DOI: http://doi.org/10.21698/simi.2019.ab11

MEMBRANE PROCESSES FOR REMOVING ORGANIC POLLUTANTS FROM WASTEWATER

Ecaterina Anca Şerban[1,2], Ioana Diaconu[2], Elena Ruse[2], Gheorghe Nechifor[2]

[1]National Research and Development Institute for Industrial Ecology - ECOIND, 71-73 Drumul Podul Dambovitei Street, code 060652, Bucharest, Romania
[2] Faculty of Applied Chemistry and Materials Science, University Politehnica Bucharest, 1-7 Polizu Street, Bucharest, *diaconuioana12@yahoo.com*, Romania

Keywords*: bulk liquid membranes, nitrophenols, organic acids, phenols*

Introduction

Organic acids, phenols and their derivatives represent a category of chemical compounds frequently encountered in wastewater because of their use in various industrial fields. Some of these compounds have a high toxic potential and their removal from wastewater is a necessity.
Membrane processes are often indicated for this purpose due to the many advantages they present: high efficiency and selectivity, low cost price etc.
Experimental studies performed on a group of organic compounds: organic acids (indole-3-acetic acid, nicotinic acid) and nitrophenols (o-, m-, p-nitrophenol) have demonstrated the applicability of a membrane technique to remove these compounds in yields over 90%. The optimal of operational parameters of a bulk liquid membrane system were determined in the performed studies: the concentration of the organic substrate in the feed phase, the nature and concentration of the stripping agent in stripping phase, the type of membranes, the transport time.

Materials and methods

Experimental studies of membrane transport have been performed in a cell type transport tube in tube.
The membrane system consisted of: Feed phase (FP) - organic compound solution in the concentration range of 10^{-4} - 10^{-3} mol / L at the pH=2 (established on the basis of speciation diagrams) when the organic substrate is mostly non-dissociated and active for transport; Volume $_{FP}$ = 20 cm^2; Membrane phase (M) – the carrier solution (tributylphosphate - TBP, trioctilphosphine oxide – TOPO, Aliquat 336) of concentration 10^{-2} mol / L in chloroform; Stripping phase - sodium hydroxide solution of concentration 1 mol/L; $Volum_M$ = 50 cm^3; Stripping phase (SP) - sodium hydroxide solution in the concentration range of 10^{-2} – 1 mol/L; $Volum_{FR}$ = 7cm^3.
The stirring rate of the phases was 180-200 rpm. All reagents used were of analytical grade from Merck.

Results and conclusions

The transport of acidic organic compounds in the membrane system shown is an active transport reaction in the stripping phase. The experimental data obtained showed that the driving force of the process is the chemical potential gradient, the determinant

factor being the pH gradient. The highest yields are obtained at low concentrations transport the organic substrate feed phase (10^{-4} mol/L) and that higher concentrations of stripping agent (>10^{-2} mol/L). The presence of the carrier help to obtaining the transport efficiency are over to 90% for all studied compounds. The transport time was 4-6 hours. Analytical control of the process was performed spectrophotometrically.

The process unfolds after first-order kinetics corresponding to irreversible consecutive reactions. The variation in time of low concentrations of organic substrate showed a degree of correlation between the experimental data and the model proposed by over 0.98 as shown in figure 1.

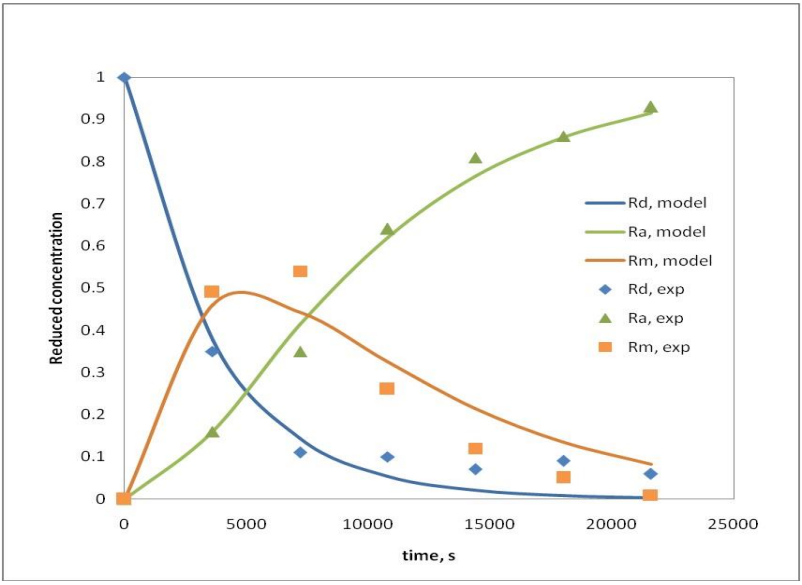

Figure 1. The transport of nicotinic acid in the presence of the Aliquat 336 carrier.

Experimental conditions: Feed phase - nicotinic acid solution 10^{-4} mol/L. Membrane phase - the Aliquat 336 solution, the concentration of $6x10^{-4}$ mol/L in chloroform. Stripping phase - sodium hydroxide solution, the concentration 1 mol/L.

In conclusion, the liquid membrane transport is a viable method for removing acidic organic compounds from aqueous media. The efficiency of the process is over 90%. Based on the results obtained, a kinetic model was identified based on two consecutive, irreversible, first-order reactions.