Leaching

Refining metals at Sherritt begins with the leaching of cobalt and nickel from a variety of feed materials. The cobalt feeds are segregated into high and low cobalt containing types and are fed to different locations in the plant.

The high cobalt feeds consist mainly of mixed nickel and cobalt sulphides. These feed materials are blended with an ammonium sulphate leaching liquor in a repulp tank and then the slurry is pumped into autoclaves. In the autoclaves, most of the metals are dissolved into the leach liquor at elevated pressure and temperature. The resulting slurry passes to a lamella thickener where the leach liquor is separated from the solid residue. The solid residue containing mostly iron oxide and some residual unleached sulphides is sent to the 2nd stage leach for further processing.

Similarly, low cobalt containing nickel feeds, such as nickel sulphates, are repulped in leaching liquor before being fed to the 2nd stage leach autoclave circuit. The slurry discharge from this leach is fed to another lamella thickener where the solids are separated from the leach liquor. The residue, consisting mainly of iron oxide with minor unleached sulphides, is repulped with leach liquor. The resulting slurry is pumped to the final autoclave circuit where the residual metals are dissolved. The final autoclave slurry discharges to a washing and filtration system, and the washed filter cake is stockpiled or sold. The filtrate is recycled to the process.

Cobalt Recovery

The solution from the high and low cobalt leaches are transferred to the nickel-cobalt separation plant. Here cobalt is removed and is sent to the cobalt reduction plant. Cobalt powder is recovered, using high pressure hydrogen reduction in an autoclave, much like the process described later for nickel. The nickel rich solution remaining after cobalt separation, is recycled to the copper removal system in the leach plant.

Copper Separation

The dissolved copper is removed in this section of the plant. The blended nickel-rich solution is heated in distillation pots to drive off ammonia. As the pH is lowered, the copper, unsaturated sulphur compounds and elemental sulphur combine to form solid copper sulphide. The slurry is passed through a lamella thickener and polish filters to recover the copper sulphide solids. The clarified solution then proceeds to nickel recovery. The solids in the thickener underflow are filtered, washed and sold as feed to a copper smelter.

Nickel Recovery

Before nickel can be recovered, unsaturated sulphur compounds and sulphamate must be eliminated from the solution. This is achieved at high temperature in the oxyhydrolysis tower.

The reduction of nickel occurs as a batch operation in the reduction autoclaves. Here an autoclave is filled with the purified solution and a small amount of nickel powder. Hydrogen is added under pressure and the nickel precipitates from solution, depositing on the nickel powder. The autoclave is agitated to keep the nickel in suspension. When the precipitation is complete, the depleted solution is drawn off and fresh solution is added. The cycle is repeated until the nickel particles grow too heavy to stay in suspension.

The slurry is then discharged to a flash tank. Nickel powder from the flash tank is transferred to a pan filter where the nickel particles are washed. The nickel powder is then dried and either packaged in this form or compacted into briquettes and sintered.

Sulphide Precipitation

Liquor from nickel reduction still contains minor amounts of nickel and cobalt. Hydrogen sulphide is used to precipitate metal ions from the liquor as insoluble sulphides. This slurry is passed through a lamella thickener where the precipitate is removed and recycled to the leaching process. The solution now contains mainly ammonium sulphate. This is recovered as crystals in the ammonium sulphate plant by evaporation, and is converted into Sherritt fertilizer.

Since its construction in 1954 to treat nickel concentrates from the Lynn Lake mine, the refinery has undergone several expansions and modifications. Present capacity is approximately 32,000 tonnes/year nickel and 3,500 tonnes/year cobalt.
How Sherritt Refines Nickel

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