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ION TRANSPORT AND ELECTROCHEMICAL STABILITY OF STRONGLY BASIC ANION-EXCHANGE MEMBRANES UNDER HIGH CURRENT ELECTRODIALYSIS CONDITIONS

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Abstract

Rotating membrane disk and laser interferometry methods were used to study the mechanism of ion transport, hydrodynamic instability at the solution/membrane interface and electrochemical destruction of strongly basic homogeneous (AMX), heterogeneous (MA-41) and modified heterogeneous (MA-41M) membranes in sodium chloride solutions under intensive current regimes. Electrochemical destruction of strongly basic membranes AMX and MA-41 at current densities above limiting diffusion current is accompanied by conversion of fixed quaternary ammonium groups into weakly basic secondary and tertiary amines. The corresponding increase in the water splitting reaction leads to an increase in the transport number of hydroxide ions, a decrease in the convective instability region thickness and a reduction in the transfer of salt ions.

The properties of MA-41M membranes (in which ammonium bases in the surface layer are replaced by quaternary amines, bidentate bonded to the polymer matrix) during testing at overlimiting current regimes remain stable: the partial currents of hydroxide ions are close to zero, and the mass transfer through the modified membrane under intensive current regimes is close in magnitude to the mass transfer through the homogeneous membrane AMX. At the same time, electroconvection becomes the dominant mechanism for the transfer of salt ions through the modified heterogeneous membrane.

Keywords: anion-exchange membrane; water splitting; electroconvective instability; rotating membrane disk; laser interferometry.

1 Introduction

The transition to electrodialysis at current densities exceeding the limiting electrodiffusion current (so-called high-intensity electrodialysis) is one of the priorities of