WATERCARE MINING

Case Study

Membrane-based Metal Upgrade Plant

Using membrane technology to optimise nickel sulphate recovery from a waste stream of the PGM industry and minimise downstream process dilution.

A current global trend is the growing value attached to raw materials utilised in the manufacture of batteries. High-purity nickel sulphate is a raw material for the manufacture of rechargeable lithium ion batteries, the global market for which is expected to generate revenue of around $46 billion by 2022. Lithium ion batteries, used in electric and hybrid-electric vehicles, consist of 80% nickel. Nickel has additional applications in energy-storage batteries, rechargeable battery devices and the more traditional nickel-plating market.

PROCESS DESCRIPTION

A by-product of the Platinum Group Minerals (PGM) industry is a crude nickel sulphate stream. An opportunity exists to purify the crude nickel to a grade suitable to market to the lithium ion battery industry.

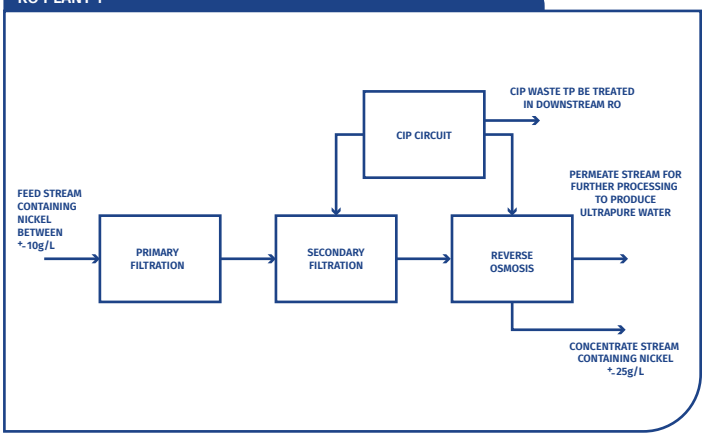
During the metallurgical processing of crude nickel, various waste streams are generated, some of which are regarded as high-value streams, as they contain entrained nickel sulphate. A secondary waste stream, containing high levels of sodium sulphate, is also generated. The waste streams cannot be reintroduced back into the process, as this may cause dilution and return a portion of the impurities. The management options for these streams are to either recover them via a separate process, or dispose of them, using an external third-party disposal company.

The cost of waste disposal is a key factor which limits the economic viability of the crude nickel beneficiation process as disposal costs are charged per mass of waste. The ideal situation was to reduce the waste stream to the lowest possible volumes, thereby minimising the amount of waste generated and their associated disposal costs.

Watercare Mining designed, built and commissioned a membrane plant to integrate into the nickel sulphate purification plant. The plant was designed to purify the nickel sulphate, while simultaneously addressing the challenges associated with the generation of the waste streams. The Nickel Purification Plant comprises a reverse osmosis (RO) package, consisting of 3 RO plants, designed and built by Watercare Mining. The RO plants include pre-treatment for solids removal.

RO Plant 1 is the nickel reverse osmosis circuit (Ni RO), configured to include upfront primary and secondary filtration followed by reverse osmosis. It upgrades and recovers nickel from dilute streams to be processed further through the Nickel

RO PLANT 1



Purification Plant. The nickel is upgraded into the concentrate stream, which is important for the minimisation of downstream dilution of the main nickel concentrate stream feeding the crystalliser.

RO Plant 2 treats the sodium-bearing solutions to minimise volume, which in turn lowers disposal costs. The sodium reverse osmosis circuit is configured to include primary

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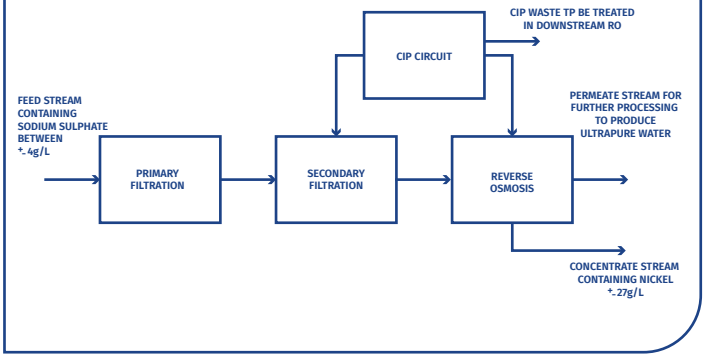
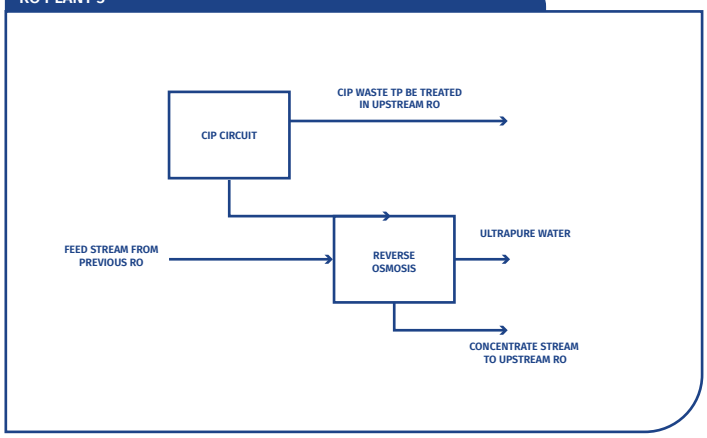
RO PLANT 2



filtration and secondary filtration followed by reverse osmosis. The major role of the sodium RO circuit is to concentrate the sodium as much as possible, reducing the volume of concentrate to be disposed of.

RO PLANT 3



RO Plant 3 is the final RO unit, fed from the nickel (RO Plant 1) and sodium reverse osmosis permeate streams (RO Plant 2), to produce ultra-pure process water for re-use in the plant with no pre-treatment. RO Plant 3 optimises water usage, by producing water to recycle.

The Nickel Purification plant has generated the following results:

1. An increased recovery of purified nickel per month.
2. A reduction in the volume of sodium sulphate solution that needs to be transported from the plant for disposal.
3. Recovery of ultrapure water for re-use, offsetting the municipal consumption.

The associated benefits of the project have been:

1. Maximising the recovery of nickel.
2. A significant reduction in waste removal costs by decreasing volume.
3. A reduction in municipal water consumption and costs, as ultra pure water is generated by the system and recycled back into the process.
4. The creation of an additional potential revenue stream, as sodium sulphate is a raw material for other industries such as the paper, board, glass, detergent and chemical industries.

PROCESS DESCRIPTION

In conclusion, this case study demonstrates Watercare Mining's membrane technology capabilities.

"This nickel purification plant is a flagship black industrialist project and we are proud to partner with ...– such initiatives are key for beneficiation in South Africa and market extension for our by-product streams," commented the mining house CEO (Engineering News 5th September 2018)