



Invasive Mussel Control Concept



Quagga Mussel



Zebra Mussel



Golden Mussel

Novel *chlorOrgano*: Neutral Electrochemical NaOC Organochlorine 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

2026-05-18

Statement of Problem

Watercraft and boats used on lakes and rivers retain trapped ballast water. Trapped water transports aquatic invasive species including mussel veliger's/larvae, newly settled juveniles, and biofilm-associated propagules

Concept of Solution

chlorOrgano is manufactured from $H_2O + NaCl + \text{dual-polarity electrochemistry} = \text{finished product}$

Theoretical Mode of action

chlorOrgano delivers available chlorine to residual ballast water, causing oxidative stress expected to inactivate transport stages and attachment/biofilm establishment

Operational validation

The concept uses a simple “green light” logic, package / lot check → product chemistry confirmation → tank dose confirmation → release gate

Why it matters

Approach intended use is at freshwater lakes / rivers where environmentally safe solutions are important

Concept status

Phase 1 concept; species-specific efficacy under realistic ballast conditions is the next validation step

Target
Small volumes of residual ballast water in personal watercraft and boats used on lakes and rivers.

Inputs to manufacture chlorOrgano
H₂O + NaCl electrolyte + Electricity + Dual polarity electrochemistry

Core process
Dual-polarity electrolysis
Acidic membrane separation
Basic Neutral bonding

Differentiator
Non-regulated, non-pesticide, environmentally safe “single salt organochlorine-species” engineered for facilitated diffusion and passive transport delivery as an alternative to oxidation/corrosion

NaOC species ranges
Acidic: 2.4 pH to 6.5 pH
Neutral: 7.4 pH, 40 ppm AFC to
Light Concentrate 9.8 pH 2000 ppm AFC

Boat-side deployment
Finished medium delivered by batch dose or simple metered injection into residual ballast water

Optional later deployment
Ramp - or WID site on-demand manufacturing units and or product storage of public use volumes for assisted application



EPA regulated chlorines are effective for this problem, but application is limited by the corrosive nature of the pesticides and residuals. In concept, chlorOrgano is intended to bridge that gap using only NaCl electrolyte in a dual-polarity electrochemistry process to produce a non-toxic single-salt non-pesticide organo chlorine that does not rely on oxidation or corrosion for delivery, keeping it outside the EPA-regulated Class 8 Corrosive pesticide category

A novel delivery system and a novel environmentally safe organo chlorine species. It is conceived as an electronically structured single molecule / single ion system engineered for the passive transport and facilitated diffusion requirements of an organic cell's aquaporin

The novelty is the NaOC manufacturing and delivery architecture. There are no data relative to this exact task. The understanding of the technology is the basis for confidence in achieving the objective

chlorOrgano is both a neutral range and acidic ranges. The innovation is the ability to manufacture and stabilize NaOC across these ranges as finished mediums for reasonable personal and commercial applications

Using dual-polarity membrane separation, strong mediums are produced. The acidic stream produces NaOC as an HCl-type range to a released HOCl-type range by pH, while neutral bonding produces NaOC as OCl- type species

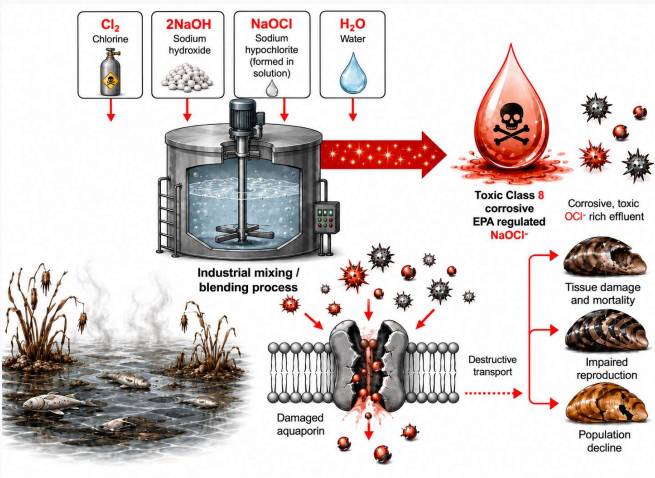
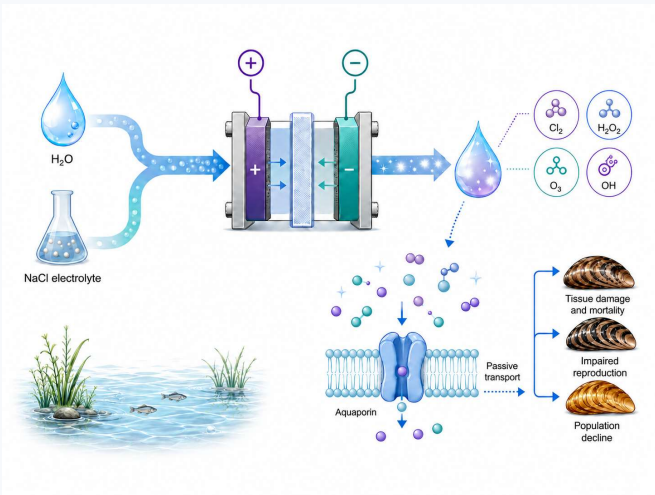
Strength is not defined by AFC ppm alone. Electrolyzed mediums, purity, and electronic balance allow for stronger storage capability and more efficient mass transfer with optimized delivery through increased ionic product energy

Testing target ranges: 30 ppm AFC to 2000 ppm AFC at pH 2.4 to 9.8. The proper operating range remains to be validated under the test plan

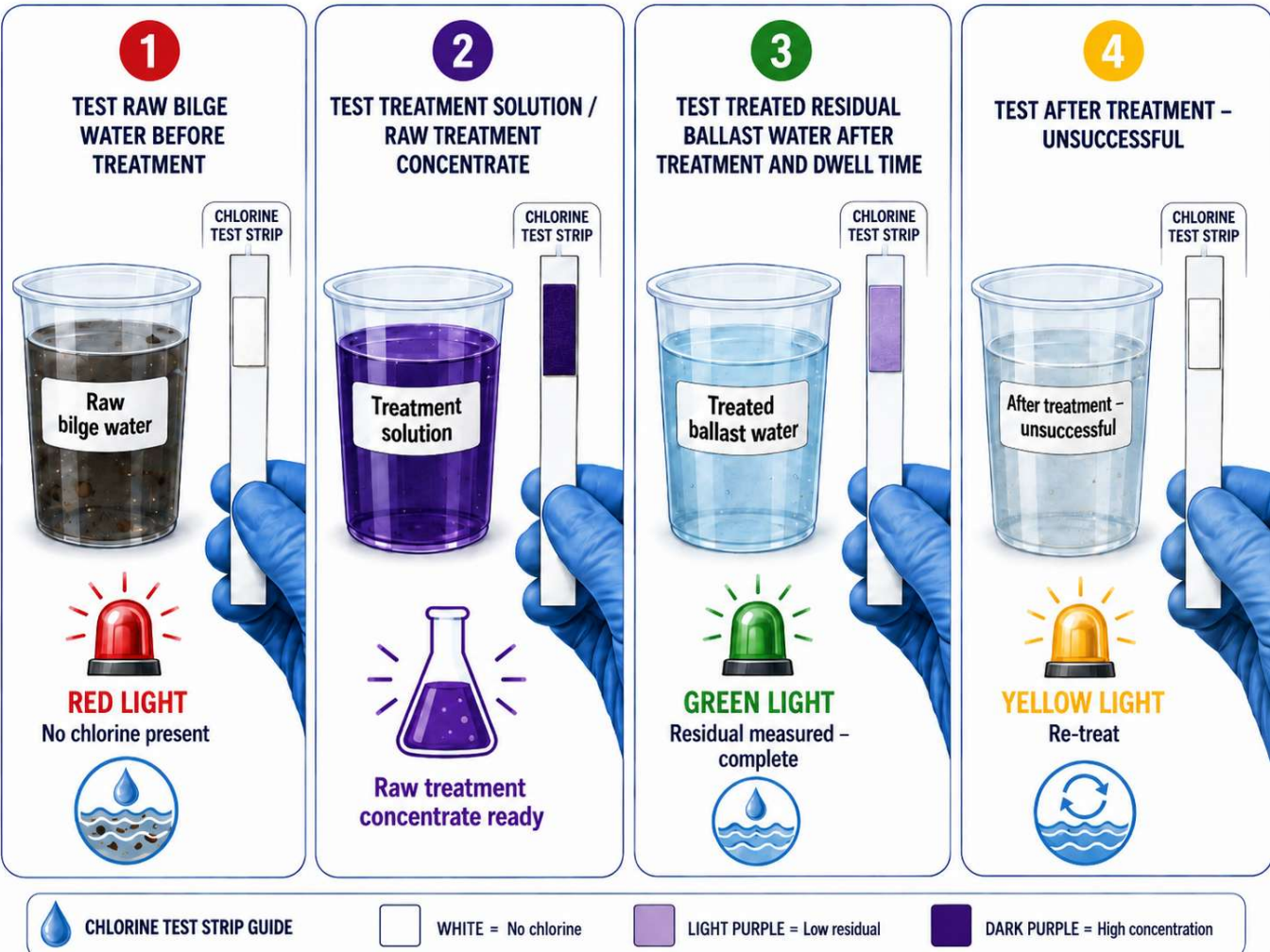
Typical chemical pesticide products store one reactive oxygen species. Oxidation at the anode produces multiple reactive oxygen species. These gases remain as dissolved, compatible, and measurable stored together.
Example: H2O2 is typically about one-half the value of measured Cl2. From NaCl, expected ROS may include OH, Cl2, H2O2, and O3 at a minimum. The Cl2 and H2O2 are easily measured with simple typical measuring strips.

This ability to store multi-ROS together is unique to this manufacturing method and technology

This innovation in manufacturing the neutral OCl- range has not been 3rd-party validated. Low acidic range has been tested in agriculture and general water-treatment applications. This page is presented in concept context and states what is intended to be proven under the validation plan



- Application readiness gate**
Container seal, lot, and label
Required treatment strength and volume per application
Required tools for treatment
Chlorine test strips
- Product chemistry gate**
chlorOrgano is not dependent on pH and ORP
Confirming reading is Total Cl2 / AFC concentration
- Tank treatment gate**
Residual measured after the mixing and dwell period
- Residual chlorine reading**
the “finished” indicator.
- Release / safety gate**
Dwell time complete
Optional quench if needed
Measured residual below discharge target
Drain safe neutralized residual from bilge



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)

Regional Usage

- Zebra mussels are found in 32 states, and quagga mussels are found in 19 states, with many of these jurisdictions employing some form of chlorine control for management. *The Safeguarding the West from Invasive Species initiative, which includes 17 states (WA, OR, CA, ID, NV, MT, AZ, UT, WY, CO, NM, OK, KS, TX, ND, SD, NE), utilizes chlorine treatment methods for mussel control, with applications used in water infrastructure*

Limitations - why this is Phase 1 concept

- Species-specific chlorOrgano 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 measured Total / 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



Commodity manufacturing inputs

Water + salt + electricity (no rare reagents)

Production hardware uses existing supply chains

Pumps/valves, tanks, plastics, sensors, power electronics, membranes/electrodes

Easily Scalable

Centralized or regional production of finished medium plus standard packaging / dispensing formats for OEM, retrofit, and WID use

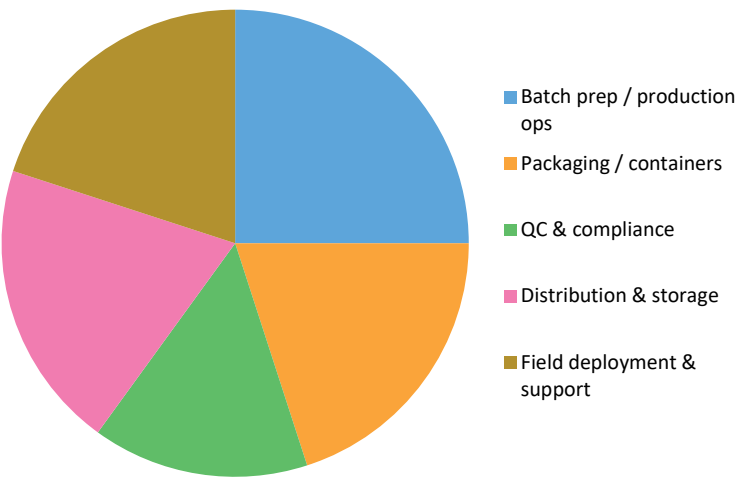
QA/acceptance

Lot-release testing for chemistry in-range (pH/ORP/free chlorine) plus labeled dose guidance

Primary commercialization cost drivers

Batch prep, packaging, QC/compliance, distribution, and field support

Illustrative commercialization cost driver mix (conceptual)



Conceptual allocation (not priced); intended to show which areas typically dominate effort at pilot-to-production scale.

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

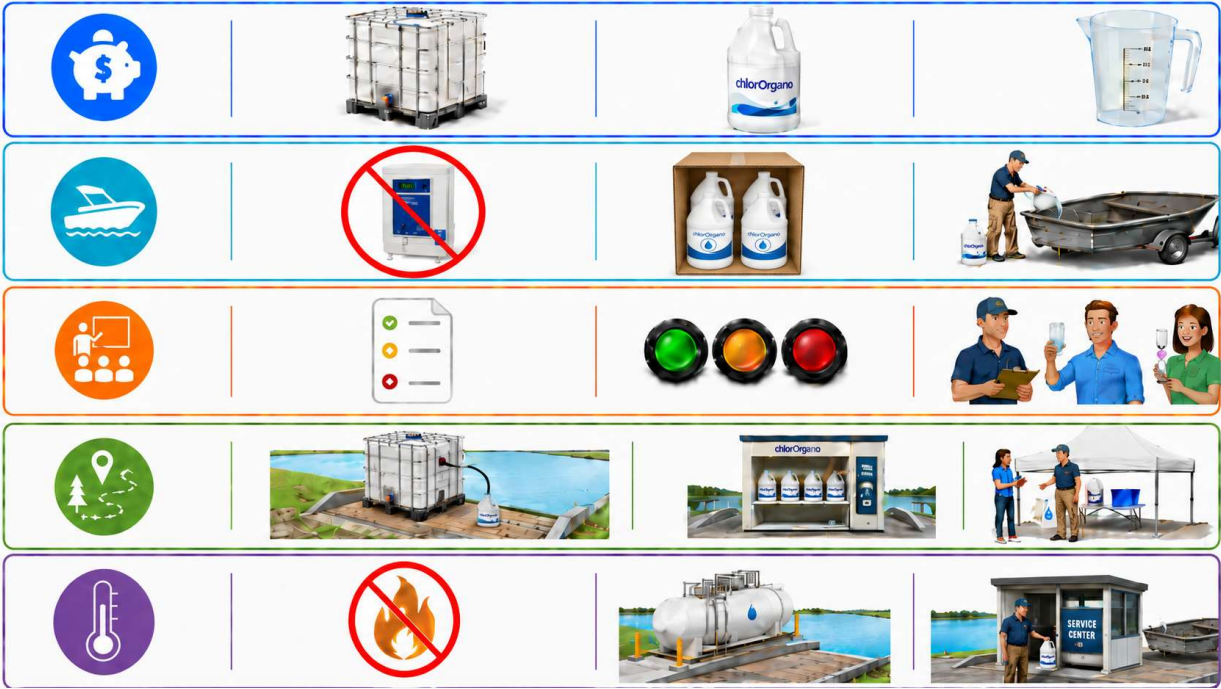
Training:
One-page SOP + green/amber/red decision logic; minimal training required for inspectors, dealers, or owners

Remote use: suited to launch ramps and remote sites because application can be performed with minimal infrastructure at point of use

Non-thermal operating concept:
For Tier 3, public-use volumes can be stored or prepared ramp-side for assisted application

Treatment performance does not depend on elevated temperatures

The medium is compatible with the 140-degree operating temperatures tolerances as well as the stability needed for the wide operating conditions of this objective



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.



Stage 1 | 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 2 | 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 3 | 12–24 months

DFM + supplier qualification

Storage / transport robustness validation

Scaled pilots with data logging

Commercial launch: Tier 1 → Tier 2 → Tier 3

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.

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

Paul E. Seaver — Technology Provider / Lead. Founder of Palm Beach Springs Water Company Inc.; provides leadership, commercialization experience, and ~12 years of electrochemistry and water-treatment R&D. Leads chlorOrgano concept definition, treatment-medium history, validation planning, and deployment strategy.

Edward Alexander — President, Innovative Designs and Technology USA. Provides advanced engineering of dual-polarity electrochemistry and manufacturing of the specialized electrolysis equipment used to produce the treatment medium upstream.

Alan Miller — SpiroFlo. Provides technical and operational experience in water-movement technology. Relevant scope: SpiroFlo stabilization/remediation methods to infuse chlorOrgano into target water, improving aeration, agitation, turbulence, and treatment contact in ballast volumes.

Sam Glucksman, DPM, C3P, CAM — President, The Phyto Doctor. Provides agricultural and biological systems background relevant to treatment application, environmental use conditions, and broader project qualification.

The rules state:

I agree that, if any elements of my submission are prepared with the use of Generative AI, I will identify in my submission which sections were prepared with the use of Generative AI and how it was used.

Generative AI Disclosure

Portions of this submission were prepared with the assistance of Generative AI. AI was used to help organize content, improve wording and readability, condense material to fit page and character limits, align the document structure to the Phase 1 submission rules, and assist in preparing certain illustrative graphics/layout concepts. AI-assisted drafting was used in portions of the Abstract, Technical Description, Commercial Potential, Development Milestones, Team & Relevant Experience, and supporting figures.

All underlying concepts, technical content, project history, testing context, and subject-matter direction were provided by the submitter Paul E. Seaver. Paul E. Seaver along with his team reviewed, corrected, and approved the final content for accuracy and context.

Generative AI was used as an editorial and organizational tool only; it was not used as an independent source of scientific proof, validation, or original experimental results.