Study of the Effect of Some Parameters Governing the Recovery Process of Formic Acid from its Aqueous Solution by Alcohols

Hadj Seyd Abdelkader [1][+], Lanez Touhami [2], Belfar Mohamed Lakhdar [2], Kemassi Abdellah [3],

Gharib Toufik [3] and Ben Brahim Fouzi [3].

[1] University Mohamed Khider-Biskra. B.P. 145, Biskra 07000, Algeria.
[2] VTRS Laboratory, El-Oued –University. B.P. 789, 39000 El-Oued, Algeria.
[3] University Centre of Ghardaia, 47000 Ghardaia, Algeria.

Abstract. Optimization of experimental conditions of formic acid recovery from its aqueous solution by a liquid-liquid extraction, with alcohols, was carried out in this study. The effect of each parameter governing the process such as: pH of aqueous solution, partition coefficient and initial concentration on acid, volume ratio between phases and temperature, was studied. Variation of distribution coefficient and yield of extraction of formic acid, depending on these parameters, was investigated to determine the favorable conditions to recover this acid from its aqueous solution.
Results show that, in comparison to the other alcohols used, butan-1-ol gives the higher values of yield and distribution coefficient, the optimal conditions of extraction are obtained at low pH values (lesser to its pKa), a yield of 46.15 % was obtained at pH:2.29. A departure solution concentrated on acid and a high volume ratio of organic solvent favor the extraction (69.45 % of the acid were extracted for V_{org}/V_{aq}=3:1). Finally, we noted that the yield and the distribution coefficient increase with increasing temperature, nearly 53.23 % of formic acid were extracted at 318.15 K.
The study will be useful in the design of liquid-liquid extraction process by alcohols for formic acid recovery.

Keywords: liquid extraction, distribution coefficient, yield, solvent, solute.

1. Introduction

Liquid-liquid extraction is a method of separation of one or more components from a mixture; it is based on the distribution of the solute between two liquids practically immiscible.

The yield and the distribution coefficient are the most critical factors in liquid-liquid extraction and influenced by other parameters such as solutes concentration, nature of solvent, pH of the solution, temperature, hydrophobicity of extracted substances [1].

Formic acid is one of the simplest carboxylic acid used as a preservative and antibacterial in foods [1]. It is also used in many other industries and manufactures. It is the main product of combustion of fuels such as ethanol and methanol. It is also used as a solvent for removing paint and rust from metal surfaces [2]. It is used in the pharmaceutical industry as pH adjuster. Its salts are used as a deicing agent of first quality and valuable auxiliary in the production of oil [3,4]. Formic acid is used for the production of coagulated natural rubber destined for the production of tires and also used in textile and in chemical industries [2,5] .

Various technologies have been reported for the separation of organic acids, especially formic acid from complexes mixtures. The work toward developing removal and recovery of waste stream components is started in 1974. The separation of organic acids from waste water has been important and essential from the points of view of pollution control and industrially for more than a century [6,7]. Several separation

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