CASE STUDY

Chemical-Free Boron Rejection Enhancement

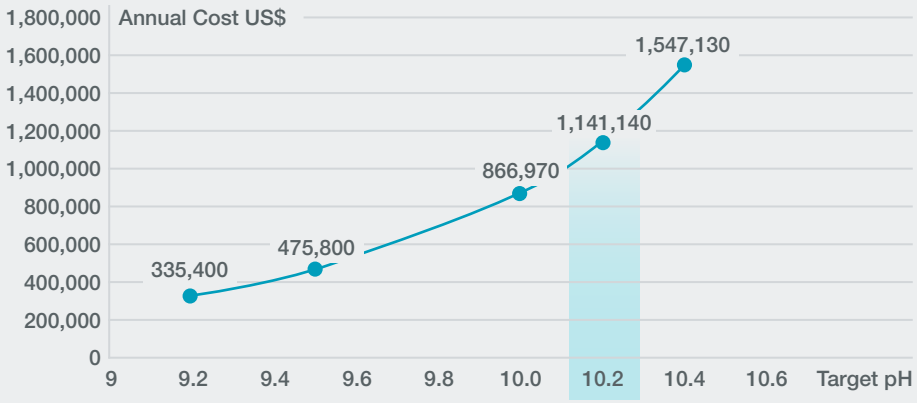
Overview

This patent-protected approach evaluated the performance of Active SWRO (Seawater Reverse Osmosis) membranes under seawater conditions, with a specific focus on boron rejection enhancement. The objective was to determine whether an applied electrical potential could enhance boron removal—without chemical dosing—a common requirement in conventional RO systems.

In typical seawater desalination, boron exists primarily in its neutral form (boric acid), which is poorly rejected by standard RO membranes. To compensate, the common strategy is to pass the permeate from the first

NaOH Dosing Cost

100 M m^3/Year Plant targeting inter-stage pH of 10.2 – $1.14 M Annual Cost Savings



pass is through a second pass where the pH is raised to above 10 using sodium hydroxide (NaOH), increasing complexity and cost, and environmental footprint.

These tests explored whether Active Membranes can achieve equivalent or higher boron rejection at neutral pH, eliminating the need for chemical addition into the second pass altogether.

Key Results

Chemical-Free Boron Rejection:
Active membranes achieved comparable boron rejection without NaOH dosing.

Significant Cost Savings:
For a 100 million m^3/year SWRO plant, avoiding interstage pH adjustment translates to over $1.14 million in annual cost savings as well as simplifying operation.

Optimized Electrical Conditions:
The applied voltage likely creates localized pH shifts at the membrane surface, enabling effective boron removal without altering the bulk pH.

No Compromise on Salt Rejection:
Salt rejection was on par with passive membranes, confirming that chemical-free boron rejection does not compromise desalination performance.
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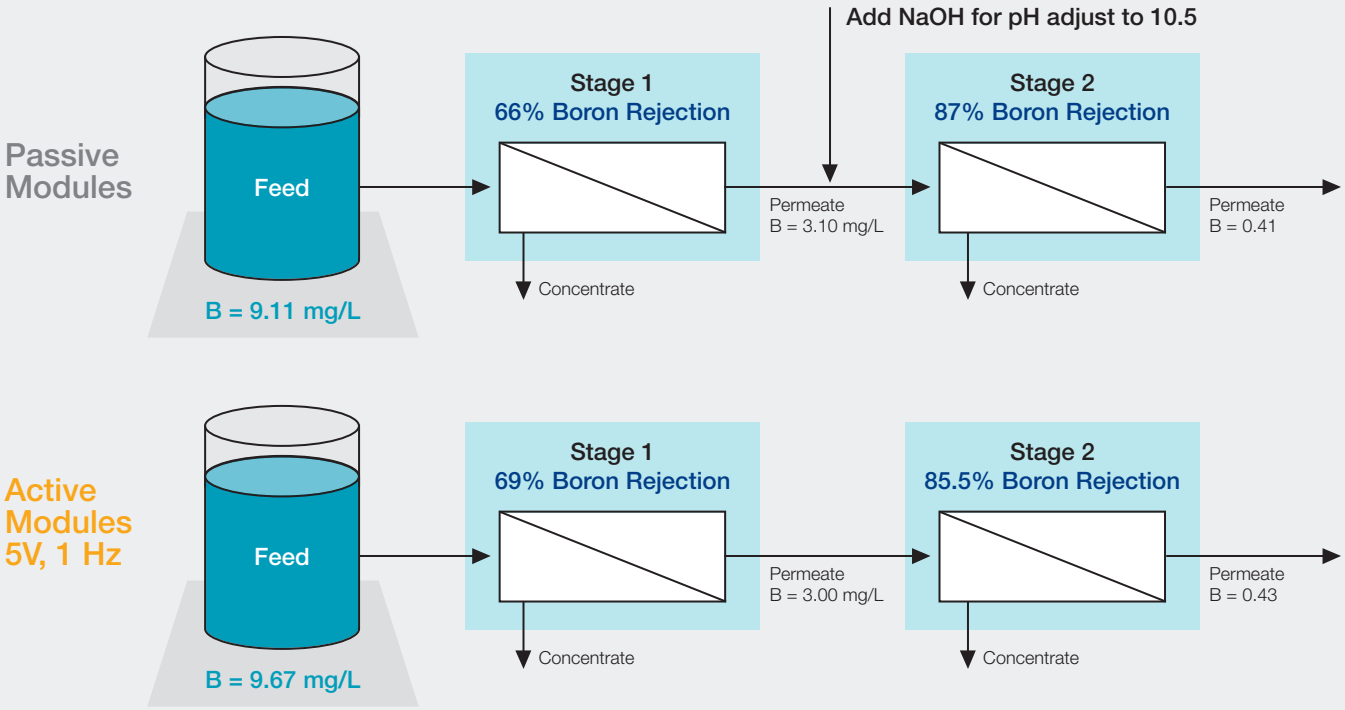
Boron Rejection Tests: Passive Vs Active



Conclusion

The SWRO Boron Rejection approach confirmed that Active Membranes enable high boron rejection without the need for chemical dosing. By replacing sodium hydroxide with applied electrical potential, this approach reduces chemical handling, lowers operational costs, and simplifies system design. Once again, Active Membranes prove to be the new standard in RO technology — enhancing performance while supporting safer, cleaner, and more sustainable desalination operations.

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