Biocatalysis for Environmental Clean Up: Past, Present and Future Developments

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Widespread environmental pollution by a variety of chemicals including emerging micropollutants necessitates the development of novel strategies of mitigation and restoration. Decades of research in environmental biotechnology have evidenced the effectiveness of cell-free enzyme processes regarding pollutant removal at lab- and pilot-scale. In particular, enzyme catalysis combined with physicochemical technologies, such as membrane filtration and electrochemistry, seems to be advantageous over conventional treatments with respect to process performances and energy input requirements [1].

For instance, hydrolases (*e.g.* cellulase, chitinase, keratinase) can transform complex heterogeneous biological polymer wastes from agri-food industries into more biodegradable and bioavailable compounds for further downstream bioprocessing. Oxidoreductases (*e.g.* laccase, peroxidase) and lyases (*e.g.* nitrile hydratase) can convert anthropogenic pollutants (plasticizers, drug residues, textile dyes, nitriles, *etc.*) into less toxic compounds amenable to microbial degradation and enhanced natural attenuation.

The limited number of enzymatic field applications points out the imbalance between the biocatalytic process performances and the overall process cost, which is even more pronounced in a low-value added sector like the environment. Current research in enzyme technology aims at making environmental biotechnology an industrial reality by searching for enzymes with enhanced activities through prospecting and enzyme engineering, and by increasing biocatalyst performances through enzyme immobilization and reactor design.

References

1. P. Demarche, C. Junghanns, R. R. Nair and S.N. Agathos, *Biotechnol Adv*, in press, doi:10.1016/j.biotechadv.2011.05.013