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Editorial

Using Different Tools to Evaluate Reverse Osmosis (RO) Drinking Water Treatment

Kate Wilson*

Editorial office, Journal of Membrane Science and Technology, Spain

EDITORIAL NOTE

The ability of Reverse Osmosis (RO) to remove organic micro pollutants from a range of water matrices has been demonstrated. Under the driving force of an externally applied pressure, semi-permeable membranes remove solutes from water molecules. Solvent and solutes are transferred to the permeate side independently via their transmembrane chemical potential gradient in a solution–diffusion mechanism through RO membranes. Organics' diffusion is hampered mostly by compound size, which is regulated by the charge and hydrophobicity of solutes and membranes. Physical separation is the basic mechanism for chemical removal by RO, therefore by-products are unlikely unless the membrane integrity is damaged or the feed water is disinfected. Despite the fact that RO is an energy-intensive step when used in traditional treatment trains, stand-alone RO applications to produce potable water from natural waters with minimal pre-treatment have emerged, presenting a new scenario for achieving excellent removal of harmful chemicals and waterborne pathogens with low operational costs and environmental impact. The use of RO as a single-step treatment for producing high-quality drinking water from riverbank filtrate has been proposed. Riverbank Filtration (RBF) is an energy-efficient process that happens naturally or can be produced in catchment areas impacted by anthropogenic activities to improve source water quality. RBF can reduce micro pollutant levels due to biodegradation and sorption processes that occur mostly in the hypothetic zone and to a lesser extent in the aquifer. The biogeochemical circumstances of RBF systems, as well as the physicochemical features of molecules, have a significant impact on the fate of polar organics. By hydrophobic and electrostatic interaction mechanisms, sorption is typically effective in retaining non-polar, moderately hydrophobic compounds and cationic compounds, whereas neutral hydrophilic substances and anionic organics can pass through the hypothetic zone and remain unchanged if they are not biodegraded. The use of stand-alone Reverse Osmosis (RO) to produce high-quality drinking water from raw riverbank filtrate contaminated by anthropogenic activities has been proposed. Biological analyses were integrated with non-target screening utilising high-resolution mass spectrometry and open cheminformatics tools to assess RO performance in eliminating organic micro pollutants. In the Ames-fluctuation test, the bank filtrate caused xenobiotic metabolism via the Aryl Hydrocarbon Receptor (AhR), adaptive stress response via the transcription factor Nrf2, and Geno toxicity via the transcription factor Nrf2. The absence of these effects in the RO permeate (product water) indicates that bioactive micro pollutants are removed by RO membranes The confirmed compounds' bioactivity data showed that 2,6-dichlorobenzamide and bent zone in water samples can contribute to AhR activation and the oxidative stress response. The bioactivity data of seven compounds that were tentatively identified with high confidence suggested that these structures could play a role in the production of these effects. This research found that riverbed filtration followed by RO may generate drinking water that was free of the harmful effects evaluated. In full-scale drinking water treatment, Reverse Osmosis Filtration (ROF) directly applied to a raw riverside filtrate was capable of produce potable water with no evident harmful effects in the applied battery. Enriched bank filtrate activated toxicity pathways related to xenobiotic metabolism, adaptive stress response, and Geno toxicity. It would only take a 6- to 8-fold concentration of this ROF to elicit cellular damage pathways in the gene reporter tests. The lack of hormone receptor-mediated effects found when RO feed water was investigated suggested that RBF may have a role in attenuating endocrine disruptive chemicals. The water used in this investigation came from anthropogenically impacted surface waters confirming RBF's appropriateness as a drinking water pre-treatment. RO is extremely effective in eliminating compounds that can cause specific and non-specific possibly hazardous effects, according to the bioanalytical methods utilised in this investigation.

Correspondence to: Kate Wilson,Editorial Office, Journal of Membrane Science and Technology, Spain, E-mail:membranescitechnol@journalres.com

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