Praca dyplomowa inżynierska

Investigation of separation of hydrogen peroxide from solutions using membranes

Autor: Maria Dorota Grabowska

Nr albumu: 234901

Promotor: dr hab. inż. Paweł Sobieszuk
Opiekunowie pomocniczy: Dipl. Chem. Manfred Kraut
Dr. Katja Haas-Santo
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Introduction

Currently, membrane technologies are one of the fastest developing fields of chemical engineering, finding application in numerous branches of industry. By means of a high amount of conducted research and investment new methods of separation with the use of membranes are being developed. For instance, separation of hydrogen peroxide from the synthesis mixture in order to obtain a more concentrated aqueous solution of hydrogen peroxide by pervaporation through a zeolite membrane is one of the directions of such research.

Purpose and scope of work

The aim of this thesis is to evaluate if pervaporation is an appropriate process for the aforementioned application. The experimental part of the thesis was accomplished at the Institute for Micro Process Engineering at the Karlsruhe Institute of Technology in Germany. The scope of this thesis includes:
- A review of literature covering the issues related to membrane techniques,
- Performance of experiments with the use of pervaporation process equipment,
- Presentation and analysis of the results,
- Conclusions and recommended activities in the perspective of further research of pervaporation process.

Dehydration of ethanol

On the basis of Fig.1. it was determined that the average concentration of ethanol in the permeate reached values between 10 and 16 wt.% for membrane 1 and between 1.5 and 4 wt.% for membrane 2. Membrane 2 was much more effective in the separation of water and ethanol as the average concentration of EtOH in the permeate was lower for membrane 2 than membrane 1 with similar ethanol concentrations in the feed.
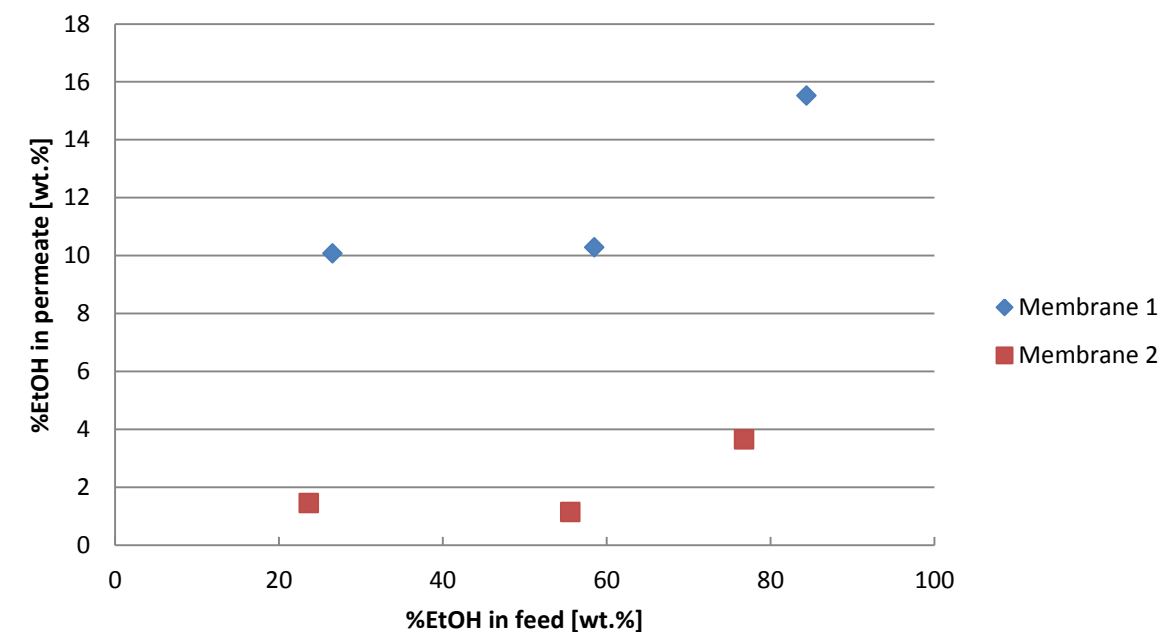

Fig.1. Comparison of membrane 1 and 2 separation capacities

Separation of hydrogen peroxide

Table 1. Measurement results for membrane 1 and 2

	EtOH wt. % in feed [%]	H_2O_2 wt. % in feed [%]	EtOH wt.% in permeate [%]	H_2O_2 wt. % in permeate [%]
Membrane 1	83.0	0.96	33.8	0.038
Membrane 2	88.4	1.07	10.6	0.041

Table 1. presents the average EtOH and H_2O_2 concentration in feed and permeate for both membranes. For membrane 1 high ethanol concentrations in the permeate in comparison to the H_2O_2 concentrations were obtained. For membrane 2 ethanol concentrations in the permeate reached lower values, however concentrations of H_2O_2 did not increase.

Conclusions

Despite the fact that the performance of membrane 1 and 2 in the process of dehydration of ethanol was satisfactory, the membrane separation of hydrogen peroxide should be developed in the future in order to enhance the effectiveness of the process.
The following theoretical or experimental work is suggested:
- Comparison of molecule sizes,
- Determination of ion interactions in the mixture,
- Determination of the impact of temperature on the process,
- Installation of a heat exchanger in the system,
- Exchange of sodium ions in the membrane with, for instance, barium cations in order to improve its ability to transfer species in a selective way.