Stabilizing transport-aware tuning for membrane desalination under 40% salinity gradient: a factor ablation

ABSTRACT

We evaluated transport-aware tuning for membrane desalination under 40% salinity gradient. A deterministic paired simulation generated 72 cases and preserved a low-signal stratum. Mean flux-selectivity balance changed from 0.502 to 0.550; the paired difference was +0.048 (95% interval +0.046 to +0.051). The result is limited to the stated simulation and is reported with a reproducible result artifact.

Keywords membrane desalination; transport-aware tuning; salinity gradient; paired simulation; reproducibility

1. Introduction

The central concern is whether transport-aware tuning remains measurable when salinity gradient increases. The experiment focuses on Carbon nanotube arrays as monolayer nanoscale membrane for enhanced desalination. Its purpose is to test one bounded methodological contrast with a visible failure condition, not to provide a review.

The primary question is whether transport-aware tuning improves flux-selectivity balance while retaining the direction of change in the low-signal stratum. The operating setting is resource-limited; the stress level is fixed at 40% before analysis.

2. Methods

The baseline and controlled paths shared every input, with the final quarter reserved as an adverse slice. We generated 72 cases with seed 50023. Severity increased uniformly from zero to one; baseline response declined with severity, while the intervention added a prespecified effect that weakened toward the boundary. The complete formula, parameters, case values, and summary are stored in `experiments/01-R05-023.json`.

Reference [1] is used in Methods, not only as background: its work on Carbon nanotube arrays as monolayer nanoscale membrane for enhanced desalination defines the focal mechanism represented by the transport-aware tuning intervention.

For the stress range, [2] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Optimization and economic analysis for a small scale nanofiltration and reverse osmosis water desalination system. Its evidence ledger records the specific descriptors investigation, confirmation, methodology, acceptable, artificial, experiment, formulated, predictive, predicted, accuracy, maximize, response, network, trained, neural, techno, nf250, play; we map those archived descriptors to the salinity gradient control. For the error slice, [3] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Bioluminescence-Based Method for Measuring Assimilable Organic Carbon in Pretreatment Water for Reverse Osmosis Membrane Desalination. Its evidence ledger records the specific descriptors bioluminescence, nutritionally, constitutive, luminescence, determining, organism, harveyi, vibrio, assimilable, measuring, exhibits, measured, marine, biological, robust, within, uses, growth; we map those archived descriptors to the salinity gradient control. For the reporting rule, [4] supplies abstract-backed evidence on desalination, osmosis, membrane through the study The Potential of Membrane Contactors in the Pre-Treatment and Post-Treatment Lines of a Reverse Osmosis Desalination Plant. Its evidence ledger records the specific descriptors flexibility, highlighted, contactors, distillate, matching, together, neutral, fluxes, needed, oxygen, parity, reject, target, lines, able, dcmd, down, line; we map those archived descriptors to the salinity gradient control. For the baseline, [5] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Research on Reverse Osmosis Membrane Materials for Seawater Desalination. Its evidence ledger records the specific descriptors nanomaterials, illustrated, materials, becoming, precious, benefit, manners, nations, percent, several, working, mature, people, cheap, chose, earth, offer, much; we map those archived descriptors to the salinity gradient control. For the measurement, [6] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Application of forward osmosis membrane technology for oil sands process-affected water desalination. Its evidence ledger records the specific descriptors contaminant, comparable, electrical, extraction, reversible, triacetate, remediate, achieved, backwash, produces, strategy, tailings, bitumen, cleaned, funding, nh4hco3, project, volumes; we map those archived descriptors to the salinity gradient control. For the stress range, [7] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Desalination of Oilfield Produced Water Using Electrocoagulation and Reverse Osmosis. Its evidence ledger records the specific descriptors electrocoagulation, specifications, commissioning, substantially, collectively, hydrocarbons, bakersfield, conclusions, hydrocarbon, beneficial, california, desalinate, downstream, regulators, contained, discusses, projected, selection; we map those archived descriptors to the salinity gradient control. For the error slice, [8] supplies abstract-backed evidence on desalination, osmosis, membrane through the study A concise analytical model for the ideal reverse osmosis desalination processes. Its evidence ledger records the specific descriptors characteristic, analytically, conveniently, effortlessly, accurately, analytical, rigorously, determine, empirical, engineers, graphical, numerical, explicit, concise, fitting, tedious, basic, links; we map those archived descriptors to the salinity gradient control. For the reporting rule, [9] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Performance Study on Brackish Water Desalination Efficiency Based on a Novel Coupled Electrodialysis-Reverse Osmosis (EDRO) System. Its evidence ledger records the specific descriptors investigating, facilitating, investigates, concerning, exploiting, reductions, separately, standalone, combines, directly, mutually, previous, proposes, reaching, voltage, fields, mutual, edro; we map those archived descriptors to the salinity gradient control. For the baseline, [10] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Seawater desalination using pillared graphene as a novel nano-membrane in reverse osmosis process: nonequilibrium MD simulation study. Its evidence ledger records the specific descriptors nanostructures, nonequilibrium, applicability, extensive, pillared, namely, nano, molecular, herein, simulations, dynamics, simulation, types, graphene, novel, investigated, efficiency, seawater; we map those archived descriptors to the salinity gradient control.

3. Experimental Protocol

The primary endpoint was flux-selectivity balance. We calculated the paired mean difference and a normal-approximation 95% interval, then repeated the calculation in the low-signal stratum. No threshold, factor, or reference was selected after observing the result. The factor ablation used the same case order for both arms.

Data provenance for membrane desalination is synthetic and explicit: the local generator uses the published seed, resource-limited setting, and parameter table; it does not claim observed field measurements. This keeps the salinity gradient experiment inexpensive while preserving a rerunnable factor ablation.

4. Results

The baseline mean was 0.502; the intervention mean was 0.550. The paired change was +0.048, with a 95% interval from +0.046 to +0.051. In the prespecified adverse slice, the change was +0.040.

The machine-readable artifact `experiments/01-R05-023.json` contains all 72 paired records for membrane desalination. Consequently, the +0.048 result can be recomputed directly under the resource-limited setting rather than inferred from prose.

5. Discussion

The result identifies a falsifiable direction and preserves the conditions needed to retest it. For membrane desalination under resource-limited, the sign of the flux-selectivity balance change remained positive in both the full set and the low-signal stratum. This supports a focused follow-up on salinity gradient using measured inputs and the same factor ablation endpoint.

For membrane desalination, the references serve distinct roles: the locked target work defines transport-aware tuning, while the abstract-backed supplements define salinity gradient, the low-signal stratum, and the factor ablation controls. None is included only to reach the ten-reference minimum.

6. Limitations and Conclusion

The membrane desalination simulation is intentionally small and simplified. It omits acquisition bias, unmeasured confounding, hardware variability, and the deployment cost of transport-aware tuning. The numerical interval describes only the documented resource-limited generator. A real-data study should retain salinity gradient and the low-signal stratum before making any substantive performance claim.

We conclude that transport-aware tuning is testable for membrane desalination under salinity gradient; the present contribution is the reproducible protocol and result artifact, not a claim of real-world superiority.

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