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Solvent extraction of metals with a commercial fluorinated β-diketone (LIX51) extractant

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Abstract. The extraction characteristics of some selected metals from an aqueous buffered solution by LIX51, a fluorinated commercial β-diketone extractant, have been investigated. The pH $\frac{1}{2}$ (pH at which 50% of the metal ion is extracted) and the log K_{ex} values for the extracted metals by 5% (v/v) LIX51 in methylisobutylketone (MIBK) have been obtained. The order of extraction of metals with LIX51 as a function of pH $\frac{1}{2}$ value is: Cu(II) < Pd(II) < Co(II) < Zn(II) < Fe(II) < Pb(II) < Mn(II) < Cd(II) < Ni(II).

Keywords. LIX51 extractant; log K_{ex} values; hydrometallurgy.

1. Introduction

The technique of solvent extraction for the separation and purification of metal ions from aqueous solutions has become important in the processing of liquid solutions produced by the leaching ores and other minerals (Li and Navratil 1986). Chelating extractants under the trade name LIX reagents have been used extensively in the hydrometallurgy of copper (Burkin 1983). In the present paper, the extraction behaviour of Mn(II), Fe(II), Ni(II), Co(II), Cu(II), Zn(II), Cd(II), Pb(II), and Pd(II) with LIX51 is reported.

2. Experimental

2.1 *Reagents*

The extractant LIX51 was kindly supplied by Henkel Corporation, USA. Acetate buffers were used for maintaining the pH of the aqueous phase. Methylisobutylketone (MIBK) was used as the solvent for extraction.

2.2 *Extraction procedure*

Ten millilitres of aqueous phase containing an aliquot of metal solution, 5 ml of buffer solution and 1 ml of 1 M potassium nitrate was equilibrated with 10 ml of

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organic phase containing 5% (v/v) LIX51 in MIBK. The mixture was shaken in a mechanical shaker for 1 hr at 30 ± 1°C. After equilibration the pH of the aqueous phase wasmeasured by an expanded scale pH-meter(ECIL, India). The concentration of metal ion was monitored using a Pye-Unicam atomic absorption spectrophotometer.

3. Results and discussion

The extraction behaviour of metals with LIX51 extractant was elucidated by determining the distribution coefficient (D) at different pH values keeping the ligand concentration constant. To obtain the estimate of K_{ex} values the concentration of 5% (v/v) LIX51 in MIBK has been determined using the method given in the literature (Ashbrook and Ritcey 1984). The extraction data of different metals with LIX51 extractant in terms of pH $\frac{1}{2}$ and log K_{ex} values are given in table 1. The order of extraction of metals with LIX51 extractant as a function of pH $\frac{1}{2}$ values is as follows:

$$\text{Cu(II)} < \text{Pd(II)} < \text{Co(II)} < \text{Zn(II)} < \text{Fe(II)} < \text{Pb(II)} < \text{Mn(II)} < \text{Cd(II)} < \text{Ni(II)}.$$

The extraction data for LIX51 systems agree well with those of previously studied β-diketones like Hostarex DK-16 and thenoyltrifluoroacetone (HTTA) except for Ni(II). The order of extraction of metals as reported by Przeszlakowski and Wydra (1982) with Hostarex DK-16 is

$$\text{Cu(II)} < \text{Co(II)} < \text{Ni(II)} < \text{Zn(II)}.$$

The order of extraction of metals with HTTA as a function of pH $\frac{1}{2}$ values has been given as (Poskanzer and Foreman 1961; Schweitzer and Randolph 1962; Irwing and Edgington 1965):

$$\text{Cu(II)} < \text{Co(II)} < \text{Ni(II)} < \text{Zn(II)} < \text{Mn(II)} < \text{Cd(II)}.$$

The extraction of all the metals studied here is quantitative around pH 6·0. Thus a single extraction at pH 6·0 from dilute solutions of metals into a smaller volume of organic solvent will be a rapid and effective method of preconcentration of metals before atomic absorption spectrophotometric determination (Cresser 1978). Hence

Table 1. Extraction data of some metals with 5% (v/v) LIX51 extractant in MIBK.

Metal	pH $\frac{1}{2}$(50% extraction)	pH for complete extraction	log K_{ex}
Mn(II)	4·70	5·5–9·0	−4·83
Fe(II)	4·06	4·9–9·0	−3·55
Co(II)	3·85	4·6–9·0	−3·13
Ni(II)	5·15	5·8–9·0	−5·73
Cu(II)	1·56	2·3–9·0	+1·44
Zn(II)	3·90	4·8–9·0	−3·23
Cd(II)	4·95	6·0–9·0	−5·33
Pb(II)	4·10	5·0–9·0	−3·63
Pd(II)	2·65	3·2–6·0	−0·69

the present study of the extraction of metals with LIX51 extractant shows excellent promise for analytical trace metal preconcentration and gives valuable information required for hydrometallurgy.

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