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传递现象

高分子致密膜内渗透现象的同一性研究

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摘要 在渗透汽化（PV）和蒸汽渗透（VP）膜分离过程，利用高分子膜材料对原料中不同组分的溶解度与扩散系数不同实现混合物分离. 由于两种过程原料状态分别呈现液态和蒸汽形式，长期以来作为两种膜分离过程展开研究，其传质推动力都是组分在膜中的化学位梯度. 为了从热力学和传质角度研究PV和VP膜分离过程，本文设计了特殊的渗透池，可以在同一渗透池中同时进行渗透汽化和蒸汽渗透膜分离过程，保持气液界面为热力学平衡状态. 使用PVA/PAN复合膜进行水/乙醇混合物以及水/异丙醇混合物的PV和VP渗透实验，对两个过程中渗透通量随浓度变化情况进行了分析和比较. 实验结果和理论分析表明：溶液的PV过程和与之呈相平衡的蒸汽相的VP过程在一定温度范围内，当原料中水含量较低的情况下具有相同的渗透通量，其传质遵从溶解扩散机理；当原料溶液中水含量较高时，PV过程中膜溶胀现象较为严重，渗透通量存在一定差别.

关键词 渗透汽化 蒸汽渗透 溶解扩散模型 PVA/PAN复合膜

分类号

Permeation behaviors consistency in polymeric homogenous dense membranes

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Abstract

Pervaporation(PV) or vapor permeation(VP) process was proved to be effective for removing the pollutant from industrial emission, dehydrating organic solvent and separating organic/organic mixtures.Depending on the feed state, researchers generally classify such processes as different membrane separation processes, and engineers design the separation with different method in commercial application. However, both pervaporation and vapor permeation can be analyzed based on the solution-diffusion mechanism, and they ought to possess identical permeation behavior.As a matter of fact, if observation was based on the viewpoint inside a polymer matrix, diffusion behavior of molecules in both operations would take on the identical nature.In order to obtain direct experimental evidence, a specifically designed equipment was developed.A stainless steel cylinder was connected with PV and VP membrane cells on both ends, and half of tank was filled with permeation feed. The feed in this tank showed vapor-liquid equilibrium, nitrogen sweep gas was introduced into the permeation side to remove the permeate on time. Therefore, pervaporation and vapor permeation processes were carried out in one tank simultaneously. This study used ethanol and 2-propanol aqueous, PVA/PAN composite membrane was used to measure individual component permeation behavior in PV and VP,and the results were analyzed based on the thermodynamic equilibrium theory. This investigation showed that water, ethanol and 2-propanol had the almost same permeation rate in both PV and VP process.The experimental results gave a direct evidence for the permeation behaviors consistency in a polymeric homogenous dense membrane.

Key words pervaporation vapor permeation solution-diffusion PVA/PAN composite membrane

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