Membrane Permeation of a Binary Compound for Cocurrent and Cross Flow Modes

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Abstract

This study is focused to reveal the behavior of air-sweep pervaporation in a mixture of two volatile organic compounds (VOCs) combination from a solution, for two flow modes of operation, namely cocurrent and cross flow mode. Two models namely single compound and binary compound permeation are studied. Results indicate that the membrane shows a higher affinity for one of the compounds compared to the other. Higher affinity may have led to higher sorption and higher permeability rate. The flux production in the cross flow mode is found to be higher than co-current flow mode. However, selectivity is unaffected by the flow mode of operation. A study on mutual coupling effect shows that due to the presence of one compound, the flux of the other compound reduces. The reduction in the flux production is found to be higher in the cocurrent flow mode than the cross flow mode especially for higher concentration of the interfering compound. Model study indicates that the transfer of the VOC through the bulk liquid phase to, and sorption on the membrane surface is the rate-limiting step. A difference in the flux values from the experiments and that predicted by the binary compound permeation model is noted. The difference is found to be constant irrespective of the compound used. This may be mainly due to the flow mode of operation. To incorporate this effect and various other influencing effects, preliminary modification of the model is proposed, in the form of empirical constant.

Keywords

Pervaporation, Trichloroethylene, 1,1,1 - Trichloroethane, Cocurrent Flow mode, Cross Flow mode, Air Perstripping, Binary Compound Permeation, Solution-Diffusion Model, Resistance-in-Series Model

1. Introduction

For environmental application of pervaporation to separate volatile organic compounds (VOCs) from wastewater, it is felt that more studies should be made and experience should be gained about the behavior of pervaporation when more than one compounds are present which is frequently the case with industrial wastewater. Though many researches have been directed towards the separation of a single compound from its pure solution using pervaporation, a few can