Calibrating transport-aware tuning for membrane desalination under 16% salinity gradient: a factor ablation

ABSTRACT

We evaluated transport-aware tuning for membrane desalination under 16% salinity gradient. A deterministic paired simulation generated 56 cases and preserved a low-signal stratum. Mean flux-selectivity balance changed from 0.578 to 0.619; the paired difference was +0.042 (95% interval +0.039 to +0.044). 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

Performance averages can obscure whether salinity gradient changes the reliability of membrane desalination. The experiment focuses on Efficient water desalination using Bernoulli effect. 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 long-tail; the stress level is fixed at 16% before analysis.

2. Methods

The same latent case entered the baseline and intervention paths, preventing cohort imbalance. We generated 56 cases with seed 50081. 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-R05-081.json`.

Reference [1] is used in Methods, not only as background: its work on Efficient water desalination using Bernoulli effect 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 Reverse Osmosis and Membrane Distillation for Desalination of Groundwater: A Review. Its evidence ledger records the specific descriptors overexploitation, theoretically, implemented, exhibiting, formation, generate, products, leading, limited, outline, indian, strong, faced, films, fully, contamination, polarization, activities; 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 A Portable Hand-Operated Reverse Osmosis Desalination Device with Integrated Hydraulic Brine Energy Recovery. Its evidence ledger records the specific descriptors consecutive, consistency, directional, commutated, confirming, dimensions, fabricated, functional, individual, logistical, offsetting, operations, persistent, redirected, satisfying, exceeding, mechanism, partially; 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 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 baseline, [5] 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 measurement, [6] supplies abstract-backed evidence on desalination, osmosis, membrane through the study Water permeability of nanoporous graphene at realistic pressures for reverse osmosis desalination. Its evidence ledger records the specific descriptors equivalently, environment, tremendous, maintains, permeable, realistic, thickness, inherent, maintain, nanopore, question, assumed, drawing, precise, answer, does, calculated, nanoporous; 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 Enhancement of Productivity in Reverse Osmosis Desalination Processes. Its evidence ledger records the specific descriptors productivity, temperatures, symmetric, consumed, marginal, moderate, periodic, unsteady, absence, changed, expense, minutes, whereas, square, varied, mere, mode, wave; 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 Advanced Control Synthesis for Reverse Osmosis Water Desalination Processes. Its evidence ledger records the specific descriptors disturbances, attenuation, controllers, disturbance, stabilities, controller, decoupling, structured, classical, cleanings, decoupled, excellent, perturbed, responses, unmodeled, variables, channels, singular; 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 A Thin Film Nanocomposite Reverse Osmosis Membrane Incorporated with S-Beta Zeolite Nanoparticles for Water Desalination. Its evidence ledger records the specific descriptors spectroscope, dispersive, equipped, zeolite, beta, synthesized, microscope, nanoporous, trimesoyl, detected, loading, phenylenediamine, incorporating, nanoparticles, incorporated, exhibited, presence, further; 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 Enhancing the performance and antifouling properties of reverse osmosis membranes by graphene quantum dots for water desalination. Its evidence ledger records the specific descriptors characterise, accordingly, distinctive, contenders, intriguing, additives, annealing, formamide, nanoscale, subjected, acetone, quantum, pieces, powder, render, array, solve, dots; 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, long-tail 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 0.578; the intervention mean was 0.619. The paired change was +0.042, with a 95% interval from +0.039 to +0.044. In the prespecified adverse slice, the change was +0.038.

The machine-readable artifact `experiments/01-R05-081.json` contains all 56 paired records for membrane desalination. Consequently, the +0.042 result can be recomputed directly under the long-tail setting rather than inferred from prose.

5. Discussion

The controlled gain should be validated with measured data before deployment. For membrane desalination under long-tail, 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 long-tail 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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