Hydrometallurgical Process Development

MINTEK has facilities to undertake hydrometallurgical projects from basic flowsheet design through to laboratory testwork, piloting, and full-scale plant commissioning. This service includes optimisation of process conditions based on experimental work and computer simulation. These results are used by the client to determine the most cost-effective process route for a specific application. A professional team of process chemists and engineers, analysts, mineralogists, and engineering workshops, works together in close collaboration throughout a project and assists the client and engineering contractor with the final design and feasibility studies.

Ongoing research in techniques and equipment design is undertaken to develop new technologies and improve existing ones. Mintek also has excellent piloting facilities for the recovery and refining of metals, allowing the continuous testing of hydrometallurgical processes within integrated flowsheets.

**Leaching**

Mintek is able to select and optimise atmospheric and pressure leaching conditions for ores and concentrates, based on an in-depth understanding of the basic chemistry involved, mathematical modelling and process optimisation. Mineralogical analysis of the ore often provides invaluable information to develop the most efficient recovery and leaching strategies.

**Precipitation**

When using precipitation techniques to purify or concentrate process streams, both purity and recovery need to be considered. Expertise is available on base metal precipitation using various precipitants as well as the oxidative precipitation of iron and manganese from process streams.

**Solvent extraction**

Entrenched expertise and modern laboratory equipment is available for the development, evaluation, and understanding of fundamental SX process chemistry, as well as various sizes of mixer-settler equipment for continuous pilot-plant evaluations. Bateman Pulsed Column (BPC) testwork is carried out in a joint venture with Bateman Minerals & Metals. A nickel synergist reagent, Nicksyn™, has been developed to optimise nickel recovery and nickel-calcium separation. The benefits include reduced co-loading of calcium on the organic phase, higher nickel recoveries using fewer stages, and lower reagent losses. Mintek also developed a SX-based gold refining technology, which has been implemented commercially on a number of gold refineries.

**Ion exchange**

The best-known metallurgical application of ion exchange is in the recovery of uranium – a South African-developed process in which Mintek, with its NIMCIX fluidised-bed contactor, played a major role. Other industrial applications include gold recovery and purification of electrolytes for electrowinning. Mintek has devoted a major effort to the development of resin-in-pulp/leach (RIP and RIL) processes for gold, and a gold-selective resin (Dowex-Minix) was developed that is particularly effective for preg-robbing ores, where activated carbon yields poor recoveries. Recent developments in RIP technology have focused on
the recovery of uranium and base metals from slurries that are difficult to filter or settle. A further innovative development is the use of ion-exchange fibres, which promise much faster adsorption kinetics, for the recovery and purification of base and precious metals.

Electrowinning
Mintek has expertise in the electrowinning of base metals such as cobalt, copper, chromium, manganese (under exclusive contract), nickel, and zinc, as well as gold, PGM recovery from effluent streams, and the production of electrolytic manganese dioxide (EMD). Laboratory-scale electrowinning cells have been developed for investigating both cathodic and anodic processes, as well as cells for pilot-plant testwork on both synthetic and real plant solutions.

Recent projects
• Dutwa nickel laterite, Tanzania. Leach testwork and mineralogical characterisation.
• Kalukundi, DRC. Flowsheet development, encompassing milling and sample preparation, leaching, and recovery of copper and cobalt by solvent extraction and electrowinning.
• Mopani Copper Mines, Zambia. Laboratory and pilot-plant testwork (on-site and at Mintek) for purification of the cobalt stream and recovery of cobalt metal. The testwork consisted of copper and iron removal by ion exchange, solvent extraction for zinc removal and cobalt recovery and purification, followed by cobalt electrowinning.
• Idaho Cobalt. Continuous mini-plant exercise, consisting of atmospheric and pressure leaching, various stages of solution purification by precipitation, ion exchange and solvent extraction, and electrowinning of cobalt and copper.

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