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PRELIMINARY TECHNO-ECONOMIC ANALYSIS OF NON-COMMERCIAL CERAMIC AND ORGANOSILICA MEMBRANES FOR HYDROGEN PEROXIDE ULTRAPURIFICATION

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HIGHLIGHTS

- Organosilica and ceramic non-commercial membranes for hydrogen peroxide ultrapurification
- Simulation demonstrated the technical viability of the process for both membranes
- Ceramic membrane less appropriate for Na as limiting impurity due to low rejection
- Economic viability for both membranes, but uncompetitive against polymeric membranes
- Permeability and rejection improvements required to attain competitiveness

Abstract. Polymeric membrane cascades have demonstrated their technical and economic viability for hydrogen peroxide ultrapurification. Nevertheless, these membranes suffer from fast degradation under such oxidative conditions. Alternative membranes with higher chemical resistance could improve the ultrapurification process. Therefore, this work presents the preliminary techno-economic analysis of two non-commercial membranes (a ceramic one and a hybrid organosilica one). This analysis is complemented with further research regarding the competitiveness of these alternative membranes compared to polymeric ones. The results confirm the technical viability for both membranes, but the ceramic membrane is not appropriate when Na is considered as the limiting impurity (because it has too low rejection coefficient). The economic viability of the proposed ultrapurification processes is also probed, but not under competitive conditions, as the polyamide membrane appears to be the optimal choice. Nonetheless, improvements in the permeability of the hybrid membrane (an increase in the membrane permeability by a factor of 10) or the rejection performance of the ceramic membrane (an increase in the reflection coefficient above 0.85) could transform these non-commercial membranes into the most profitable alternative.

Keywords: Organosilica membrane, Ceramic membrane, Ultrapurification, Hydrogen peroxide, Membrane cascade

1. Introduction

The discovery of semiconductor materials and their consequent application greatly influenced the changes that developed societies have experienced as a consequence of the technological revolution of the second half of the 20th century. In this manner, the present global society started to be configured, where information and communications technology emerged as the characteristic and indispensable cornerstone of the scientific and technological development that current lifestyles are based on. Nevertheless, the development of prioritized areas of science and technology, which are going to play a key role in future progress, is associated with further advances in the evolution from microelectronics to nanoelectronics, complemented by optical fibers and lasers. The ability to produce innovative technological instruments and devices, with radically new possibilities derived from these breakthrough advances, strongly depends on the quality of the starting chemicals and the related processing materials and