

Effects of hypochlorite exposure on morphology and trace organic contaminant rejection by NF/RO membranes

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Abstract. The impacts of membrane degradation due to chlorine attack on the rejection of inorganic salts and trace organic contaminants by nanofiltration (NF) and reverse osmosis (RO) membranes were investigated in this study. The rejection of trace contaminants was examined at environmentally relevant concentrations. Changes in the membrane surface morphology were observed as a result of chlorine exposure. A small increase in rejection was consistently observed with all four membranes selected in this study after being exposed to a low concentration of hypochlorite (100 ppm). In contrast, a higher concentration of hypochlorite (i.e., 2000 ppm) could be detrimental to the membrane separation capacity. Membranes with severe chlorine impact showed a considerable decrease in rejection over filtration time, possibly due to rearrangement of the polyamide chains under the influence of chlorine degradation and filtration pressure. The reported results indicate that loose NF membranes are more sensitive to chlorine exposure than RO membranes. The impact of hypochlorite exposure (both positive and negative) on rejection is dependent on the strength of the hypochlorite solution and is more significant for the neutral carbamazepine compound than the negatively charged sulfamethoxazole.

Keywords: nanofiltration; reverse osmosis; water recycling; hypochlorite; membrane degradation; trace organic contaminants

1. Introduction

Potable water scarcity presents a major challenge to water authorities in many regions in the world particularly in the context of on-going climate change and continuing population growth (Shannon *et al.* 2008). A strategic approach to address this issue is the augmentation of the natural water supply with reclaimed water from treated effluent using advanced water treatment technologies including high-pressure membrane processes such as reverse osmosis (RO) and nanofiltration (NF) (Fujioka *et al.* 2012, Wintgens *et al.* 2005). Most commercially available NF and RO membranes for water treatment are polyamide thin-film composite (TFC) and consist of a thin polyamide active skin layer that is responsible for solute separation on top of a porous supporting layer (Chang *et al.* 2010). Polyamide membranes offer excellent permeate flux, high salt and trace organic rejection, durability and a wide operating pH range, however, they are susceptible to chlorine degradation. This particular drawback of polyamide membranes has an

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