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分离工程

纳滤分离中性溶质的截留分子量参数细孔模型

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摘要 基于纳滤膜截留分子量（MWC）所对应的分子Stokes半径(rs)与膜的等效细孔半径(rp)相等的假设，通过建立rs与分子量(MW)之间、rp与MWC之间的定量关系方程，并以立体阻碍－细孔模型（SHP）和Spiegler-Kedem模型为基础，组建了一个以截留分子量为特征参数的纳滤分离中性溶质的细孔模型（MWC-SHP）。通过NF270纳滤膜对葡萄糖和蔗糖的透过实验，采用MWC-SHP模型对NF270纳滤膜的开孔率与膜厚之比（Ak/Δx）和rp进行了估算，估算结果同SHP模型一致。应用MWC-SHP模型预测中性溶质分子的截留率随透过通量的变化关系，与实验结果吻合.因此，MWC-SHP模型同SHP模型一样，可用于纳滤膜结构评价和分离性能预测。与SHP模型相比，MWC-SHP模型的求解更方便，具有较好的实用性。

关键词

纳滤 分离模型 立体阻碍-细孔模型 截留分子量 中性溶质

分类号

Steric-hindrance pore model for separation of uncharged solutes by nanofiltration with molecular weight cut-off as parameters

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Abstract

A model to describe the retention of solute could reduce the need of repeated testing for each new application and be useful for understanding the separation mechanisms of nanofiltration.For uncharged solutes, the separation is achieved by sieving effect, and steric-hindrance pore(SHP)model is appropriate.But obtaining membrane pore radius (rp) from SHP model needs permeation experiments of uncharged solutes, which are difficult and burdensome.On the other hand, the molecular weight cut-off (MWC) is a concept that is strongly established in membrane field.By introducing the MWC in SHP model, the existing information about the membrane can be used, which can simplify the implementation of model.In this paper, the correlation between the Stokes radius (rs) and molecular weight (MW) was established.[HJ*4/9]Then based on the assumption that the membrane pore radius equals the Stokes radius of uncharged solute with molecular weight equal to MWC, rp and rs can be expressed as functions of MWC and MW respectively.On the basis of SHP model and Spiegler-Kedem model, a model named as MWC parameters steric-hindrance pore model (MWC-SHP) was established.Permeation experiments of aqueous solution of glucose and sucrose with spiral membrane (NF270) were conducted and the structural parameters (rp and the ratio of membrane porosity to membrane thickness) were estimated by using MWC-SHP model and SHP model respectively.The results estimated from MWC-SHP model were in agreement with SHP model.Moreover, rejection prediction of uncharged solutes by nanofiltration with MWC-SHP model was in agreement with experimental data, which showed MWC-SHP model could be applicable to the evaluation of the structure of nanofiltration membrane and rejection prediction of uncharged solutes.

Key words

nanofiltration separation model SHP model molecular weight cut-off uncharged solutes

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