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Selective Extraction of Cu from Ni by D2EHPA in Presence of Additives: Tartaric Acid and Sodium Acetate

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1- Introduction

The solvent extraction process is one of the important separation processes in hydrometallurgy. Many solvents have been used to extract metals in hydrometallurgical processes. Among them, organophosphorus extractants such as oxime and Cyanex have been used to extract nickel and copper from acid and alkaline solutions. Organophosphorus extractants (D2EHPA, Cyanex 272, and PC-88A) have been widely used for the nickel extraction. D2EHPA is a low-cost and high-performance extractant in the solvent extraction industry. This extractant extracts copper and nickel simultaneously. Therefore, for the separation of these two ions using D2EHPA from a solution containing copper and nickel ions, modifiers were used. According to research data, acetate ions have been used only to improve the extraction of copper by D2EHPA and its effect on the separation of copper from nickel has not been studied; therefore, this research is innovative in this regard. In this research, the optimum condition of the sodium acetate concentration for the maximum copper extraction was investigated. Then, the extraction of copper and nickel was studied in the presence of two different carboxylates, namely tartaric acid and sodium acetate with D2EHPA. The purpose of adding these two carboxylates was to improve the selective copper extraction against nickel. To evaluate the behavior of these additives, effective parameters such as pH, carboxylate concentration, and mixing time were investigated. Finally, the best combination of carboxylates was selected based on the copper separation from solution.

2- Experimental

The purpose of these experiments is to investigate the effects of carboxylates such as tartaric acid, sodium acetate, and their mixtures on the copper and nickel separation. In the preparation of organic and aqueous solutions, the incubator was used to mix at a specific temperature and time. In each experiment, 40 ml of an aqueous solution and 40 ml of an organic phase were mixed with a mechanical stirrer at 800 rpm for 10 minutes. Then, about 15 minutes were given to separate two phases.

3- Results and Discussion

The results showed that the extraction of both metals i.e. in the presence of sodium acetate was fast and carried out at 10 minutes, as the extraction efficiency reached 90%. Thus, for subsequent experiments, the mixing time was selected to be 10 minutes. According to the results, under a concentration of 20% D2EHPA, mixing time of 10 minutes, copper and nickel concentrations equal to 500 mg / L, and the concentration of sodium acetate of 5 g/L to 93% of nickel and 99.6% of copper were extracted. It was also observed that the increase of sodium acetate in the solution increases the extraction efficiency of both copper and nickel, considerably. In the absence of sodium acetate, the extraction rate is low, but by adding 5 g/L of sodium acetate, the extraction percentage increases. According to the results, using sodium acetate of 5 g/L, the optimum pH range of 6.5-5.5 for the maximum extraction of copper was obtained. The purpose of this study is to maximize the copper extraction and separate it from nickel. Although this aim was obtained at lower pHs, the nickel was extracted about 70%, which was high. Moreover, in the presence of tartaric acid, the percentage of copper extraction and nickel increased and reached almost a level. This result shows that tartaric acid does not have an influence on the separation of copper from nickel. The effect of D2EHPA concentration on the percentage of copper and nickel extraction in the presence of tartaric acid showed no significant separation between nickel and copper in various concentrations of D2EHPA. The results of the mixing of tartaric acid and sodium acetate show the selective extraction of copper. By adding 0.04 grams of sodium acetate and 0.03 grams of tartaric acid in one liter, the best separation of copper from nickel was observed.

4- Conclusions

In this study, the effect of D2EHPA as an extractant and carboxylates as additives was investigated on copper and nickel extractions. With the use of 20% D2EHPA, at the initial pH of 5.12, and O:A ratio of 1, the extraction of copper and nickel with a concentration of 0.5 g/L was possible. Carboxylates were used to improve the extraction and separation of these elements using D2EHPA. In the first series of experiments, the effect of sodium acetate was studied with regard to the high extraction of copper (not selective). The results showed that sodium acetate greatly increased the extraction of both metals. In this case, using sodium acetate of 5 g/L, time of 10 min, and an optimal pH range of 5 to 6, more

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than 90% of nickel and copper were extracted. In the second series of experiments, tartaric acid has no ability to improve the extraction or separation of these elements. Also, in the results of the third series of experiments, the effects of the combination of tartaric acid and sodium acetate on the solvent extraction, showed that the separation of copper and nickel using 0.04 g/L of sodium acetate and 0.03 g/L of tartaric acid at time of 10 minutes and optimal pH of 5.12-5.4 was promising.