

PhD Thesis: Interactions of Natural Organic Matter and Microfiltration Membranes in Potable Water Treatment

Linhua Fan

School of Civil and Chemical Engineering

Faculty of Engineering

RMIT University, Melbourne, Australia

June 2002

Abstract

The fouling of membrane filters by natural organic matter (NOM) remains a major obstacle in the use of microfiltration (MF) processes for potable water treatment. The primary objectives of this study were to determine the main factors responsible for the decline of the permeate flux rate in the microfiltration of aqueous solutions containing dissolved and colloidal NOM, and to obtain a more detailed understanding of the physicochemical interactions between the NOM and the membranes. Experimentation was performed in a stirred-cell microfiltration system using hydrophobic and surface-modified hydrophilic MF membranes on the NOM isolated from three Australian surface waters. The NOM in each water was also separated into four fractions based on hydrophobicity and charge in order to identify the components in NOM causing membrane fouling. The study focused on the fouling of hydrophobic membranes as this type of membrane is employed in most potable water microfiltration plants in Australia. Variables studied included membrane properties (physical structure, surface chemistry), NOM characteristics (molecular size, aromaticity, fractional components), solution chemistry (pH, ionic strength, calcium concentration) and operating conditions (transmembrane pressure). The three key findings of this thesis are:

1. hydrophobic interaction between the NOM and the membranes was the primary factor governing the adsorptive fouling of NOM on the microfiltration membranes;
2. hydrophilic neutral compounds were the major fraction of NOM determining the rate and extent of flux decline; and
3. the interactions between the polysaccharide- Ca^{2+} complexes and the membranes were the main cause of the high fouling potential of the hydrophilic neutral compounds in NOM.