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ORIGINAL PAPER

Influence of operating conditions on performance of ceramic membrane used for water treatment

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The removal of natural organic matter (NOM) is a critical aspect of potable water treatment because NOM compounds are precursors of harmful disinfection by-products, hence should be removed from water intended for human consumption. Ultrafiltration using ceramic membranes can be a suitable process for removal of natural substances. Previously reported experiments were dedicated to evaluating the suitability of ultrafiltration through ceramic membrane for water treatment with a focus on the separation of natural organic matter. The effects of the membrane operating time and linear flow velocity on transport and separation properties were also examined. The experiments, using a 7-channel 300 kDa MWCO ceramic membrane, were carried out with model solutions and surface water at trans-membrane pressure of 0.2–0.5 MPa. The results revealed that a loose UF ceramic membrane can successfully eliminate natural organic matter from water. The permeability of the membrane was strongly affected by the composition of the feed stream, i.e. the permeate flux decreased with an increase in the NOM concentration. The permeate flux also decreased over the period of the operation, while this parameter did not influence the effectiveness of separation, i.e. the removal of NOM. It was observed that the increased cross-flow velocity resulted in the decrease in the membrane-fouling intensity and slightly improved the retention of contaminants.
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Keywords: surface water treatment, natural organic matter, low-pressure membranes, ultrafiltration, ceramic membrane

Introduction

Nowadays, the direct use of natural water in domestic and industrial applications is rendered almost impossible due to its contamination. Water pollution is consistent with basin industrialisation, level of environmental deterioration and atmospheric conditions in the area. In typical surface water, anthropogenic organic contaminants are to be found, e.g., polycyclic aromatic hydrocarbons, pesticides, surfactants, and crude oil derivatives. These substances impair living organisms, disrupt the water's biological balance, and also hinder treatment due to its trace presence and seasonal concentration changes. The other contaminants commonly found in surface water, which in terms of water treatment are no less burdensome than anthropogenic contaminants, are natural organic substances (Liu et al., 2011; Sobsey et al., 2008). NOM is an intermediate or final product of biological synthesis or decomposition by microorganisms present in water or soil, animals, and plants. These substances include proteins, fats, carbohydrates, dyes, lignin, or humic substances (Raspati et al., 2011; Jaouadi et al., 2012; Grefte et al., 2013). The presence of NOM in water being treated is undesirable for a number of reasons one of which is that it worsens the water's organoleptic properties (colour, taste, smell). Furthermore, NOM intrudes on the water's biological stability and self-purification process. However, the most troublesome feature of NOM is that it may function as a precursor of disinfection by-products, create coordination complexes with inorganic anthropogenic compounds,

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