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Biological combination processes for efficient removal of pharmaceutically active compounds from wastewater: a review and future perspectives

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Abstract

Pharmaceutically active compounds are widely diffused in surface and ground water, entering the environment mainly through treated wastewater discharges, aside from specific sources such as pharmaceutical industry discharges, and threatening safety and use of water resources. Among various technologies that have been developed and applied to remove these compounds prior to discharge, membrane biological reactors (MBRs) and bioelectrochemical systems (BESs) have both shown encouraging results. MBRs have shown good removal efficiencies on a wide range of different compounds, both at the laboratory and full scales. In order to achieve the desired removal performances, the technology can be improved with additional features, such as activated carbon adsorption, carrier media for enhanced biofilm growth, and others. BESs, on the other hand, have shown that it is possible to produce energy while treating wastewater. This paper reviews and discusses current state-of-the–art technologies for pharmaceutically active compounds removal using MBRs and BESs, with a particular focus on innovative configurations; the future use of MBR-BES systems is also discussed.

Keywords: pharmaceutically active compounds, wastewater treatment, membrane bioreactors, microbial electrochemical technologies, microbial fuel cells, microbial electrolysis cells