RARE METALS
Vol. 25, No. 2, Apr 2006, p. 99

The pilot test of Pt-Pd and Pt-Rh feeds extracted and separated with a new sulfoxide extractant

ZHU Ping[1)], *GU Guobang*[2)], *QU Zhiping*[3)], *HUANG Yanfei*[3)], *and YAO Wenxue*[3)]

1) College of Environment Science and Engineering, Shanghai University, Shanghai 200072, China

2) Department of Applied Chemistry, South China University of Technology, Guangzhou 510640, China

3) Institute of Material Reutilization of the Ministry of Internal Trade, Xuzhou 221006, China

(Received 2004-11-27)

Abstract: Platinum, palladium and rhodium of the raw feeds extracted and separated with a new sulfoxide extractant (MSO) were studied in the paper. The pilot test results showed that the percentage extractions are more than 99% for platinum and palladium in Pt-Pd feed, and the percentage strippings are 100% and 99.2% with HCl and ammonia, respectively. The ratio of palladium to platinum is 0.0016 in stripping platinum solution, and the ratio of platinum to palladium is 0.0020 in stripping palladium solution. The percentage extraction of platinum is 99% in Pt-Rh feed, and the percentage stripping is 100%. The ratio of rhodium to platinum is 0.0002 in stripping platinum solution. Therefore, platinum, palladium, and rhodium feeds are separated effectively with MSO.

Key words: solvent extraction; pilot test; sulfoxide; platinum group metals

1. Introduction

Solvent extraction is a new high technology in separation science being applied widely to purify and separate precious metals. During the recent thirty years, many scholars have devoted themselves to study it. Though a lot of papers are reported every year [1-6], there is still little literature about the processes of purifying and separating precious metals with solvent extraction. In addition, some technological descriptions published are too simple to be understood in detail.

By analyzing the extraction processes of some famous precious metal refineries at home and abroad, the approximate separating order is expressed as follows. Firstly, gold was extracted with dibutyl carbitol (DBC) or methyl isobutyl ketone (MIBK); secondly, palladium was extracted with hydroxyl oxime or dialkyl thioether; thirdly, platinum was extracted with tertiary amine or tributyl phosphate (TBP); fourthly, iridium was extracted with tertiary amine or TBP or trialkyl oxygen phosphine; then, rhodium was separated and purified with precipitation or ion exchange method; and finally, osmium and ruthenium were separated and purified commonly with the distillation method. At present, except for extracting gold with DBC, there are some problems for extracting other precious metals. For example, the rate of palladium extracted with hydroxyl oxime is so slow that the operation cannot be automatized; it is possible that thioether is oxidized into sulfoxide during the extraction of palladium, which affects the separation between platinum and palladium. In addition, the direct recovery of iridium and rhodium is influenced because of the dispersion in the solution while platinum is extracted by the tertiary amine extractant.

For extracting and separating platinum and palladium, they were coextracted with amino acid and stripped together in the Lonrho refinery of South Africa. Palladium was extracted with thioether to be separated with platinum [7-8]. Two kinds of extractants were used in the above process. In the study, only one kind of extractant MSO was applied to the

Corresponding author: ZHU Ping **E-mail:** xhnzp@staff.shu.edu.cn

extraction and separation of platinum, palladium and rhodium. The pilot test was done.

2. Experimental

2.1. Raw materials and reagents

The feeds were the solution of dissolving waste catalysts, in which the contents of precious metals and copper were high, and the content of iron was low. The data is listed in Table 1.

MSO was a sulfoxide extractant that was synthesized by our task team. It was a weak yellow and stiff liquid, and its density, viscosity, and boiling point were 0.899 $g \cdot cm^{-3}$, 25 mPa·s, and 300°C, respectively. The sulfur content was 10.27% in MSO, and it was diluted with kerosene.

Table 1. Contents of main elements in feed solution

Feeds	Pt / ($g \cdot L^{-1}$)	Pd / ($g \cdot L^{-1}$)	Rh / ($g \cdot L^{-1}$)	Cu / ($g \cdot L^{-1}$)	Fe / ($g \cdot L^{-1}$)	H^+ / ($mol \cdot L^{-1}$)
Pt, Pd	3.27	6.78	0.00	21.42	0.04	3.00
Pt, Rh	6.01	0.00	0.45	5.92	0.01	3.00

Ammonium chloride and sodium chloride were analytical reagent grades. The chemical reagents included hydrochloric acid, ammonia and oxalic acid, and sodium hydroxide was industrial reagent grade.

2.2. Apparatus

The extracting equipment was a mix-settler of 2.5 L. The reagents flowed into the mix-settlers from the upper slots. The total process of extraction occurred in the mix-settlers, and the raffinate and stripping solution were exported from the mix-settler into the low container. The concentration of the metal ion in the aqueous phase was determined with the WFX-IE3 atom absorption spectrophotometer.

2.3. Process flow

Fig. 1 shows the process flow diagram of treating the Pt-Pd feed, which includes three-stage coextracting platinum and palladium, two-stage scrub, two-stage stripping platinum, three-stage stripping palladium, and one-stage regenerating MSO. On the other hand, the process of treating the Pt-Rh feed includes five-stage extracting platinum, two-stage scrub, three-stage stripping platinum, and one-stage regenerating MSO, whose flow diagram is shown in Fig. 2. Every segment of the two flows is operated with counter current, and the scrubbed solvent is merged into the feed.

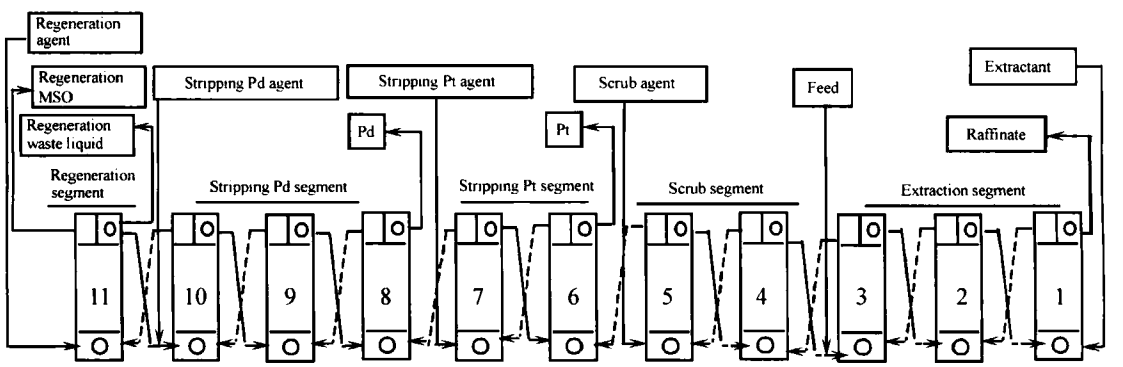

Fig. 1. Process flow diagram of extracting and separating Pt and Pd. The broken line denotes the flowing direction of organic phase.