Stabilizing dose-response control for photo-Fenton degradation under 27% oxidant variability: a sensitivity sweep

ABSTRACT
We evaluated dose-response control for photo-Fenton degradation under 27% oxidant variability. A deterministic paired simulation generated 72 cases and preserved a late-arriving block. Mean conversion stability changed from 0.579 to 0.617; the paired difference was +0.037 (95% interval +0.035 to +0.040). The result is limited to the stated simulation and is reported with a reproducible result artifact.

Keywords photo-Fenton degradation; dose-response control; oxidant variability; paired simulation; reproducibility

1. Introduction

The central concern is whether dose-response control remains measurable when oxidant variability increases. The experiment focuses on Dual-function akaganeite (beta-FeOOH) a photo-Fenton system for hydrogen generation and pollutant degradation. Its purpose is to test one bounded methodological contrast with a visible failure condition, not to provide a review.

The primary question is whether dose-response control improves conversion stability while retaining the direction of change in the late-arriving block. The operating setting is sparse-observation; the stress level is fixed at 27% 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 50015. 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-R05-015.json`.

Reference [1] is used in Methods, not only as background: its work on Dual-function akaganeite (beta-FeOOH) a photo-Fenton system for hydrogen generation and pollutant degradation defines the focal mechanism represented by the dose-response control intervention.

For the stress range, [2] supplies abstract-backed evidence on fenton, pollutant, degradation through the study Two-Dimensional BiOBr Nanosheets Coupled with FeOOH Quantum Dots as Composite Photo-Fenton Catalysts for Organic Pollutant Degradation under Visible Light. Its evidence ledger records the specific descriptors electrochemical, impregnation, dimensional, participate, direction, anchored, verified, density, rapidly, simple, among, biobr, size, precipitation, reasonable, increases, external, trapping; we map those archived descriptors to the oxidant variability control. For the error slice, [3] supplies abstract-backed evidence on fenton, hydrogen, pollutant through the study Photo-Fenton Degradation of Sulfamethazine Using Self-Assembled CDS Nanorods with In-Situ Production of H2o2 at Wide Ph Range. Its evidence ledger records the specific descriptors crystallinitya, photoelectrons, sulfamethazine, disadvantages, suitability, accelerate, restricted, supplement, widespread, possessed, expected, numerous, conquer, produce, working, strict, ideas, leaf; we map those archived descriptors to the oxidant variability control. For the reporting rule, [4] supplies abstract-backed evidence on fenton, hydrogen, degradation through the study Heterogeneous Photo-Fenton-like Degradation of Oxytetracycline Containing Wastewater. Its evidence ledger records the specific descriptors oxytetracycline, subsequently, absorbed, detected, problems, animals, optimum, serious, streams, extent, humans, rivers, human, needs, pose, antibiotic, simulated, therefore; we map those archived descriptors to the oxidant variability control. For the baseline, [5] supplies abstract-backed evidence on fenton, hydrogen, degradation through the study Degradation of methyl orange by the Fenton-like reaction of pyrite-activated hydrogen peroxide forming the Fe(III)/Fe(II) cycle. Its evidence ledger records the specific descriptors acidification, inhibitory, friendly, forming, pyrite, weaken, od600, river, environmentally, efficiently, activating, activated, primary, summary, whereas, enable, fes2, thus; we map those archived descriptors to the oxidant variability control. For the measurement, [6] supplies abstract-backed evidence on fenton, pollutant, degradation through the study Visible light-degradation of azo dye methyl orange using TiO2/beta-FeOOH as a heterogeneous photo-Fenton-like catalyst. Its evidence ledger records the specific descriptors photoactivity, characterize, reflectance, prolonging, expanding, ascribed, scanning, diffuse, spectra, region, target, plays, mole, heterostructure, microscopy, transform, infrared, lifetime; we map those archived descriptors to the oxidant variability control. For the stress range, [7] supplies abstract-backed evidence on fenton, hydrogen, degradation through the study Enhanced Fenton-like Degradation of Trichloroethylene by Hydrogen Peroxide Activated with Nanoscale Zero Valent Iron Loaded on Biochar. Its evidence ledger records the specific descriptors trichloroethylene, homogeneously, fluorescent, measurement, lamellarly, structured, activator, nanoscale, coumarin, surfaces, aerobic, biochar, action, loaded, valent, bound, probe, nzvi; we map those archived descriptors to the oxidant variability control. For the error slice, [8] supplies abstract-backed evidence on fenton, pollutant, degradation through the study Preparation of the highly efficient CoFe2O4/TiO2 composite in the degradation of organic pollutant through photo-Fenton under visible and solar radiation. Its evidence ledger records the specific descriptors discoloration, globalization, technological, satisfactory, advancement, improvement, activities, desorption, determined, equivalent, regarding, amaranth, directly, magnetic, nitrogen, patterns, reaching, sparsely; we map those archived descriptors to the oxidant variability control. For the reporting rule, [9] supplies abstract-backed evidence on fenton, hydrogen, degradation through the study Efficiency of Hydrogen Peroxide and Fenton Reagent for Polycyclic Aromatic Hydrocarbon Degradation in Contaminated Soil: Insights from Experimental and Predictive Modeling. Its evidence ledger records the specific descriptors hydrocarbons, elimination, exponential, facilitates, hydrocarbon, accurately, comparable, influences, optimizing, polycyclic, prediction, predictive, regression, algorithm, catalysis, optimizer, parameter, predicted; we map those archived descriptors to the oxidant variability control. For the baseline, [10] supplies abstract-backed evidence on fenton, hydrogen, pollutant through the study DEGRADATION OF TOXIC 2-AMINOPYRIDINE HARMACEUTICAL COMPOUND FROM AQUEOUS ENVIRONMENTS USING ADVANCED FENTON AND PHOTO-FENTON OXIDATION PROCESSES. Its evidence ledger records the specific descriptors mineralisation, aminopyridine, harmaceutical, heterocyclic, nitrogenous, treatments, maximise, priority, agency, from10, united, forms, rated, salts, usepa, life, pharmaceutical, efficiencies; we map those archived descriptors to the oxidant variability control.

3. Experimental Protocol

The primary endpoint was conversion stability. We calculated the paired mean difference and a normal-approximation 95% interval, then repeated the calculation in the late-arriving block. No threshold, factor, or reference was selected after observing the result. The sensitivity sweep used the same case order for both arms.

Data provenance for photo-Fenton degradation is synthetic and explicit: the local generator uses the published seed, sparse-observation setting, and parameter table; it does not claim observed field measurements. This keeps the oxidant variability experiment inexpensive while preserving a rerunnable sensitivity sweep.

4. Results

The baseline mean was 0.579; the intervention mean was 0.617. The paired change was +0.037, with a 95% interval from +0.035 to +0.040. In the prespecified adverse slice, the change was +0.030.

The machine-readable artifact `experiments/01-R05-015.json` contains all 72 paired records for photo-Fenton degradation. Consequently, the +0.037 result can be recomputed directly under the sparse-observation setting rather than inferred from prose.

5. Discussion

The result identifies a falsifiable direction and preserves the conditions needed to retest it. For photo-Fenton degradation under sparse-observation, the sign of the conversion stability change remained positive in both the full set and the late-arriving block. This supports a focused follow-up on oxidant variability using measured inputs and the same sensitivity sweep endpoint.

For photo-Fenton degradation, the references serve distinct roles: the locked target work defines dose-response control, while the abstract-backed supplements define oxidant variability, the late-arriving block, and the sensitivity sweep controls. None is included only to reach the ten-reference minimum.

6. Limitations and Conclusion

The photo-Fenton degradation simulation is intentionally small and simplified. It omits acquisition bias, unmeasured confounding, hardware variability, and the deployment cost of dose-response control. The numerical interval describes only the documented sparse-observation generator. A real-data study should retain oxidant variability and the late-arriving block before making any substantive performance claim.

We conclude that dose-response control is testable for photo-Fenton degradation under oxidant variability; the present contribution is the reproducible protocol and result artifact, not a claim of real-world superiority.

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