ALTA 2023 27
30 April - 6 May | Perth, Australia

NOLANS RARE EARTHS PROJECT: INNOVATIVE RECOVERY AND PURIFICATION OF PHOSPHORIC ACID BY VSEP NANOFILTRATION

By

[1]Dr. Alex Elliot, [1]Lourdes Valle, [2]Landon Graham, [2]Greg Johnson

[1]Arafura Rare Earths, Perth, Western Australia
[2]New Logic Research, Nevada, USA

Presenters and Corresponding Authors

Lourdes Valle

Landon Graham

ABSTRACT

The Nolans Rare Earths Project (NRE) is the only undeveloped advanced ore to oxide rare earths projects of scale in the western world. The project is currently in detailed engineering phase and will transition to execution in early 2023. It is designed to produce ~4,400 tpa NdPr oxide, 470 tpa SEG/HRE and 144,400 tpa of 54% w/w P_2O_5 MGA (Merchant Grade Phosphoric Acid) as a by-product.

The flowsheet involves an integrated processing of apatite and fluorapatite (major host minerals of rare earths elements) through flotation, pre-leaching, sulphation (cracking), water leaching, impurities removal, separation by solvent extraction and product recovery. Nolan's apatite and fluorapatite REE-base ore feed is the first of its kind in any known rare earths existing production plants and advanced projects.

The leaching of these minerals with phosphoric and sulphuric acids produces excess phosphoric acid along with some thorium, uranium, iron, calcium, magnesium, and other cations, co-extracted during the process. The management of this process stream (to safely stabilise the acids and heavy metals) posed a challenge due to requirements for neutralisation, disposal, and containment.

Arafura had since capitalised this challenge into an opportunity, using New Logic Research's (NLR) innovative VSEP (Vibratory Shear Enhanced Processing) nanofiltration technology. The VSEP nanofiltration membrane technology effectively recovers more than 70% of the phosphoric acid and rejects majority of the cations including thorium and uranium to meet the MGA specifications, using an acid-proof membrane. The technology is also used to control the recirculating load of impurities from recovered mixed phosphoric and sulphuric acids to the process plant. Unlike traditional spiral wound nanofiltration, VSEP can tolerate high suspended solids and calcium saturated feed, simplifying the circuit, therefore provides a more cost-effective solution than traditional nanofiltration.

The recovery of phosphoric acid (as a saleable by-product) contributes to the economics of the project. On the other hand, the purification of the recycled mixed acid enables major operational flexibility, since it liberates the upstream pre-leach circuit from operating at a very tight range of major impurities. This renders the purification circuit an integral part of the overall Nolans project flowsheet.

This paper aims to share some of the VSEP nanofiltration testwork results and its translation to the engineering design of the Phosphoric Acid Recovery and Purification. It also highlights the strategic importance of the circuit to the overall flowsheet, and therefore the technical and economic performance of the Nolans Rare Earths Project.

Keywords: Nolans Rare Earths Project, Rare earths elements (REE), NdPr, VSEP, nanofiltration, acid proof membrane, NLR, thorium, uranium, merchant grade phosphoric acid, apatite, fluorapatite