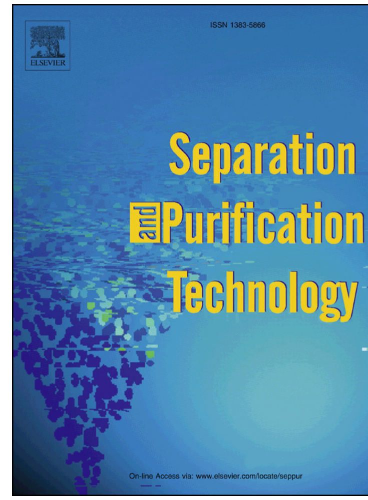
Accepted Manuscript



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PII: S1383-5866(16)30653-0
DOI: http://dx.doi.org/10.1016/j.seppur.2016.09.049
Reference: SEPPUR 13268

To appear in: *Separation and Purification Technology*

Received Date: 17 May 2016
Revised Date: 6 September 2016
Accepted Date: 6 September 2016

Please cite this article as: M. Stoller, R. Serrão Mendes, Advanced control system for membrane processes based on the boundary flux model, *Separation and Purification Technology* (2016), doi: http://dx.doi.org/10.1016/j.seppur.2016.09.049

ADVANCED CONTROL SYSTEM FOR MEMBRANE PROCESSES BASED ON THE BOUNDARY FLUX MODEL

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ABSTRACT

The development of membrane processes as a technology for environmental treatment applications and in particular for the purification of wastewater streams has significantly increased in the last decades. Fouling on membranes appears to be one of the main technical limit of this technology. This phenomenon causes the unavoidable deposition of particles on the membrane surface, building a resistive growing layer to permeability. Sensible fouling of the membrane leads to a significant reduction of the performances, a decrease of the operating life and, as a consequence, the increase of the operational costs due to the replacement or cleaning of the exhausted membrane modules. This paper will start from the theory of the boundary flux, in order to approach a novel design of an advanced control system that allows to limit fouling formation during operation. The developed system is validated by the analysis of collected experimental data from previous works, in particular on the membrane treatment process of olive vegetation wastewater streams by ultrafiltration and nanofiltration membranes.

Keywords: Control system, boundary flux, ultrafiltration, nanofiltration, fouling, Olive mill wastewater.

1. INTRODUCTION

Membrane technologies have gained great importance in water and wastewater treatment applications due to its wide range of operation, ease to scale-up and high versatility. Membranes exhibits both high productivity and selectivity values towards pollutants, and therefore high efficiencies of water treatment. Environmental hazardous effluents may be treated to an aqueous stream, reaching the requirements for a municipal sewer system discharge, superficial aquifer release or industrial reuse.

Nowadays about 60 Mm^3 of wastewater streams are treated worldwide every day, and almost 50% by membrane processes such as microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) [1]. In the next 10 years, an annual growth of 10% of this capacity is foreseen, and in respect to this, most probably membrane technology will gain more and more in importance.

The main drawback of membranes appears to be membrane fouling, that requires to be avoided or at least inhibited. This phenomenon does not permit to assure the performances of membranes over a long period of time once it starts to form. Much research and expertise is focused on understanding and avoiding membrane fouling, and covers modelling [2], reporting [3],