

Phase 1 Concept Paper (Single Submission File)

chlorOrgano: neutral electrochemical oxidant medium for residual ballast-water decontamination

Target AIS: quagga mussel, zebra mussel, golden mussel (and associated biofilm/propagule load)

Technology provider / lead: Paul E. Seaver (Palm Beach Springs Water Company Inc.)

Includes: Abstract • Technical Description (4 pages) • Commercial Potential (3 pages) • Development Milestones (3 pages) • Team & Experience

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Abstract / Executive Summary

1 page | limit: 1000 words (condensed abstract)

Executive summary

Problem: Personal watercraft and small boats used on lakes and rivers can retain residual ballast water after draining. That trapped water can transport aquatic invasive species (AIS) life stages, including mussel veligers/larvae, newly settled juveniles, and biofilm-associated propagules.

Solution concept: chlorOrgano is a neutral electrochemical oxidant medium manufactured from pretreated water + NaCl electrolyte using dual-polarity electrochemistry. Boat-side deployment is as a finished applied medium, not as an onboard electrochemistry device.

Mode of action (theoretical): The finished medium delivers available chlorine-centered oxidant chemistry and other reactive oxygen species to residual ballast water, creating oxidative stress expected to inactivate vulnerable transport stages and disrupt early attachment/biofilm establishment.

Operational validation: The concept uses a simple “green light” logic (package / lot check → product chemistry confirmation → tank dose confirmation → release gate), so an operator can verify the treatment is ready and complete.

Why it matters: The approach is intended for personal watercraft in lakes and rivers, with paths for OEM guidance on new boats (Tier 1), owner-applied retrofit use (Tier 2), and later WID / boat-ramp public-use volume deployment (Tier 3).

Concept status: This is a Phase 1 concept paper. Species-specific efficacy under realistic ballast conditions is the next validation step and is explicitly addressed in the development milestones and test plan.

Technical Description of Solution (1 of 4)

Use case, system concept, and deployment context

Use case & architecture

Target: small volumes of trapped residual ballast water after draining in personal watercraft and small boats used on lakes and rivers.

Inputs to manufacture chlorOrgano: pretreated water + NaCl electrolyte + electricity.

Core process: dual-polarity membrane separation (oxidizing anode stream + reducing cathode stream).

Differentiator: streams are recombined into one neutral chlorOrgano dosing medium.

Boat-side deployment: finished applied medium delivered by batch dose or simple metered injection into residual ballast water; not whole-waterbody treatment and not an onboard electrochemistry device.

Optional later deployment: ramp- or WID-side preparation/storage of public-use volumes for assisted application.

Operator-confirmable “on” state is built into the validation ladder (see 3 of 4).

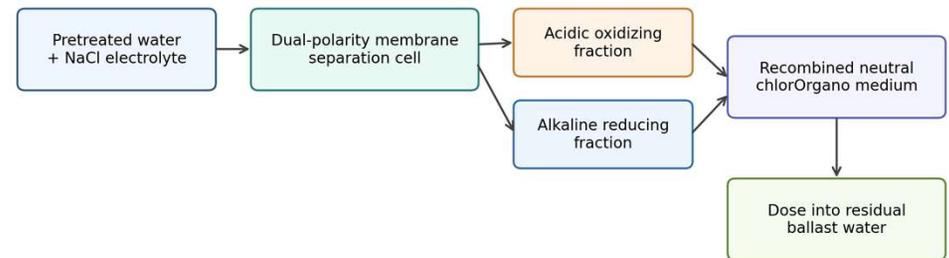


Figure 1. Dual-polarity separation, recombination, and dosing into residual ballast water

Technical Description of Solution (2 of 4)

Novelty and internal technical evidence (proposer-supplied)

What is new / innovative

- Not positioned as ordinary bulk chlorination.
- Novelty is the manufacturing + delivery architecture: separate oxidizing and reducing streams, then recombine into a neutral, storable medium.
- Internal data show strong stream differentiation before recombination (pH split).
- Reported recombined target: ~1000 ppm available free chlorine at ~pH 7.4 (to be validated under the test plan).

Phase 1 claim is process-driven (how it is made and delivered) while efficacy is validated next.

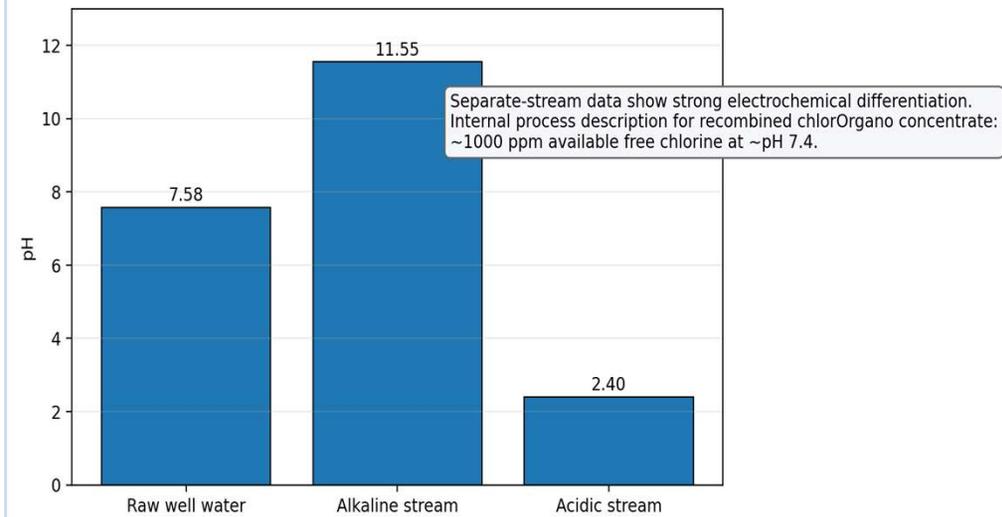


Figure 2. Proposer-supplied process evidence: pH split and stated neutral concentrate target.

Technical Description of Solution (3 of 4)

Operational validation measures and safety gates

How the operator knows it is working

Application readiness gate: container seal / lot / label confirmed; required treatment volume available; application tools ready.

Product chemistry gate: pH, ORP, and free available chlorine confirmed in range for use.

Tank treatment gate: residual measured after mixing at injection point or in tank.

Release/safety gate: hold time complete; optional quench; residual below discharge target.

This ladder supports a simple “green / amber / red” operator interface.

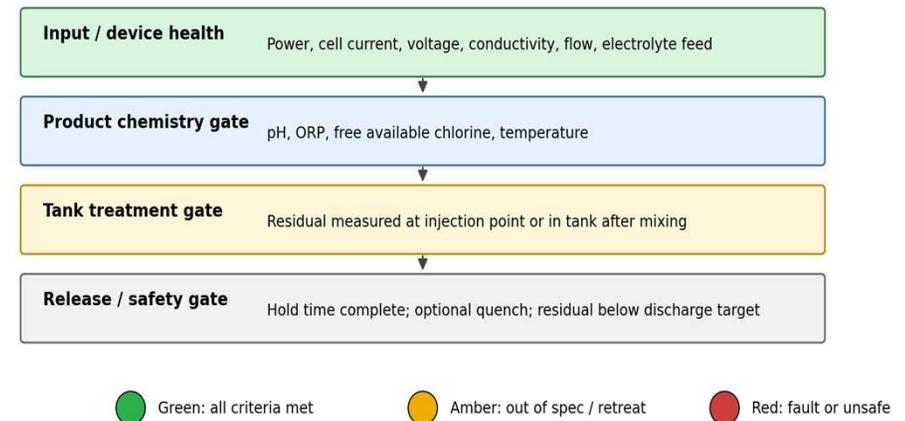


Figure 3. Proposed validation ladder for field deployment

Technical Description of Solution (4 of 4)

Literature support, limitations, and validation approach

Evidence, limitations, and next validation

What is supported today (literature + plausible mechanism):

- Residual water in boat compartments is a documented transport pathway; ballast tanks are among the highest-volume residual-water compartments.
- Chlorine-based oxidant treatment is widely recognized as an effective invasive mussel control method (with corrosion/discharge constraints).
- California agencies are actively researching low-dose chlorine for golden mussel control in infrastructure contexts.

Limitations (why this is Phase 1 concept):

- Species-specific chlorOrganic dose-response data for target mussels under realistic ballast conditions is not yet complete.
- Discharge/residual management and materials compatibility require validation with representative water quality and temperatures.

Next-step validation package:

Bench dose-response testing on target life stages (organic load, conductivity, temperature).

Confirm operating window tied to measurable pH/ORP/free chlorine limits.

Environmental storage, transport, and vibration testing for field robustness under non-thermal deployment conditions. Pilot deployments with data logging and operator SOP validation.

Commercial Potential (1 of 3)

Manufacturing, scale-up, and supply chain (<=3000 characters for section)

Why this can scale

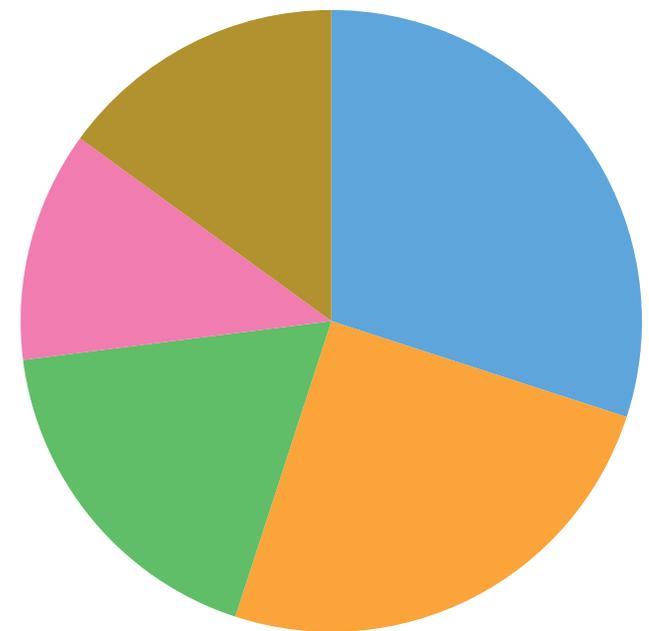
Commodity manufacturing inputs: water + salt + electricity (no rare reagents).

Production hardware uses existing supply chains: pumps/valves, tanks, plastics, sensors, power electronics, membranes/electrodes.

Scale-up path: centralized or regional production of finished medium plus standard packaging / dispensing formats for OEM, retrofit, and WID use.

QA/acceptance: lot-release testing for chemistry in-range (pH/ORP/free chlorine) plus labeled dose guidance.

Illustrative cost drivers (normalized)



Note: illustrative only (no pricing claims).

Commercial Potential (2 of 3)

Cost effectiveness, maintenance, training, remote use

Field practicality

Cost effectiveness: field use centers on a finished applied medium; boat-side requirements are limited to storage, measured dosing, and simple application tools.

Maintenance: no onboard electrochemistry hardware is required for small personal watercraft; upkeep is mainly packaging integrity, shelf-life control, and simple dispensing equipment as used.

Training: one-page SOP + green/amber/red decision logic; minimal training required for inspectors, dealers, or owners.

Remote use: suited to launch ramps and remote sites because application does not require heat and can be performed with minimal infrastructure at point of use.

Non-thermal operating concept: treatment delivery does not depend on elevated temperature. For Tier 3, public-use volumes can be stored or prepared ramp-side for assisted application.

Commercial Potential (3 of 3)

Target markets and implementation scale (Tier 1 highest priority)

Tier 1 | New fleet integration (manufacturers)

OEM guidance for ballast access, labeling, and recommended chlorOrgano dosing package on new wake/surf boats and similar personal watercraft.

Highest leverage: standardized access points, instructions, and dealer support. Scales with model-year integration and dealer networks.

Tier 2 | Existing fleet retrofit (owners)

Owner-applied finished-medium package for existing wake/surf boats and similar trailered watercraft.

Sold via dealers / e-commerce + service partners.

Designed for low training and quick use at launch or retrieval.

Tier 3 | WID station installation (operators)

Station-dispensed or ramp-stored public-use volumes after workflow proven.

Procurement cycle + throughput constraints.

Lower priority but expands coverage later.

Development Milestones (1 of 3)

Detailed timeline from concept → prototype → commercialization (<=4000 characters for section)

Stage | 0–6 months

Bench dose-response tests on target life stages

Define operating window (pH/ORP/free chlorine)

Materials compatibility screening

Prototype application SOP / indicators

Stage | 6–12 months

Packaging + dispensing formats (OEM guidance + retrofit kit)

Pilot trials in representative ballast water

Refine dose + contact time + mixing approach

Draft SOP, training, and residual management

Stage | 12–24 months

DFM + supplier qualification

Storage / transport robustness validation

Scaled pilots with data logging

Commercial launch: Tier 1 → Tier 2 → Tier 3

Development Milestones (2 of 3)

Commercialization gates (go / no-go checkpoints)

Gated path reduces risk

Gate 1

Chemistry repeatability: Stable neutral medium; repeatable oxidant output; storage/handling defined.

Gate 2

Biological efficacy: Dose/contact time defined for target life stages in representative residual water.

Gate 3

Application usability: Operator can verify product readiness, dose, contact time, and treatment completion via clear indicators.

Gate 4

Field readiness: Pilot users confirm fit with ramps/inspections and realistic maintenance.

Gate 5

Revenue readiness: OEM integration package + retrofit offer + training/support ready for first deployments.

Development Milestones (3 of 3)

Potential hurdles and how we address them

Species-specific proof

Staged efficacy tests on quagga, zebra, and golden mussel life stages; third-party validation where feasible.

Adoption / usability

Design for minimal training, clear indicators, and predictable replenishment intervals; pilot with real operators.

Water quality variability

Test matrix: temperature, conductivity, organic load; define operating window and controls.

Residual management

Verify residual; optional quench; define safe release targets and SOPs consistent with local rules.

Materials compatibility

Early screening of seals, hoses, ballast materials, and container materials used with treated water; select chemically compatible field-ready components.

Scaling suppliers

Dual-source critical components (sensors, membranes/electrodes) and qualify alternates during DFM.

Team & Relevant Experience

1 page | limit: 2000 characters (additional members can be added as available)

Paul E. Seaver — Technology Provider / Lead

Paul E. Seaver provides leadership, commercialization experience, and electrochemistry/water-treatment R&D for chlorOrgano.

Background includes family-operated industrial services (commercial refrigeration, beverage manufacturing/distribution, ice and carbonic gas supply), active duty USMC service (1984–1989; honorable discharge 1990), and multiple business leadership roles.

Founded and operated Absolute Storm and Security Protection Inc. (2000–2015; metals contracting/field delivery). Incorporated Palm Beach Springs Water Company Inc. (2015–present) to lead advanced electrochemistry R&D, product formulation, equipment sales, installation, and service.

Relevant technical scope: electrochemical sanitation and water-treatment systems (Esperer.H2O and ElectroLIFE extensions), chlorOrgano development in the NaOCl- range, oxidation of cyanide and trace PFAS analytes in freshwater, and applied oxidation/sanitizing products.

Project contribution: defines chemistry and device concept, guides prototype build and validation plan, and supports deployment/commercialization pathways aligned to Tier 1 (OEM), Tier 2 (retrofit), and Tier 3 (WID) adoption.

Generative AI Disclosure

Generative AI was used as a **consulting, organizational, and drafting tool** in the preparation of this submission. AI-assisted support was used to help organize and refine the **Abstract/Executive Summary, Technical Description, Commercial Potential, Development Milestones, Team and Relevant Experience statement, and slide layout** so the submission would conform to the specific rules and format of the contest.

The **underlying idea, technical rationale, historical testing, data, product background, and development experience** were supplied by the submitter. The submitter reviewed and verified the final content, corrected context where needed, and assumes full responsibility for the submission.

Paul E. Seaver
PBSWC Inc.