Asian Journal of Chemistry Vol. 19, No. 6 (2007), 4173-4176

Solvent Extraction of Iron from Aluminium Sulphate Leach Solution Using Acetylacetone-Chloroform

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The purified aluminium sulphate which contains important Al compounds has been used in paper milling industry and water purification. This work is focused on the extraction of iron from aluminium sulphate leach solution by acetylacetone-chloroform as leaching agent. The results showed that iron can be efficiently extracted from leach solution in short time. The influence of effective variables including acidity, temperature, type and concentration of extracting solvent, aqueous to organic phase ratio (enrichment factor) and kind of diluents were investigated. The optimum extraction condition has been set as follow: pH 2.57, temperature 40ºC, phase ratio of 1:1 and solvent concentration of 0.6 M. The unique advantage of the present work relative to other reported method is the higher extraction efficiency and lower cost.

Key Words: Solvent extraction, Acetylacetone, Chloroform, Iron, Aluminium sulphate.

INTRODUCTION

Aluminium sulphate is one of the most important compounds that has broad applications in industrial process such as paper mill, water treatment and tanning because of its low preparation cost and relative high abundance of bauxite ore as a raw material. Because of the presence of iron compound as an impurity in the aluminium sulphate solution, restricted its applications in various industrial process especially in paper mill. In order to cope with this limitation, development of efficient purification process is required. Extraction of metal salts, specially at low concentration can be achieved using acidic or basic leaching based on the following reactions[1,2]:

$$Al_2O_3 + 6H^+ = 2Al^{3+} + 3H_2O \quad (1)$$

$$Al_2O_3 + OH^- = 2AlO_2^- + H^+ \quad (2)$$

It was shown that iron sulphate can be separated from aluminium sulphate solution using ethanol, so that the desired purity for aluminium sulphate can be obtained[2]. Using reducing agent after leaching is one of the most common way for reducing iron content. This method used multi stages and required high operating cost, which can be overcome using the

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aluminium hydroxide as a simple and less step method. Solvent extraction method can be used as a powerful tool for separation and purification of metal ions[3]. In the present work a simple and efficient method for iron removal from aluminium solution, using acetylacetone in the presence of diluents is reported.

EXPERIMENTAL

All of acids and bases were of highest purity available from the Merck Company used as received. The bauxite soil was provided from Dena aluminium sulphate factory.

The metal ions content determination were carried out on a Varian 1275 atomic absorption spectrometer with a respective hallow cathode lamp at the recommended operational conditions.

In the preparation of stock solution, typical soil sample from Kohgeloyeh ore with composition of Al_2O_3 = 51.54 % and Fe_2O_3 = 9.3 % was dissolved in distilled water. Leaching of aluminium sulphate was performed by elution of soil sample with 16 M sulphuric acid as the following procedure:

Sulphuric acid with mole ratio of 4:1 was added to 20 g of bauxites soil and diluted to a volume of 200 mL in beaker. After boiling for 5-6 H, the solution was filtered out and a yellowish green solution was obtained.

Green extraction procedure: An aliquot solution containing aluminium was taken in a mixer-settler. After pH adjustment, this solution was equilibrated with acetylacetone in the presence of benzene and chloroform as diluents for 10-20 min. After allowing the sufficient time for phase separation, the absorbance of organic phase containing metal ion was measured against a reagent blank.

RESULTS AND DISCUSSION

In order to achieve high efficiency, the effects of various parameters including pH, amount of extracting solvent, varying the phase ratio, temperature and amount of diluents on the efficiency of iron extraction were investigated.

Effect of pH: The effect of acidity on the sensitivity the of reaction of acetylacetone with iron and its extractability into organic phase was studied and results are shown in Fig. 1. The results indicate that high extraction efficiency can be achieved at pH = 2.57 after 10 min at 700 rpm. It is assumed that the reaction to form this complex could have competed against hydroxide precipitation at higher pH and formation of aquatic iron complexes in acidic media, which both lead to reduce in extraction efficiency.

Effect of solvent: Various concentrations of the solvent were used to dissolve and extract the complex. Extraction efficiency for various organic solvents are shown in Table-1. Among these solvents, acetylacetone at

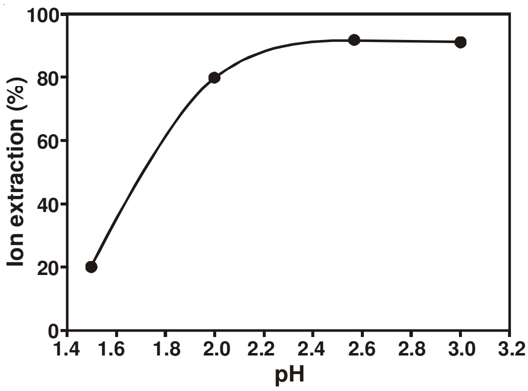

Fig. 1. Effect of pH variation of solution on iron extraction efficiency at optimum conditions

TABLE-1
EFFECT OF TYPE OF SOLVENT ON IRON(III) ION EXTRACTION EFFICIENCY

Solvent	Extraction efficiency (%)
Acetylacetone	93.4
Chloroform	88.9
Carbon tetrachloride	81.6
Toluene	7.8
Di-2-ethyl hexaphosphric acid	92.7

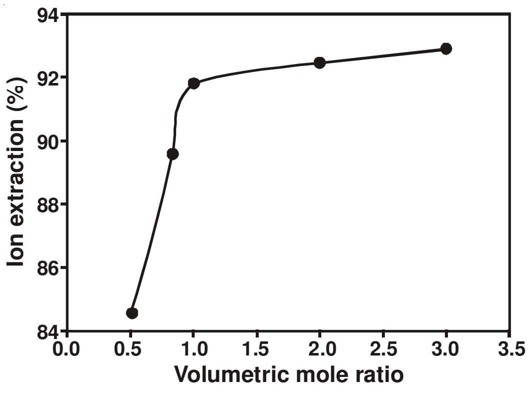

Fig. 2. Effect of volumetric phase ratio on iron extraction efficiency

concentration of 0.6 M as a high dielectric constant and lipophilicity can quantitatively extracted the iron, so further studies have been accomplished, using this concentration of acetylacetone. This value of the solvent was selected for further studies. At volume ratio of 1:1, maximum recovery can be achieved (Fig. 2). This regarded as the optimum conditions from economic view point and selected for further studies.

Effect of temperature: The critical role of temperature is because of the temperature effect on solubility and equilibrium constant of the reaction. The effect of reaction temperature on the extraction efficiency was tested closely. The iron extraction efficiency at fixed optimum value of other parameters for different temperatures between 10-50ºC was examined and the results are given in Fig. 3. It can be shown, with increasing temperature up to 40ºC, the extraction of the complex into benzene was achieved at a rapid rate and completed by shaking for 10 min at 700 rpm. Further increase in temperature leads to decrease in extraction recovery. The decrease in the iron extraction is due to decomposition and temperature instability of the complex (Fig. 4).

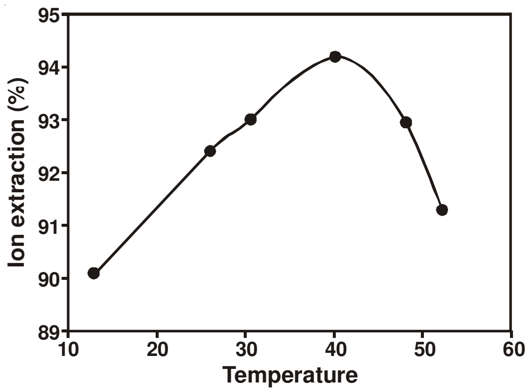

Fig. 4. Effect of solution temperature on iron extraction efficiency

Conclusion

This work presented experimental results of iron extraction from aluminium sulphate leach solution using acetylacetone-chloroform. The pH of solution, temperature, concentration of extracting solvent are significant parameters on extraction performance. The comparison of the results obtained from different solvents indicates that the acetylacetone chloroform is a suitable stripping agent for iron extraction in view of economical operational conditions.

REFERENCES

1. T.R. Scoot, *J. Met.*, **14**, 121 (1962).
2. P. Shiva and G.O. Laercio, *J. Indian Chem. Soc.*, **74**, 556 (1997).
3. H. Fathi, A Textbook of Hydrometallurgy, pp. 409-420 (1992).

(*Received*: 12 January 2006; *Accepted*: 28 March 2007) AJC-5537