Nickeleach®

A Proprietary Leaching Technology of

Metaleach®

Technology Summary

Suitable for public dissemination

Company background

MetaLeach® was set up to own the proprietary and novel leaching technologies AmmLeach®, NickeLeach®, HyperLeach® and MoReLeach™ which have been developed over more than 10 years on global research & development. These technologies are all protected by an extensive and rigorous intellectual property strategy, including a comprehensive suite of patent applications in targeted countries around the world.

Technology overview and application

Successful trials have been made on a wide range of sulphide materials including, chalcopyrite ore and concentrates, other copper sulphide minerals, nickel sulphide and matte, molybdenite, lead, zinc and polymetallic ores. The process is eminently suitable for concentrates and ores and can be used in heap or tank leaching modes.

NickeLeach® Process

NickeLeach® is a new hydrometallurgical process for the extraction of nickel and cobalt from lateritic ores. Unlike most current processes, NickeLeach® is an ambient temperature ambient and pressure process capable of being run using either heap leaching or agitated tank leaching. The use of such comparatively benign operating conditions ensures a low capital cost compared to those using smelters, Caron process, pressure acid leach plants and hot acid leach plants.

One of the strengths of the NickeLeach® process is the high selectivity of the leaching stage compared with acid processes. The AmmLeach® solution is substantially cleaner than the leach solutions from acid processes, which typically contain very high levels of iron, manganese, aluminium, silica, magnesium and calcium, as well as lower levels of nickel and cobalt. In acid processes, the indiscriminate nature of the leaching process necessitates purifying the leach solution, typically by the addition of lime, to remove the unwanted elements in several precipitation stages followed by solid liquid separation. Each of these precipitation / separation steps results in loss of valuable metals. The nickel and cobalt are most commonly precipitated by the addition of magnesia and sold to refineries for 50-65% of the contained metal value. Even after the value metals are recovered the resultant solution will need to be further treated to remove the calcium and sulphate as gypsum. For autoclave-based processes the acid consumption is typically more than 400 kg H_2SO_4/t ore, atmospheric leaching processes have higher consumption as, unlike autoclaves, acid is not regenerated within the process.

Acid heap leaching of laterites has become more popular in recent years with variable success. Operationally, they are very difficult to manage since the omnivorous leaching of the acid results in extremely complex solution chemistry which results in significant precipitation of jarosite and gypsum within the heap and elsewhere within the process. This leads to blockages and solution channelling reducing the efficacy of the leaching. The high extents of dissolution also lead to problems with heap stability as the volume of ore is constantly decreasing during leaching leading to slumping and blockages. The long-term stewardship of such an unpleasant residue is likely to

be both time consuming and expensive. Acid consumptions of up to 900 kg H_2SO_4/t ore have been reported for heap leaches. This is typically the greatest operating cost and determines the minimum head grade of ore that can be treated economically.

The acid processes are akin to using a sledgehammer to crack a nut. Very large quantities of acid are used and virtually none is recycled with consumptions being typically in excess of 400 kg H_2SO_4/t ore even for the lowest consumption operations.

In contrast to acid leaching, the purification of the solution occurs during leaching since the only elements soluble in the AmmLeach® solution are the nickel and cobalt. This eliminates any need to precipitate iron, manganese, aluminium, silica, magnesium and calcium as these are essentially insoluble. Once the leach solution has been separated from the solids it can proceed directly to nickel and cobalt separation using a very simple solvent extraction process. The nickel can be electrowon as cathode and the cobalt recovered as a high purity hydroxide eminently suitable for feed to chemical plants. The separation and metal purification from the leach solution is similar to that used in Caron process plants. However, unlike the Caron process, no preliminary high temperature reduction of ore is required as the ore can be treated directly. The similarity of the NickeLeach® refinery to those used in Caron process plants greatly reduces the use of new technology in the process.

The ammonia leach solution is also recycled rather than consumed, greatly reducing the cost of reagent compared with the acid process. The washed tailings will inevitably contain a small amount of ammonia but experience with a copper heap AmmLeach® pilot plant has shown that this greatly encourages revegetation, minimising any problems with ongoing environmental problems.

Summary

The NickeLeach® process offer a cost effective, environmentally friendly method of processing lateritic ores and concentrates to produce separate nickel and cobalt products. The process operates at ambient temperature and pressure, greatly reducing the cost and complexity of a process plant when compared with all other available technologies.

The acid processes consume vast quantities of sulphuric acid whilst NickeLeach® recycles the leaching agent greatly reducing costs. The omnivorous nature of the acid processes results in the production of very substantial volumes of precipitated wastes (hæmatite, gœthite, jarosite, gypsum etc) which need to be stored in a lined tailings facility to eliminate any acid drainage problems. The highly selective nature of the NickeLeach® process eliminates any precipitation steps, the tailings revegetate rapidly and can be stored safely with minimal monitoring.

The ambient conditions used in the NickeLeach® process greatly reduce the capital cost of the plant compared to the high cost materials required in the acid processes. The recycling of the main leach reagent also greatly reduces the cost compared to acid processes.

Nickeleach®

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