RARE EARTHS PROCESSING and THE APPLICATION OF MEMBRANES for PHOSPHORIC ACID PURIFICATION

By

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ABSTRACT

Arafura Resources Nolan's Bore Project is a rare earth rich massive apatite deposit located in the Northern territory. It is set to become a long-term supplier of neodymium and praseodymium (NdPr) oxide, along with significant quantities of phosphoric acid.

Open-cut mining will selectively target phosphate-rich material with the milled ore initially being processed using flotation. This produces a phosphate-rich, rare earth-bearing concentrate, fed to an adjacent extraction plant where it will be subjected to a number of hydrometallurgical processes including pre-leach, sulphation, water leach, precipitation, dissolution, and purification.

As a by-product of the pre-leach process, the extraction plant will produce 144,000 tonnes of fertilizer-grade (54%) phosphoric acid each year. Rare earth chloride from the extraction plant will be further refined at an adjacent separation plant into three final rare earth products for export and sale: 4,440 tonnes per annum of NdPr oxide, 470 tonnes per annum of a mixed middle-heavy rare earth (SEG/HRE) oxide.

Arafura has completed the final phases of an extensive 4-year metallurgical pilot program and finalised the assessment and analysis of the results of this program. The completion of this metallurgical pilot program resulted in several process flowsheet modifications to incorporate the results of the testing and to optimise the metallurgical performance of the circuit. Some of these changes include:

- Changes to the rare earth hydroxide dissolution circuit to improve washing and cerium removal prior to the separation plant,
- addition of a cerium processing circuit, including leaching and solvent extraction, to recover mis-reporting rare earths and allow the production of a high purity cerium product in the future if desired,
- Change to nano-filtration from ion-exchange for rejection of impurities in the phosphoric acid product,
- Changes to various filtration equipment across the rare earth processing section of the hydrometallurgical circuits from plate and frame filters to candle filters.

The inclusion of the nano-filtration plant was based on trials undertaken by BMS Engineers and resulted in improved impurity removal. The change from IX to nano-filtration added assurance for production of on-specification phosphoric acid, a key by-product, as well as removing impurities from the recycled phosphoric acid recycled to the pre-leach circuit which improves leaching efficiency and reduces the mass of material feeding the acid bake.

Membrane applications in process plants are relatively novel, though becoming increasingly more accepted as a process unit operation. The inclusion of membrane technology over ion exchange in the Nolans Bore Project is demonstrating the increased acceptance of membranes as cost-effective alternative to traditional approaches.

Membrane technology is establishing a proven track record in challenging operating environments. Groundbreaking membrane applications by BMS Engineers in the uranium industry have proven the long-term cost effectiveness and sustainability of membranes in process applications, leading to the support by other process industries to exploits it cost and process advantages.

Keywords: acid recovery, membranes, nano filtration, phosphoric acid, BMS Engineers, Arafura Resources, Nolans Bore project, rare earths