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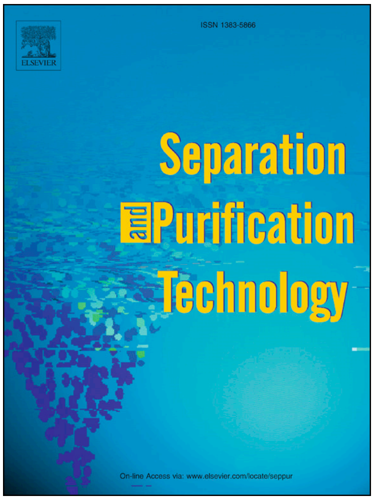

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Switching selectivity of carboxylic acids and associated physico-chemical changes with pH during electrodialysis of ternary mixtures

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Abstract:

Electrodialytic (ED) transport of carboxylic acids from their ternary mixtures (acetic, malic and citric) of different compositions were investigated through anion exchange membrane (AEM). Solution pH played crucial role in selectivity and ion transport (expressed by limiting current density, LCD). These observations were analysed based on flow hydrodynamics, ion specific properties and ionic interaction with AEM influencing water uptake and membrane resistance. Fractional hydrolysis of weak acids generated complex mixture of multiple anions of varying charges which strongly influenced LCD. Theoretically estimated LCD (from effective diffusivity, D_{eff} and Sh number based effective mass transfer coefficient, k_{eff}) could closely match experimental LCD (±4–8% deviation). The nature of solute species, concentration and their interaction with AEM strongly influenced ion transport. Estimation of D_{eff}, transport number, ion exchange equilibrium and membrane resistance could satisfactorily explain the observed LCD. At low pH, LCD was proportional to available free ions while, at pH >5.2 component specific properties/interactions dominated. Water uptake indicated variation in micro-structure and ion selectivity with different compositions of ternary mixture. This was attributed to