

## Solvent extraction of metals with commercial oxime extractant (LIX 622)

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MS received 29 October 1987; revised 11 August 1988

**Abstract.** The extraction characteristics of some selected metals from an aqueous buffered solution by LIX 622, a commercial oxime extractant have been studied. The  $pH_{1/2}$  values for extracting different metals with 5 v/v% LIX 622 extractant in methyl isobutyl ketone (MIBK) have been obtained. The order of extraction of metals with LIX 622 extractant as a function of  $pH_{1/2}$  value is determined and results agree well with the order obtained using salicylaldoxime as chelating ligand for the extraction of these metals.

**Keywords.** LIX 622 extractant;  $pH_{1/2}$  value; hydrometallurgy.

### 1. Introduction

Among the various available LIX reagents based on different chelating functionalities, LIX 622 is a chelating extractant based on a substituted salicylaldoxime moiety (Ashbrook and Ritcey 1984). Extraction of copper (II), zinc (II), cadmium (II), cobalt (II), nickel (II), manganese (II), palladium (II), lead (II), rhodium (III) and antimony (III) with LIX 622 extractant has been presented in this paper. Such a study would be helpful in developing new separation methods and preconcentration techniques. Some of this information may be useful in hydrometallurgical work.

### 2. Experimental

#### 2.1 Materials

The extractant LIX 622(HL), a substituted salicylaldoxime in kerosene was kindly supplied by the Henkel Corporation, USA, in diluted form. The pH of the aqueous phase was maintained by using standard pH buffers. A constant ionic strength in the aqueous phase was maintained by using potassium nitrate solution. Metal solutions were prepared by dissolving analar grade metal salts in distilled water, adding sufficient acid to prevent hydrolysis.

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## 2.2 Extraction procedure

The aqueous phase (10 ml) containing an aliquot of metal solution (10 to 50 ppm), five ml of buffer solution and 1 ml of 1 M potassium nitrate was equilibrated with 10 ml of organic phase containing 5% v/v LIX 622 in methyl isobutyl ketone (MIBK). The concentration of metal in the aqueous phase (after extraction) was measured using an SP191 Pye Unicam Atomic Absorption spectrophotometer. The concentration of metal in the organic phase was calculated from the difference between metal concentrations in the aqueous phase before and after extraction.

## 3. Results and discussion

The extraction of metal chelates can be described by a plot of  $D_c$  against pH at constant reagent concentration. Here  $D_c$  is defined as the concentration of the metal in the organic phase divided by the concentration of metal in the aqueous phase.

The effectiveness of a chelating extractant is determined by two factors, the values of partition coefficient and the  $\text{pH}_{1/2}$  values. At  $\text{pH}_{1/2}$  (pH at which 50% of metal ion is extracted) the equation can be written in a simplified form (as given in standard solvent extraction books).

The equilibrium constant ( $K_{\text{ex}}$ ) is related to  $\text{pH}_{1/2}$  and hence the order of extraction of metals as a function of  $\text{pH}_{1/2}$  values at given concentration of extractant parallels that of  $\log K_{\text{ex}}$  values.  $\log K_{\text{ex}}$  values for some metal systems have been calculated using the experimental values of  $D_c$  and LIX 622(HL) concentration (5% v/v LIX 622 in MIBK is  $\sim 0.0191$  M). The concentration of the ligand has been determined using the method given in the literature (Ashbrook and Ritcey 1984).

The extraction data of different metals with LIX 622 extractant are given in table 1. The order of extraction of metals with LIX 622 extractant as a function of  $\text{pH}_{1/2}$  values is as follows: Pd (II) < Cu (II) < Pb (II) < Co (II) < Zn (II) < Mn (II)

**Table 1.** Extraction data of some metals with 5% v/v LIX 622 extractant in MIBK.

Metal	$\text{pH}_{1/2}$ (50% extraction)	pH for complete extraction	Shaking time (h)	Slope value $\log D_c$ vs. pH*	$\log K_{\text{ex}}$
Mn (II)	7.52	9.2	0.5	2.0	-11.60
Cu (II)	1.5	Complete extraction in the pH range 1.5-9	0.25	-	-
Pb (II)	6.75	8.5	0.5	1.75	-10.06
Ni (II)	7.61	8.2	0.5	1.95	-11.68
Zn (II)	7.30	87% extraction	1.0	1.7	-11.16
Co (II)	7.06	94% extraction	0.5	1.83	-10.68
Cd (II)	-	30% extraction	1.0	-	-
Sb (III)	-	No extraction	3.0	-	-
Pd (II)	1.0	96% extraction	1.0	-	-
Rh (III)	-	No extraction	3.0	-	-

\* pH = 1 to 9.5.

< Ni(II), which agrees with the order obtained with salicylaldoxime extractant (Dahl 1968) with the exception of Ni(II). Since LIX 622 resembles salicylaldoxime in its extractive properties towards metals, it seems reasonable to suppose that similarities exist in their properties.

With a 5% v/v LIX 622 extractant in MIBK and by selecting the proper pH, it is possible to make analytical separations of the metal ions investigated, e.g. Co (II) and Ni (II), Zn (II) and Cd (II). Thus the present study with LIX 622 shows excellent promise for some analytical separations and analytical trace metal preconcentration.

## References

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