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ORIGINAL PAPER

Effect of viscosity of a liquid membrane containing oleyl alcohol on the pertraction of butyric acid

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Solvent formulation is important in the optimization of the mass-transfer through supported liquid membranes (SLM) in pertraction and membrane extraction. Oleyl alcohol (OA) is frequently used as the solvent or diluent in the extraction of carboxylic acids. A disadvantage of OA is its relatively high viscosity of 28.32 mPa s at 25 °C. This can be decreased by the application of a less viscous OA diluent, e.g. dodecane. The relationship between the ratio of the distribution coefficient of butyric acid (BA), D_F, and the viscosity of OA–dodecane solvents, μ, as extraction and transport characteristics, and the overall mass-transfer coefficient, K_p, through SLMs was analyzed. Dependence of the D_F/μ ratio on the OA concentration showed a maximum at the OA concentration of 15 mass % to 30 mass %. The OA concentration dependence of K_p for SLMs exhibited also a maximum at about 30 mass % and 20 mass % of OA at the BA concentration driving force of 0.12 kmol m^{-3} and 0.3 kmol m^{-3}, respectively. Shifting of the maximum in K_p dependences towards lower OA concentrations by increasing the BA concentration driving force is in agreement with the D_F/μ ratio dependence. Using pure OA as the solvent or diluent is not preferable and a mixture of a low viscosity diluent with the OA concentration below 40 mass % should be used. The presented results show the potential of the D_F/μ ratio in the screening and formulation of solvents in extraction and SLM optimization.

Keywords: pertraction, extraction, butyric acid, oleyl alcohol, dodecane, supported liquid membrane, viscosity effect

Introduction

Butyric acid (BA) has numerous applications in food, cosmetic and pharmaceutical industries. It is also a potential building block for organic synthesis in biorefineries. However, fermentation of butyric acid has a disadvantage of strong inhibition by the product (Wu & Yang, 2003; Zigová et al., 1999, 2000). Online separation of BA from the fermentation solution by an extractive technique is a possible solution of this problem (Evans & Wang, 1990; Hatzinikolaou & Wang, 1992; Marták et al., 2003; Vandák et al., 1997; Wu & Yang, 2003; Zigová et al., 1999). Various solvents and approaches have been employed in this process with different success. The application of traditional acid extractants such as amines (Bilgin et al., 2006; Li et al., 2002; Sabolová et al., 2001; Shan et al., 2006; Vandák et al., 1997; Wu & Yang, 2003; Zigová et al., 1996, 1999) or TBP (Ingale & Mahajani, 1994, 1996) for BA extraction can be found in literature.

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