Calix[4]arene-mediated uphill transport of methyl red through bulk liquid membrane: kinetics of operational variables

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ABSTRACT

The present study demonstrates the successful transport of dyes specially methyl red (MR) using 5,11,17,23-tetra-tert-butyl-25,27-dihydroxy-26,28-dimethoxycalix[4]arene (1) derivative as a carrier in bulk liquid membrane (BLM). Extraction experiments were performed regarding the optimization of fundamental parameters including pH, decomplexation, dye, and salt concentration. The UV–visible data for stoichiometric ratio suggested 1:1 complexation, which is also verified by Benesi–Hildebrand equation. The high value of formation constant i.e. $8.2 \times 10^4$ mol/dm$^3$ also suggested the strong complexation phenomenon between host and guest molecules. The transport of MR was performed through BLM under optimized conditions such as carrier concentration, type of solvent, and stirrer speed. The kinetic parameters ($k_1$, $k_2$, $R_{\text{max}}$, $t_{\text{max}}$, $J_{\text{max}}$, $J_{\text{max}}$) for MR transfer were examined by following kinetic laws of two consecutive irreversible first order reactions. The MR transport was augmented by rise in carrier (1) concentration and at high stirring speed. Moreover, the trend of MR transfer in solvents was found to be in the order of CHCl$_3$ > CH$_2$Cl$_2$ > CCl$_4$. Consequently, the developed system was successfully applied on the industrial wastewater samples and 1 was proven as an excellent carrier the removal of dyes through BLM.

Keywords: Bulk liquid membrane; Dyes; Calixarene; Wastewater; Pollution

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