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Geometric heterogeneity of homogeneous ion-exchange Neosepta membranes.

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Abstract

Today the common view of the Neosepta membranes is that their material is electrically homogeneous, i.e. it does not include heterogeneities (except reinforcing fabric). However, there are a few publications, according to which their surface is not homogeneous geometrically and this fact has an important impact on the mass transfer rate. In this paper, we thoroughly study geometric heterogeneity of four commercial homogeneous Neosepta cation-exchange (CMX and CMX-Sb) and anion-exchange (AMX and AMX-Sb) membranes by applying optical microscopy, scanning electron microscopy, scanning electrochemical microscopy (SECM) and digital micrometer. It is found that the surface of all membranes is undulated: there are repeating hills and valleys due to the waved reinforcing fabric. The amplitude of undulation increases when swelling: in the case of dry samples, it varies from 10 (AMX-Sb) to 30 (CMX-Sb) microns, while for swollen samples, from 20 (AMX-Sb) to 55 (CMX) microns. These values are comparable to the diffusion layer thickness in industrial electrodialyzers, hence might make an essential impact in enhancement of mass transfer. The period of undulation is several hundreds of microns. Despite common use of micrometer, it gives overestimated membrane thickness since its measuring faces are applied only to the tops of the hills.

Keywords: scanning electrochemical microscopy, electrodialysis, electrically inhomogeneous surface, rough surface, ion exchange membrane.

Introduction

Ion exchange membranes (IEM) are widely used in numerous engineering applications, such as water desalination, fuel cells, sensors, etc. The knowledge of the relationships linking the surface morphology with the transport characteristics is of fundamental and practical importance