

Influence of an inhomogeneous membrane charge density on the rejection of electrolytes by nanofiltration membranes

Haochen Zhu^{a,b}, Anthony Szymczyk^{a,b*}, Béatrice Balanec^{a,b}

^aUniversité Européenne de Bretagne, France

^bSciences Chimiques de Rennes, UMR 6226 CNRS. Université de Rennes 1. ENSCR, Campus de Beaulieu, av. du Général Leclerc, 35700 Rennes, France

Tel. +33 (2) 23 23 65 28; Fax +33 (2) 23 23 57 65; email: anthony.szymczyk@univ-rennes1.fr

Received 1 June 2009; Accepted 21 December 2009

ABSTRACT

The salt rejection of membranes with inhomogeneous fixed charge densities including both symmetric and asymmetric distributions has been investigated theoretically. The rejection rates for the different fixed charge distributions, have been calculated by using a standard nanofiltration (NF) model based on the extended Nernst-Planck equation, the local electroneutrality condition and a modified Donnan equation including both steric and electrostatic effects and have been compared with the rejection rate obtained for a homogeneous distribution with the same average fixed charge concentration. The effects of the ion diffusion coefficients and the pore radius on the membrane rejection have also been investigated for the various fixed charge distributions. It has been shown that inhomogeneous fixed charge distributions may significantly affect the rejection properties of NF membranes. The value of the fixed charge concentration at the pore inlet plays a major role and high charge densities at the pore inlet tend to increase the salt rejection. Nonetheless, it has also been shown that strong axial gradients of the fixed charge concentration can affect significantly the ion transport within pores.

Keywords: Inhomogeneous fixed charge distribution; Nanofiltration; Rejection rate

* Corresponding author.