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REMOVAL OF EMERGING CONTAMINANTS BY LIQUID MEMBRANE TECHNIQUE

Roxana Jidveian[1], Ioana Diaconu[2], Oana Cristina Pârvulescu[1], Cristina Orbeci[2], Laura Topală[1]

[1]National University of Science and Technology POLITEHNICA Bucharest, Department of Chemical and Biochemical Engineering, 1–7 Gh. Polizu Street, 011061 Bucharest, Romania, rjidveian@gmail.com, oana.parvulescu@upb.ro, maholealaura@yahoo.com
[2]National University of Science and Technology POLITEHNICA Bucharest, Department of Analytical Chemistry and Environmental Engineering, 1–7 Gh. Polizu Street, 011061 Bucharest, Romania, ioana.diaconu@upb.ro, cristina.orbeci@upb.ro

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Introduction
Emerging contaminants (ECs) are chemicals that have toxic potential for human, animal, and environmental health. Pharmaceuticals (*e.g.*, antibiotics, contraceptives), artificial sweeteners, personal care products, and detergents are the most common ECs. The sources of contamination are diverse, especially residual wastewater from hospitals, municipal wastewater, wastewater from various industries and agricultural activities. Significant amounts of ECs can be found in surface and groundwaters. They usually cause skin irritation, hormonal and neurological problems, and can have cardiological, reproductive, and carcinogenic effects.
ECs can be removed from the environment using various methods/technologies, including oxidative methods, biodegradation, liquid-liquid extraction, solid phase extraction (SPE), membrane technologies. Lately there has been a clear trend towards the use of liquid membrane technologies. Separation processes based on liquid membranes are simple, have high selectivity, as well as low energy consumption and cost. Furthermore, the liquid membranes can be reused.
This study presents the results obtained in the removal of two ECs, *i.e.*, aspartame and salicylic acid, from aqueous media using a bulk liquid membrane (BLM).

Materials and methods
The reagents used in the study, *i.e.*, aspartame, salicylic acid, chloroform, NaOH, HCl, Chyphos IL 101 (trihexyltetradecylphosphonium chloride), TOA (trioctylamine), were purchased from LiChrosolv®. All reagents were of analytical grade. Chyphos IL 101 and TOA were used as carriers in the chloroform membrane. The experiments were performed in a tube-in-tube device.

Results and conclusions
The effects of relevant factors, including EC type (aspartame or salicylic acid) and its concentration in the feed phase, pH of the feed phase, carrier type (Cyphos IL 101 or TOA) and its concentration in the BLM, stripping agent type (HCl or NaOH) and its concentration in the stripping phase, and process duration, on extraction efficiency (E_E) and recovery efficiency (E_R) were evaluated.
The optimal process conditions were as follows:

- for aspartame:
  - aspartame concentration in the feed phase: 10^{-4} mol/L;
  - NaOH concentration in the feed phase: 10^{-2} mol/L;
  - carrier type: Cyphos IL 101;
  - Cyphos IL 101 concentration in chloroform: 10^{-2} mol/L;
  - stripping agent type: HCl;
  - HCl concentration in the stripping phase: 10^{-2} mol/L;
  - process duration: 7 h;
- for salicylic acid:
  - salicylic acid concentration in the feed phase: 10^{-4} mol/L;
  - carrier type: TOA;
  - TOA concentration in chloroform: 10^{-2} mol/L;
  - stripping agent type: NaOH;
  - NaOH concentration in the stripping phase: 10^{-2} mol/L;
  - process duration: 5 h.

Under these conditions, the effects of EC type on E_E and E_R are shown in Figure 1. The results obtained in this study could be useful for predicting the performance of BLM-based separation systems and for optimizing relevant process factors.

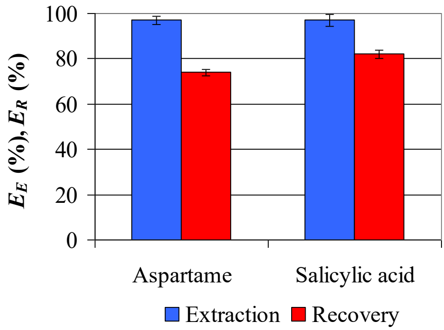

Figure 1. The effects of EC type on extraction and recovery efficiencies.

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