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New Grafted Polymer Membrane for extraction, separation and recovery processes of Sucrose, Glucose and Fructose from the sugar industry discharges.

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Abstract

Grafted polymer membranes (GPM) composed of a polymer support and an extractive agent are original materials to improve the performance in the separation process of organic molecules. In this study, a GPM was elaborated with polysulfone (PSU) and poly(1-vinylpyrrolidone) (PVP) as support containing Gluconic acid (GA) as extractive agent. The main objective is to develop a new GPM for recovering Glucose, Fructose, and Sucrose from sugar industry discharges. The membranes were prepared by the phase inversion technique after dissolution of all various constituents. Morphology of the membranes, with and without extractive agent was observed by scanning electron microscopy (SEM) analysis, and the compositions identified using; Fourier Transform Infrared (FTIR) spectroscopy. The obtained membranes were used to study the oriented process of facilitated extraction of the sugars, as well as the influence of temperature factor on their performance. A kinetic and thermodynamic model was developed to determine the values of macroscopic parameters, permeability P and initial flux J_0 microscopic parameters, association constant K_{ass} and apparent diffusion coefficient D^* , and activation parameters (E_a , ΔH^\ddagger and ΔS^\ddagger) related to the transition state of the pseudo entity [ST] formed by the association/dissociation of the substrate S with extractive agent T, required for migration of each substrate across the membrane organic phase. The parameters determined were used to explain the results and confirm the mechanism related to this oriented process. A notable difference between the values of K_{ass} and D^* was observed that confirms the molecular recognition principle during the interaction of the extractive agent (GA) with the extracted sugars. The results show that the adopted GPM is more efficient for the extraction of glucose relative to sucrose and fructose compounds, and that a selective extraction remains possible.

Keywords: Grafted polymer membranes; oriented process; Glucose; Fructose; Sucrose; Permeability; flux; association constant; apparent diffusion coefficient; molecular recognition.

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