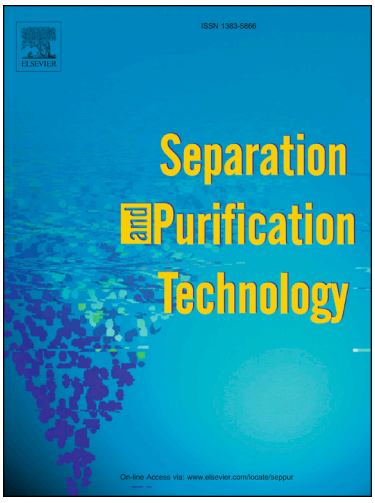

Correlating the hydrodynamics of fluidized media with the extent of membrane fouling mitigation: effect of bidisperse GAC mixtures

Andy Cahyadi, Anthony G. Fane, Jia Wei Chew

PII: S1383-5866(17)32581-9
DOI: https://doi.org/10.1016/j.seppur.2017.10.019
Reference: SEPPUR 14101

To appear in: *Separation and Purification Technology*

Received Date: 9 August 2017
Revised Date: 3 October 2017
Accepted Date: 10 October 2017

Please cite this article as: A. Cahyadi, A.G. Fane, J. Wei Chew, Correlating the hydrodynamics of fluidized media with the extent of membrane fouling mitigation: effect of bidisperse GAC mixtures, *Separation and Purification Technology* (2017), doi: https://doi.org/10.1016/j.seppur.2017.10.019

Correlating the hydrodynamics of fluidized media with the extent of membrane fouling mitigation: effect of bidisperse GAC mixtures

Andy Cahyadi [a], Anthony G. Fane [b], Jia Wei Chew [a,b*],

[a] School of Chemical and Biomedical Engineering, Nanyang Technological University, Singapore 637459
[b] Singapore Membrane Technology Centre, Nanyang Environment and Water Research Institute, Nanyang Technological University, Singapore 637141
* Corresponding author: JChew@ntu.edu.sg

Abstract

The anaerobic fluidized-bed membrane bio-reactor (AnFMBR) makes use of fluidized granular activated carbon (GAC) to mechanically scour the membrane to mitigate fouling. The question addressed in the current study is whether fluidizing bidisperse mixtures (i.e., particles of two different sizes) can improve the energy-efficiency in mitigating membrane fouling. The hydrodynamic parameters (including particle velocity, particle concentration, particle momentum and extent of segregation) of the fluidized media numerically obtained via a Two-Fluid Model (TFM) were correlated with the fouling rate experimentally obtained. Three bidisperse mixtures with the same mean particle diameter (namely, 1 mm) but different particle diameter ratios (namely, d_{p2}/d_{p1} = 1.22 – 1.86) were studied over a range of superficial water velocities. The key highlights are that (i) the fouling rate decreased (i.e., fouling mitigation was more effective) as the particle diameter ratio increased, which indicates the benefits of fluidizing multi-sized particle mixtures over monodisperse ones, (ii) the fouling rate (dTMP/dt) was positively correlated to the mixing index (M), which implies that segregated systems were more effective at mitigating membrane fouling, and (iii) the effect of bidispersity was more significant at the lower power input, which suggests that the advantages of fluidizing such bidisperse mixtures should only be harnessed at moderate power but not higher ones.

Keywords: anaerobic fluidized bed membrane bioreactor; bidisperse; two-fluid model; membrane fouling mitigation; hydrodynamics

1. Introduction

The fluidization of millimeter-sized granular activated carbon (GAC) particles as an energy-efficient means of mitigating membrane fouling was first proven practically feasible in a continuous anaerobic fluidized-bed membrane bio-reactor (AnFMBR) operated over 120 days