Ozone: Science & Engineering, 35: 208–216

ISSN: 0191-9512 print / 1547-6545 online
DOI: 10.1080/01919512.2013.771940

Effect of Ozone in UF-Membrane Flux and Dissolved Organic Matter of Secondary Effluent

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The focus of this work was to determine the effect of ozone on the removal of dissolved organic matter (DOM) from a secondary effluent and its relation with the permeated flux behavior in an ultrafiltration membrane. To assess the ozone action, the DOM of the secondary effluent was fractionated into its hydrophobic, transphilic and hydrophilic fractions, using XAD-8 and XAD-4 resins. Ozone increased the hydrophilic fraction from 32% to 42%, and this percentage remained unchanged after ultrafiltration of the secondary effluent. Permeate flux dropped to 52% in the first hour of membrane operation, but when ozone was applied as a pretreatment, it could be maintained at 84% within the first hour.

Keywords Ozone, Dissolved Organic Matter, Fraction, Ultrafiltration

INTRODUCTION

In Mexico City as in other areas of the world, aquifers that supply drinking water are being used faster than they are recharged. Reuse of treated wastewater through groundwater recharge is an alternative to compensate water scarcity. In some developing countries, aquifer recharge can be prompted by wastewater used for irrigation. In that case, aquifers can be highly contaminated, as shown in previous literature (Foster et al. 2003; Jiménez and Garduño 2001). Advanced water treatments are an alternative to ensure an appropriate wastewater treatment and subsequent reuse in aquifer recharge. Dissolved organic matter (DOM) from secondary treated sewage effluents is constituted by non-biodegradable dissolved organic carbon (DOC) composed of recalcitrant organic substances (Dignac et al. 2000). DOM is usually defined as the remnant organic matter after filtration through 0.45 μm filters. It is a complex mix of aromatic and aliphatic structures including amides, carboxyl, hydroxides, ketones and other functional groups (Leenheer and Croué 2003). Additionally, DOM can produce problems like odor, color or flavor, and contribute to the formation of disinfection by-products.

Membrane processes can effectively remove organic and inorganic pollutants present in wastewater; however, the low permeability caused by membrane fouling has become the central problem in the application of membrane technology (Wang et al. 2008). Latest research has been focused on the effects and comparisons of hydrophobic matter with hydrophilic matter on membrane filtration (Linhua et al. 2001; Zularisam et al. 2007). The hydrophilic neutral component has been reported in some works, as the prime contributor to NOM membrane fouling and flux decline during membrane filtration (Linhua et al. 2001).

Ozone is a powerful oxidant that preferentially oxidizes electron rich moieties containing double carbon bonds and aromatic alcohols (Langlais et al. 1991). It can break the structure of natural organic matter (NOM) and enhance the transformation of compounds from high to low molecular weight. Examples of this compound are: carboxylic acids, hydrophilic acids, carbohydrates and amino acids. The application of ozone prior to membrane filtration can reduce membrane fouling and enhance permeate flux. Ozonation of organic matter may also produce oxygenated functional groups that may be coupled with calcium ions to form soluble calcium complexes, thereby reducing the formation of calcium carbonate precipitate (You et al. 2007).

Studies showed that preozonation time in secondary effluents affected the membrane resistance and the apparent molecular weight distribution of dissolved organic matter (Wang et al. 2007). Literature also reports that combined ozonation and membrane filtration processes can reduce dissolved organic carbon up to 50% in drinking water, and

Received 5/4/2012; Accepted 11/2/2012
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