

# Application of nanofiltration for enhancing water recovery from mine tailing water: a case study

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## **Abstract:**

An Australian mining operation currently uses mechanical vapour recompression technology to concentrate mine tailings run-off water so it can discharge the distillate to the environment. To maintain its operations, the removal of an additional 1 MLD of water is required. The water has a high TDS and is at pH of approximately 3.4. An underutilised RO plant is available on site but it had an operating pressure maximum of 15 bar, too low to treat the tailings water's high osmotic pressure directly. A range of technology options were reviewed and assessed in terms of capex, energy use, technical maturity, time to implementation, technical risk and commercial risk. It was determined that a membrane system was the best option to deploy, and an NF/RO system was proposed. However, the tailings water pH is in the vicinity of commodity membrane isoelectric points (~3-4) so electrostatic rejection would be greatly affected. It was hypothesised that a membrane with an isoelectric point >4 would provide enhanced rejection. Two acid resistant NF membranes, with isoelectric points at approximately pH 5, were tested. Both NF membranes achieved a 60% volume recovery at the nominal operating pressure of 50 bar and demonstrated very high species rejection. The recovery was restricted due to chemical supersaturation, not osmotic pressure limitations. The permeate from one membrane was superior in terms of water quality. This permeate was neutralised to pH 7 and a modelling exercise was used to validate that the underutilised RO plant was capable of polishing the NF permeate to meet the discharge requirements. An overall system recovery of ~50% was achieved. A proposed flowsheet was developed for a system that required significantly less capital and energy compared to deploying additional thermal evaporation unit.

**Keywords:** Nanofiltration, isoelectric point, tailings water