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Removal of drugs of abuse from municipal wastewater using reverse osmosis membranes

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ABSTRACT

Drugs of abuse are important emerging contaminants due to their presence in water bodies following incomplete removal in wastewater treatment. This poses a threat to drinking water sources and has led to concerns about possible health effects, both to wildlife, ecosystems and humans. In recent years, there has been growing interest in the incorporation of reverse osmosis (RO) and nanofiltration (NF) membrane technologies into existing municipal and industrial wastewater treatment facilities as a quaternary treatment option. By improving effectiveness of wastewater treatment, the exposure of firstly, nature and secondly, humans to these compounds can be minimized. It has been suggested that these membrane techniques are suitable for cost-effective desalination and the removal of a wide range of low-molecular-weight (LMW) trace organic constituents, including drugs of abuse. This paper presents the detailed results of a feasibility assessment study on the removal of selected drugs and metabolites from secondary treated wastewater. The study was carried out at a small scale RO pilot plant. Three different FILMTEC™ brackish water membranes were used; low energy (LE) membrane, high rejection membrane (BW30) and extra fouling resistant membrane (XFR). The results show that RO membranes can reduce the amount of target compounds in the effluent water. The obtained mean rejection values for the three membranes and six monitoring campaigns were as follows: 74–83% (caffeine), 49–63% (nicotine), 94–96% (cotinine), 98–99% (codeine), 98% (norcodeine), 81% (METH), 57–64% (MDA), 93–96% (MDMA) and 47–57% (MDEA). No major differences were observed between the three different membranes. This indicates that the low energy RO membrane provides the same removal efficiency as the other two membranes, thus demonstrating the potential for a less energy intensive RO plant operation.

Keywords: Reverse osmosis (RO); Drugs of abuse rejection; Removal efficiency

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