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Radiotracer Methods for Ore and Flotation Tailings Leaching

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The copper mining and ore processing is one of the most stable and profitable branch of the Polish economy and the fastest growing industry. However the technologies used lead to high losses of valuable and so called deficit metals (rare earths, uranium and copper) in solid wastes streams. The development and implementation of hydrometallurgical technologies is a solution feasible from the higher elements recovery efficiency and decreasing hazardous impact of the wastes storage on the environment. Radiotracer methods are the suitable tool for process investigation since most of the elements involved may be activated and their radioactive isotopes easily detected. The separation efficiency, process kinetics and flow dynamics of hydrometallurgical systems can be therefore qualitatively and quantitatively evaluated.

The objective of the project is elaboration of new efficient method for recovery of copper and critical metals from the various raw materials using radiotracers for process optimization. A key stage of metal recovery process is a leaching process. The raw material was crushed and decarbonized using oxidation techniques and characterized. Initial concentrations of the copper and other elements were determined by ICP-MS, ASS and chromatography methods. The leaching process is carried out in a periodic chemical reactor. For process optimization a radiotracer techniques based on nuclear activation analysis has been used. The samples of the material were activated into neutron flux at the MARIA Reactor and mixed with leached materials. The radiotracers (activated 64Cu) were used to determine leaching efficiency instead of common analytical methods. The results were validated using ICP-MS and ASS analyses. Obtained metal solution will be separated at mixer settlers and ion exchangers also optimized by radiotracers techniques.

As raw material we used copper ore and flotation tailings. As we expected the samples contain several metals (Cu, V, Zn, Co, Ag, Ni, Mo, Fe, Pb, Mn, U, REE ect.). The copper concentration was at level 4% in the ore and less than 1% in the tailings waste. The sulfuric acid has been selected as the optimal leaching medium for future experiments. The material was ground and sieved to extract individual fractions. The optimal granulation was selected: 0.25-0.5mm. At leaching step the material was treated with sulfuric acid at various concentrations (2-16M). We also calculated activation parameters for developing activation procedure. The samples were activated and used at leaching experiment for RTD test.

Radiotracer methods seems to be suitable tool for leaching process investigation since most of the elements involved may be activated and their radioactive isotopes easily detected. The separation efficiency, process kinetics or flow dynamics of hydrometallurgical systems can be therefore qualitatively and quantitatively evaluated. Radiotracer methods were validated using common analytical procedures and can be used instead of them for controlling and optimization of the process.

This work is part of the studies for the IAEA Coordinated Research Projects: “Radiometric Methods Applied in Hydrometallurgical Processes Development and Optimization”and “Radiometric and Radiotracer Techniques in Hydrometallurgical Processes for Deficit Elements Recovery”co-financed by Polish Ministry of Science and Higher Education.

Country/Organization invited to participate

Poland

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