Thesis title: Research on the application of sorption methods in the technology of recovery and separation of precious metals

Summary: Precious metals, such as platinum, palladium, rhodium and gold, have been considered critical materials in the European Union and worldwide for many years. Recently, there has been an increasing emphasis on the recovery of these metals from secondary raw materials, which results from their limited quantities in primary sources. Solutions created after processing of waste very often contain low concentrations of gold and platinum group metals, which requires the use of appropriate techniques. The aim of the research conducted as part of the doctoral project was to determine the possibility of using sorption methods in the technology of recovery and separation of precious metals, such as platinum, palladium, rhodium and gold. Three selected commercial ion-exchange resins (Puromet MTS9200, Puromet MTS9850 and Lewatit MonoPlus MP600) with different functional groups were used in the experiments. The base solution for the tests was a chloride technological solution created by leaching the post-refining waste. The work consisted of the following steps: initial selection of ion-exchange resins, sorption tests in static conditions, sorption tests in dynamic conditions, elution tests, and precious metals and their compounds preparation tests by cementation, reduction or precipitation. The parameters of the sorption process in static conditions (ratio of the solid phase to the liquid phase, contact time, metal concentration, presence of other elements in the solution, occurrence and type of resin modification, nitric acid concentration, pH of the solution, temperature and eluent possible to use) and dynamic conditions (flow rate, bed geometry, concentration of other elements in the solution, nitric acid concentration, pH of the solution, contact time of the eluent with the resin bed, and the working and total capacities of the selected resins in relation to the precious metals) were determined. A technology for separating precious metals from the post-

Sieć Badawcza Łukasiewicz – Instytut Metali Nieżelaznych
44-100 Gliwice, ul. Sowińskiego 5, Tel: +48 32 238 02 00
E-mail: imn@imn.gliwice.pl | NIP: 631 020 07 71, REGON: 000027542, BDO: 000011457
Sąd Rejonowy w Gliwicach, X Wydział Gospodarczy, KRS: 0000051588
Bank PEKAO S.A. nr konta: 48 1240 4748 1111 0000 4877 1906

elution solutions of thiourea in hydrochloric acid has also been developed. As part of the doctoral thesis, selected physicochemical properties of the ion-exchange resins were also determined. The most important element of the work was the determination of the assumptions of the new technology for the recovery of precious metals for future implementation. The performed laboratory tests confirmed the possibility of using the ion exchange technique to recover precious metals from low-concentration post-refining solutions using generally available, commercial ion-exchange resins. Based on the conducted studies, the following key conclusions were formulated: due to the high sorption efficiency (Pt >99.9%, Pd >99.9%, Rh >97.0% and Au >99.9%), with the use of appropriate parameters, ion-exchange resins: Puromet MTS9200, Puromet MTS9850 and Lewatit MonoPlus MP600 can be used for the sorption of precious metals from solutions obtained during the processing of refining waste; thiourea in hydrochloric acid is the best eluting agent (Pt >99.8%, Pd >99.9%, Rh 99.5% and Au >99.5%); zinc dust allows for the recovery of precious metals from eluates with high cementation efficiency (Pt >99.9%, Pd >99.9%, Rh >97.7% and Au >98.8%); hydrazine hydrate is the best reducing agent (Pt >96.1%, Pd >99.7%, Rh >87.7% and Au >98.5%). Based on the obtained results, a technology was developed, including: sorption of precious metals, elution with thiourea solutions in hydrochloric acid, and selective separation of metals from eluates. The determined parameters of the individual operations provide a basis for starting the procedure of implementing the new technology.

Key words: precious metals, sorption, elution, separation of precious metals

Sieć Badawcza Łukasiewicz – Instytut Metali Nieżelaznych
44-100 Gliwice, ul. Sowińskiego 5, Tel: +48 32 238 02 00
E-mail: imn@imn.gliwice.pl | NIP: 631 020 07 71, REGON: 000027542, BDO: 000011457
Sąd Rejonowy w Gliwicach, X Wydział Gospodarczy, KRS: 0000051588
Bank PEKAO S.A. nr konta: 48 1240 4748 1111 0000 4877 1906