drainage stops but waters down-stream maintain their pH close to 4. The ubiquitous presence of gypsum and jarosite in sediments and crusts provide a source for acidity due to their dissolution. Sediments down-stream have iron-rich surface layers and dark coloured material in the deeper layers (sulphides?). Modelling results show that such pH values may be attained only if precipitation of iron oxides and sulphides occur during mixing of waters. Water samples from sites with abundant iron-oxide sediments present the association *Acidithiobacilus ferrooxidans*, *Leptospirillum ferrooxidans*, *Acidithiobacilus albertensis*, and *Leptospirillum ferriphilum*.

S. Domingos: Has a much more complex secondary mineral assemblage: gypsum, jarosite, schulenbergite, natrojarosite, szomolnokite, and coquimbite. Along the major flow path from the dams and pits, both water chemistry and parameters do not change apreciably.

Algae from both mining areas were centrifuged to extract part of their water content, and their tissues were dissolved. Concentrations of Cu and Zn in the organic material were 3 to 4 times lower than in the liquid extracts, whose concentrations were about half the corresponding concentrations in the flowing waters. Pb, Co, and Cd have only trace concentrations.

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