

Contaminant of Emerging Concern (CEC) in Potable Reuse

Evaluating occurrence of contaminants of emerging concerns in MF/RO treatment of primary effluent in a novel water recycling process

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This study experimented with the novel approach of using a microfiltration (MF) and reverse osmosis (RO) treatment train to treat the effluent of a primary treated wastewater and measure the occurrence of CECs in the MF influent, MF effluent, RO permeate, and RO concentrate.

Mission Issue

Increasing water supplies through treatment of impaired water sources such as wastewater for potable reuse helps to augment potable water supplies.

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Problem

The water industry is increasingly implementing recycled water projects to respond to current demands and challenges, such as water shortages, that the world faces today. To develop future water supplies that remain sustainable in dry years, water managers and their communities will heavily rely on reclamation plants and their abilities to make wastewater a viable source of potable water.

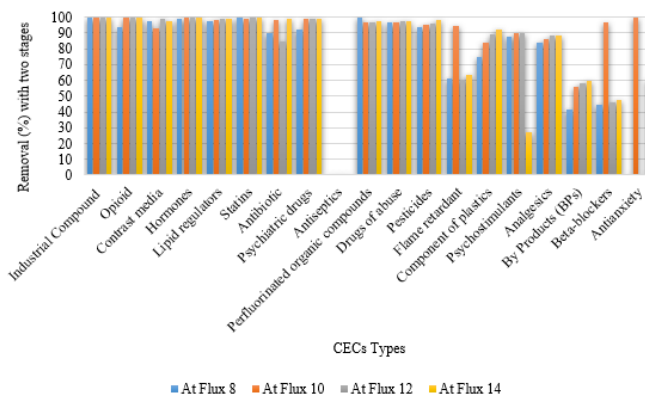
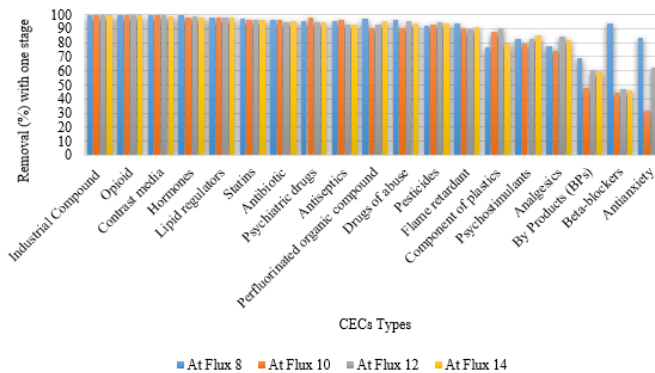
One of the key issues related to water reuse is the occurrence of CECs. Some contaminants, even at low concentrations, pose a threat to public health and safety, given the potential effects of long-term exposure. Prime examples of emerging contaminants include personal care products (PCPs), endocrine disrupting compounds, and pharmaceuticals; in particular, an expanding list of pharmaceuticals are now being found ubiquitously in the. Effluent of wastewater treatment plants' (WWTPs) contains large concentrations of CECs that are usually naturally occurring in water bodies.

Recent innovations in water analysis methods, primarily in gas chromatography mass spectrometry (GC-MS) and liquid chromatography (LC-MS), have allowed the industry to develop a more comprehensive understanding of contaminants. At the least, CECs have been found to present potential risks to water supplies due to their physiochemical properties, such as poor degradability and high water solubility.

The objectives of this study are to (a) evaluate the occurrence of CECs in MF/RO treatment of a WWTP's primary effluent and (b) demonstrate the effectiveness of MF/RO in treating primary effluent as a novel water recycling process.

Solution

This study investigated the removal of 38 different CECs in the pilot scale with different applied fluxes. In the first phase (1-stage RO), the flux of 14 gfd showed a better rejection value of 95.2% when compared with those of other fluxes. In the second phase (2-stage RO), the flux of 12 gfd showed a better rejection value of 93.7% when compared with those of other fluxes. Statistical analysis revealed that there is no significant difference between different fluxes.



Removal of CECs with different fluxes for phase one and phase two.

“The effect of CECs on the public health and the environment has urged water managers to more actively implement strategies that remove these compounds not only from drinking water but also from the wastewater treatment process.”

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More Information

<https://www.usbr.gov/research/projects/detail.cfm?id=4243>

Application and Results

The results showed that 1-stage RO with a 55% recovery rate had a better removal rate of CECs when compared with 2-stage RO with an 80% recovery rate. As the concentration gradient of contaminants increased across the membrane at the higher recovery rate, the overall removal rate decreased for various compounds.

Azithromycin, hormones, carbamazepine, diazepam, gemfibrozil, atorvastatin, methadone and iopromide were removed the most effectively by RO in both phases. All these compounds have MW >200 g/mol. All those CECs also have hydrophobic characteristics; therefore, the RO process was able to remove them efficiently. In contrast, NDMA, propranolol, acetaminophen and meprobamate were the least effectively removed, given their low MW (less than 200 g/mol).

Future Plans

Larger scale testing to investigate the fate of CECs in the various streams of the treatment process will need to be investigated in future pilot studies.