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Selective recovery of pyruvic acid from two and three acid aqueous solutions by reactive extraction

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Abstract

In this study, a multi-stage reactive extraction system is devised for the selective recovery of pyruvic acid (PA) from a multiple-acid solution having a carboxylic acid composition identical to that obtained in microbial fermentation.

With single-stage extraction, approximately 40% of the acetic acid (AA) is preferentially and selectively recovered from the aqueous three-acid solution using 0.1 M trioctylamine (TOA) in 1-octanol. Pyruvic acid is the only solute positively affected by an increase in the TOA concentration; however, the purity of the final extract is compromised by co-extracted acids. The distribution coefficient (K_D) values obtained in three-acid solutions are lower than those obtained in single-acid solutions, showing the antagonistic effects due to the presence of other acids. However, in two-acid solutions, the presence of lactic acid (LA) at an initial concentration of about 7-20% (0.05-0.15 M) of that of PA (0.75-0.85 M) causes an increase of 33-80% on the K_D of the latter. Using 0.6 M TOA in 1-octanol, 92% of initial PA is recovered from the two-acid solution. The competition with the other acid(s) for ion pair formation and its marked hydrophilicity hinders the extraction of LA from multiple acid solutions. Thus, a successful selective separation is achieved for the three acids present in the aqueous phase. A further increase in the initial concentration ratio of LA to PA in two-acid solution results in reduced K_D values for the latter. The maximum separation factor of 54.3 is obtained at the lowest acid ratio (AR, 0.19) and highest TOA concentration (0.6 M). Hence, reactive extraction can be successfully employed to selectively recover PA from two and three-acid aqueous solutions.

Keywords: Selective recovery, Multiple-acid aqueous solutions, Reactive extraction, Pyruvic acid, Trioctylamine

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