How Sherritt Refines Metals

Leaching

Refining metals at Sherritt International's Fort Site begins with the leaching of nickel and cobalt from a variety of feed materials.

The feeds at the Fort Site consist mainly of mixed nickel and cobalt sulphides. These feed materials are blended with an ammonium sulphate leaching liquor in a mix tank and the mixture is pumped into pressure autoclaves. In the autoclaves, most of the metals are dissolved into the leach liquor at elevated pressure and temperature, using oxygen from air to react the sulphur. The resulting slurry passes to a lamella (inclined plate) clarifier where the leach liquor is separated from the solid residue. The leach liquor is further clarified before it is sent for cobalt recovery.

The solid residue from the first stage leach, which contains mostly iron oxide with some unleached and/or precipitated nickel and cobalt, is sent to the final leach stage for further processing. A portion of the residual metals are dissolved, and the final leach residue is clarified to produce a recycle liquor stream used within the plant. The solids are discharged to a filter press and washed before being dried and sold to customers for recovery of remaining nickel and cobalt values.

Cobalt Recovery

The leach solution is transferred to the nickel-cobalt separation plant. Here the bulk of the cobalt is recovered and sent to the cobalt reduction plant. Cobalt powder is precipitated, using high pressure hydrogen reduction in an autoclave.

The reduction of cobalt occurs as a batch operation in the reduction autoclaves. An autoclave is filled with the purified solution and a nucleation seed solution. Hydrogen is added under pressure and the cobalt precipitates from solution, depositing on the seed. The autoclave is agitated to keep the powder in suspension. When the precipitation is complete, the depleted reduction end solution is drawn off and fresh solution is added. The cycle is repeated until the particles grow to the desired product size.

The cobalt slurry is discharged to a flash tank, and cobalt powder is recovered, filtered, washed, and dried. The cobalt powder is then packaged in this form or compacted into briquettes, which are then sintered at high temperature to produce a high-purity final cobalt product.

The nickel-rich solution remaining after cobalt separation is sent to the copper removal system in the leach plant.

Since first starting production, over 1.3 million tonnes of nickel and 90,000 tonnes of cobalt have been produced at the refinery.

Copper Removal and Ammonia Recovery

The dissolved copper is removed in this section of the plant. The nickel-rich solution is heated in distillation pots to drive off ammonia. As the ammonia is removed, sulphur and sulphur dioxide are added, and react with dissolved copper to form a solid byproduct. The solution is clarified and sent to nickel recovery. The solids in the clarifier underflow are filtered, washed and sold as feed to a copper smelter.

Through the copper removal process, significant quantities of ammonia and water are removed from solution. This vent gas is condensed and combined with aqueous ammonia streams from the leach and cobalt separation stages. The resulting aqueous ammonia solution is distilled to produce separate reusable ammonia and water streams.

Nickel Recovery

Before nickel can be recovered, unsaturated sulphur compounds must be eliminated from the solution. This is achieved by adding air at high temperature in the oxydrolysis tower. The nickel is then recovered from solution using hydrogen reduction, similar to cobalt.

After filtering, washing, and drying the nickel powder, it is either packaged in this form or compacted into briquettes, which are either sold directly or sintered to LME-grade nickel product.

Sulphide Precipitation and Ammonium Sulphate

The solution after nickel reduction still contains zinc, nickel and cobalt. Hydrogen sulphide is used to precipitate metal ions from the liquor as insoluble sulphides in two stages. In the first stage, zinc is recovered as a saleable byproduct. In the second stage, remaining nickel and cobalt are recovered and recycled to the leaching circuit. The remaining solution now contains mainly ammonium sulphate. This is recovered in the ammonium sulphate plant by evaporation of water, and is sold as 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 over 34,000 tonnes/year nickel and 3,500 tonnes/year cobalt.

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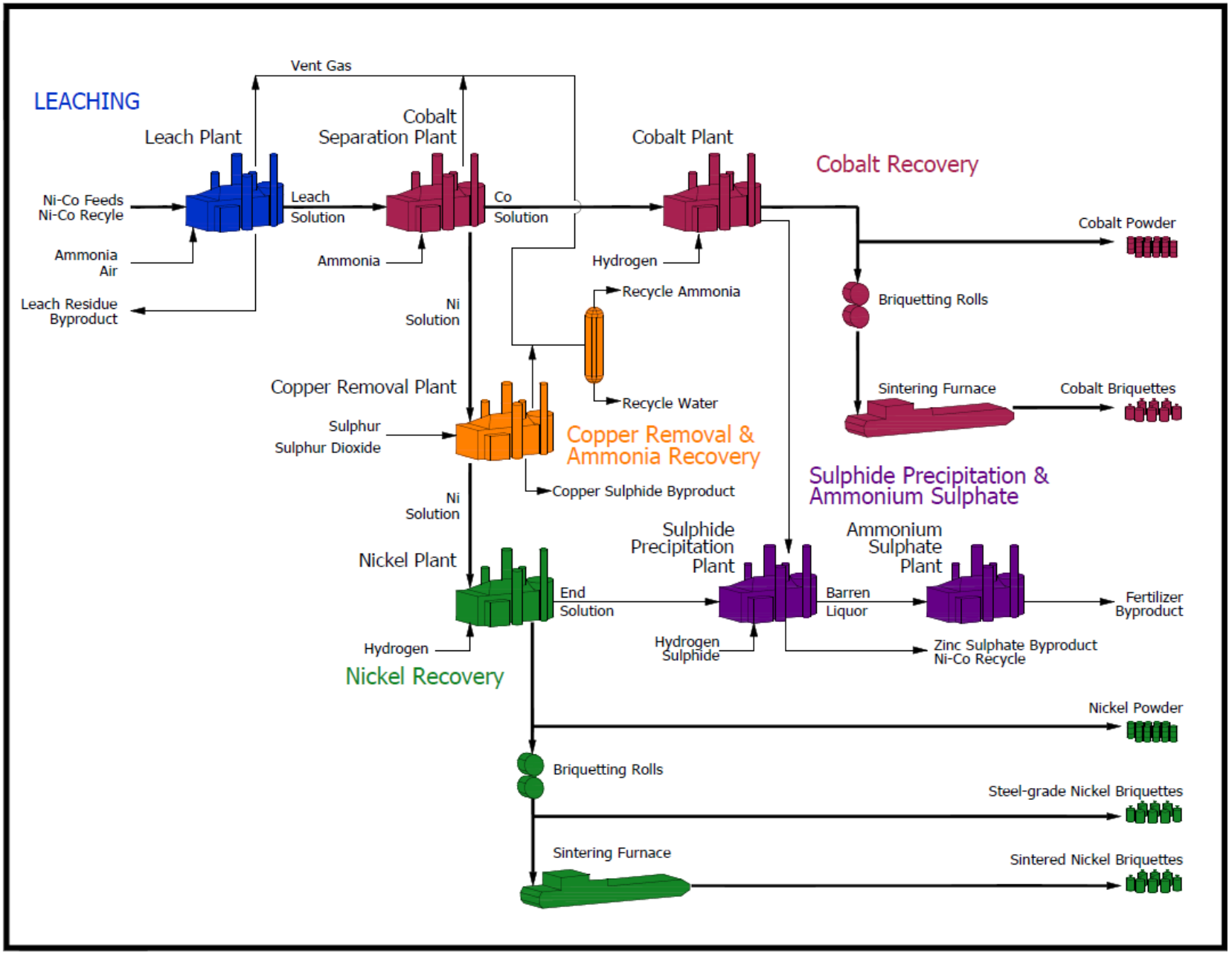

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Sherritt International Corporation
PO Box 3388
Fort Saskatchewan
Alberta, Canada T8L 2T3