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Performance of a novel electrodeionization technique during citric acid recovery

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Abstract

This paper concerns with the behavior of an electrodeionization (EDI) system for concentration of citric acid from fermentation broth. Commercially cation-exchange membrane (MC-3470) and anion-exchange membrane (MA-3475) were used as ionic selective barriers of the EDI stack. The diluted compartments of the EDI stack were filled with mixed ion-exchange resins (purolite strong acid cation-exchange, C-100E and strong base type I anion resins, A-400). The experiment used feeds with citric acid concentration in the range of 500–10,000 ppm and feed flow rate in the range of 1–4 l h^{-1}. The *V–I* characteristics indicated that there were essential differences in current transport and electrical resistance between the EDI and the electrodialysis (ED) processes. Moreover, the overall current efficiency was in the range of 40–96% and has been found to be a function of feed concentration and current density. The performance of the EDI system was also stable during 24 h operation.
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Keywords: Citric acid; Continuous deionization; Electrodeionization; Ion-exchange membrane

1. Introduction

Citric acid is one of the largest carboxylic organic acids produced generally through fermentation of low molecular weight carbohydrate solution such as glucose, molasses, or dextrose by *Aspergillus niger*. It is found in almost all fruits especially lemon, citron, and pineapple. Citric acid and its salt have an important role in foods, pharmaceuticals, cosmetics, and chemicals industries [1]. Million tones of citric acid and its salt per year are required to meet the need of those industries. In Indonesia, the necessity of citric acid and its salt is estimated more than 50,000 t per year. Hence, it is not so surprise as the substance has high commercial value.

Fermentation broth of citric acid can be separated from biomass by means of filtration or centrifugation. The citric acid is then usually purified by either lime-sulfuric acid method or liquid extraction process [2] and is concentrated by multiple effect evaporation. It clearly indicates that down stream processing of citric acid using conventional technique involves at least three different steps. The conventional technique has several disadvantages. It requires a large quantity of chemical agents and high energy cost. In the conventional technique, large amount of water effluent and solid residue are also produced. Furthermore, phase changes involved in the process lead to degradation of citric acid quality.

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