



Separation of Re and Mo from roasting-dust leach-liquor using solvent extraction technique by TBP

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ABSTRACT

Re/Mo separation is studied by a new solvent extraction technique which is based on extraction mechanisms of the constituent metals. Based on McCabe–Thiele plots, a flow diagram has been proposed for separation and purification of Re over Mo. Re-recovery section of the diagram shows that Re is extracted when major amount of Mo is removed. For removal of the remained Mo, a two-stage extraction is required at pH = 2 and $V_a/V_o = 1$. In order to obtain Re, the resulted aqueous phase is stripped by adding sulfuric acid. According to the results, while more Re is extracted at less pH, optimum extraction of Mo happens at pH = 1.2. Re selectivity over Mo maximizes by approaching of the pH to zero.

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1. Introduction

Re and Mo are strategic metals with special properties and important applications [1,2]. With ceaseless exploitation of world Mo/Re resources, high grade reserves are getting depleted on a daily basis. Primary supplies are presently insufficient for fulfillment of the world demand. Low-grade ore is, hence, inevitably exploited.

Re can be obtained via roasting/solvent extraction or direct reduction of the molybdenite concentrate [3]. Different processing routes for various Mo/Re resources have previously been investigated [4]. The recovery of Re and Mo from bearing solutions has both economic and environmental benefits. Separation of Re from Mo of the aqueous solutions has, however, been always a problem. Adjacent positions in the periodic table result in their similar chemical behavior. Differences do, however, exist [5].

Current industrial practices for extraction of Re from Re/Mo bearing solutions are ion exchange (resin) and solvent extraction processes [6,7]. Ion exchange is known as a costly process due to its small capacity, low selectivity and lengthy absorption procedure [8].

Liquid–liquid extraction using organic solvents has proved an efficient technique for separation and purification of metal ions.

Ease of use, low cost and recyclability of components are advantages of this technique [6]. Extraction of Mo/Re from acidic leach solutions of the roasted Mo bearing ores is usually carried out by organic solvents. Extraction of Mo/Re with amines and organophosphorous compounds is possible at low pH values. Tri-butyl phosphate (TBP), tri-octyl amine (TOA), ketones, and long chain alcohols such as 1-octanol and 1-decanol are the extractants usually used for extraction of Mo/Re [4]. Further development of solvent extraction technique and purification processes are, thus, vital to progress of the art.

Compared to other extractants, TBP is relatively inexpensive with low solubility in water and good extraction performance [9]. Previous reports show that mechanism of extraction by TBP involves an ion association in which TBP molecules are protonated by H^+ or H_3O^+ as cation [10]. TBP is an appropriate extractant for extraction of anionic species, while it is unable to extract Fe from sulfuric acid media.

Karagiozov [11] has studied the extraction of Mo from weak acid solutions containing Re by using Aliquat 336 as the extractant. Xiong et al. [3] have investigated the kinetics and mechanism of Re extraction employing mixtures of tri-alkyl amine and tri-*n*-butyl phosphate, recently. They found out that the separation of Re from Mo becomes more feasible when employing kinetic limitations than utilizing thermodynamic equilibrium conditions.

In Karmania Co. of Kerman, I.R. Iran, a large amount of rhenium is annually wasted as outgoing dust of molybdenite roasting furnaces. This definitive source of rhenium/molybdenum can be lea-

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