

PALADIN ENERGY LTD – NANO-FILTRATION TECHNOLOGY FOR REAGENT RECOVERY

By

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ABSTRACT

A membrane-based acid recovery plant has been successfully installed and commissioned at Paladin Energy's Kayelekera Uranium Mine in northern Malawi. This Acid Recovery Plant (ARP) is believed to be the first commercial-scale operation of its kind in the world. The design has successfully demonstrated that a uranium-containing acid stream can be separated into a clean, uranium-depleted acid stream containing the majority of the acid and a low-volume, concentrated uranium stream. Apart from the significant acid savings (circa 40 t/day 98% sulfuric acid), the ARP also resulted in significant savings in neutralising chemical requirements downstream of the ARP.

Continuous operation over a six month period has demonstrated the success of the design and the long-term sustainability of membrane performance and cost savings. At a capital cost of US\$5M, the net operating cost savings of approximately US\$3 per lb U₃O₈ resulted in a simple payback period of 7 months. The project has been successful from both a technical and financial perspective. Despite the success of the ARP in reducing operating costs, Kayelekera Uranium Mine has since been placed on care and maintenance due to sustained low uranium prices.

Uranium can be stripped from ion exchange resins using a variety of acid and alkaline eluants. At Kayelekera, the eluant is sulfuric acid, while at Paladin's flagship operation, Langer Heinrich in Namibia, the eluant is sodium bicarbonate. Both eluants strip adsorbed uranium from ion exchange resins to produce Concentrated Eluate (CE). The acid or alkali component of the CE can be recovered using the nano-filtration technology developed by Paladin Energy and BMS Engineers. Paladin Energy has recently been granted a patent for this technology. Based on the success of the first membrane plant at Kayelekera, a second plant has been designed, installed and commissioned at Langer Heinrich. This plant, designed to recover sodium bicarbonate from the CE stream, was successfully commissioned in March 2015 and continues to perform above design expectation.

The Bicarbonate Recovery Plant (BRP) at Langer Heinrich recovers sodium bicarbonate from the CE and produces a clean, uranium-depleted sodium bicarbonate stream and a low-volume, uranium-rich stream. The sodium bicarbonate stream is recycled and fortified with fresh sodium bicarbonate to be reused as fresh eluant for further resin stripping in the ion exchange circuit, resulting in significant sodium bicarbonate and fresh water savings. At a capital cost of US\$7M and net operating cost savings of circa US\$6 per lb U₃O₈, this project has demonstrated a simple payback period of 3 months.

Keywords: acid recovery, membranes, nano filtration, Kayelekera, BMS Engineers, Paladin Energy