# ZM-X: A New Biochemical Dreissenid Control Technology



**Safe. Scalable. Scientifically Sound.**

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# Presentation Outline

1. Background: What is ZM-X?
2. Answers to the Top Five ZM-X Questions

# What is ZM-X?

# ZM-X: Safe. Scalable. Scientifically Sound.

- Patent Pending (ZM Controllers)
- Highly efficacious: 100% mortality in < 3 days
- Compatible w/ materials and safe for workers
- Approved in US
- Environmentally sound
- Scalable & readily available
- Cost-effective

# Invasive Mussels Have Catastrophic Impacts

- Infest *any* system exposed and:
  - clog water inlets, pumps and pipes
  - obstruct flow
  - cause erosion
  - strain pumps and other equipment
  - harm native species
  - are hazardous to swimmers
  - reduce aesthetics

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# ZM-X Buffers pH with Organic Acids

Invasive mussels have a narrow range of pH tolerance[1] and minimum required level of calcium[2]

By manipulating pH with specific **organic acids** we can control their survival **without** impacting the environment or infrastructure.


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# ZM-X: CITRIC ACID

We have chosen to market our citric acid formulation first due to:

*Efficacy, availability, and EPA approval status*


# ZM-X Has a Broad Range of Applications

**We expect to serve:**

- Irrigation districts
  - *ZM-X has added benefits for agriculture!*
- Watercraft decontamination agencies
  - *907,021 boats inspected in 2015*[3]
- Power industry
  - hydro, nuclear, coal
- Drinking water industry
  - Trihalomethane limitations

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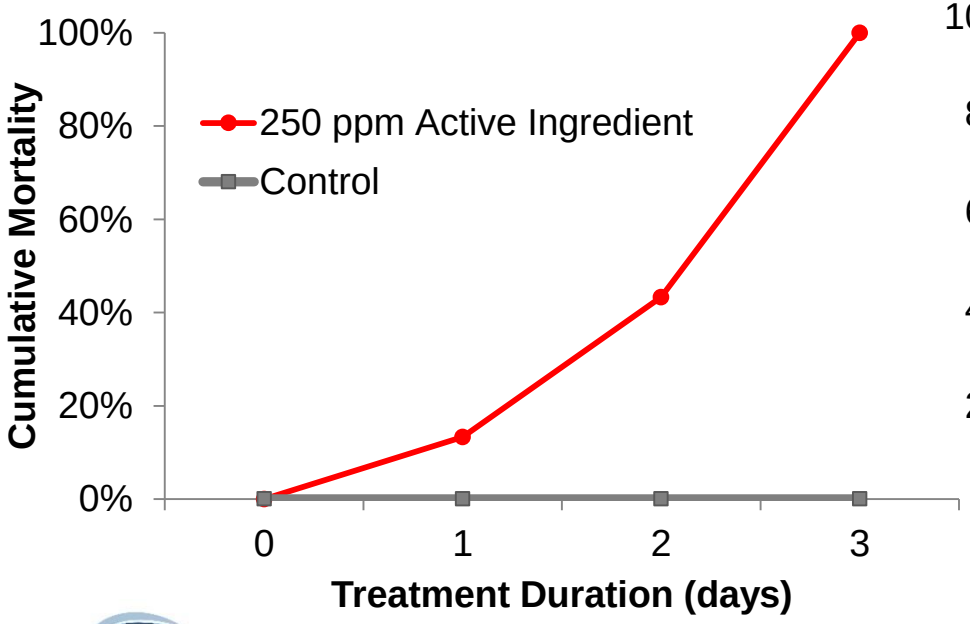
# Top Five ZM-X Questions

# 1. Is ZM-X Efficacious?

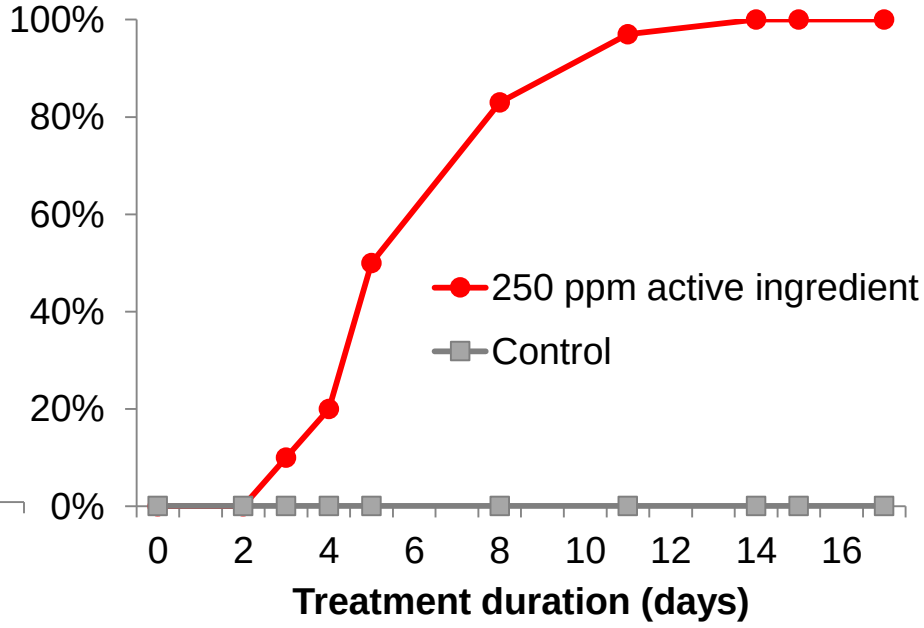
# ZM-X Yields 100% Adult Mortality in 3 days

**Independent lab tests (RNT Consulting) indicate faster mortality than current chemical technologies**

100% mortality in 3 days
in warm water (~20ºC)




100% mortality in 14 days
in cold water (~10ºC)

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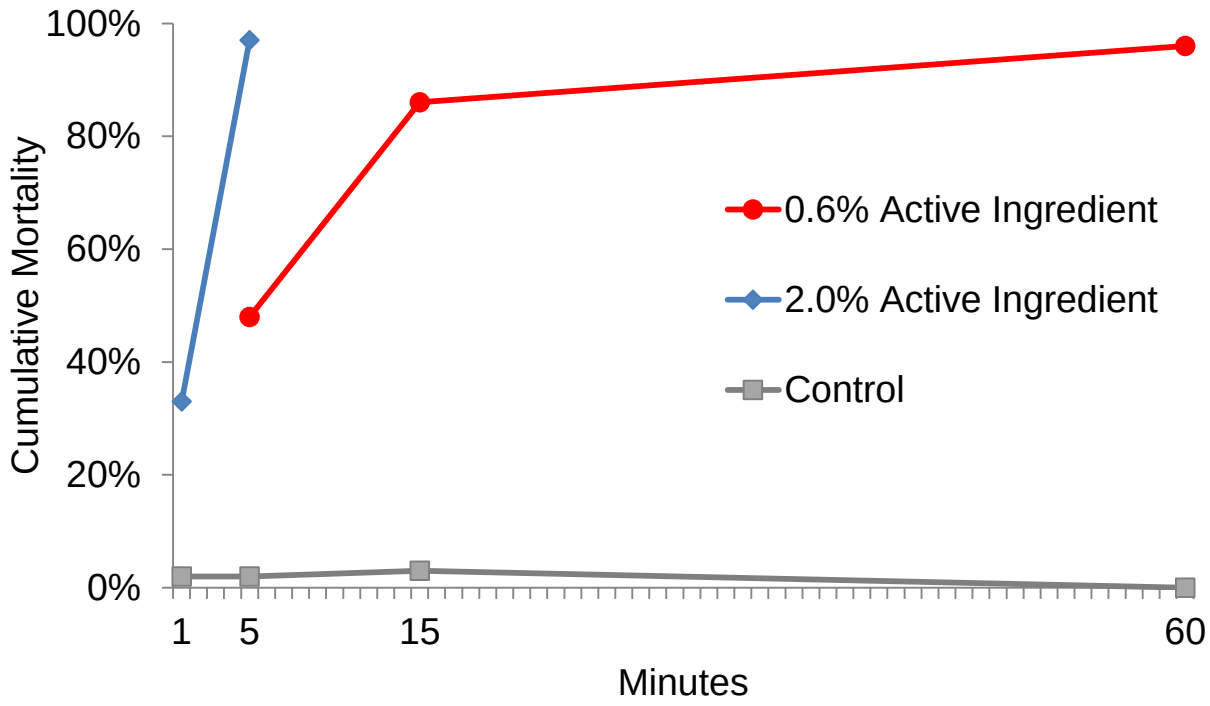
# ZM-X Kills Veligers in ~5 minutes

**Independent lab tests (KASF Consulting) indicate 97% veliger (mussel larvae) mortality within 5 min of exposure**



# 2. Is ZM-X Compatible with Construction Materials and Safe for Workers?

# Organic Acids are Compatible with Most Construction Materials and Safe for Workers

- Soft drinks, orange juice, lemon juice, etc. contain significantly more citric acid than treatment concentrations[4]


- Citric acid is compatible with most construction materials[5]

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# 3. How Much Does ZM-X Cost?

# ZM-X is Cost-Effective

- Citric acid is a commodity produced worldwide
- Cost falls in the middle of products on the market now.
- If we value environmental impacts, cost is relatively low.

| | ZM-X | KCl/Potash | Copper | Chlorine Bleach | Quaternary Ammonium |
|---|---|---|---|---|---|
| **Persistent toxins or byproducts** | None; Discharge is chelated calcium | Persistent in aquatic systems | Remains in water column for weeks to months; accumulates in soil | Hazardous; Produces carcinogenic byproducts | Persists in benthos for 10,000+ years |
| **Costs** | Moderate | Low to Moderate | Low to Moderate | Low, but “detox” costs can be more than application | Expensive |

# Cost ÷ Benefits = Value

**Features/Advantages/Benefits (FAB's):**

- De-scales pipe interiors and flow surfaces[6,7,8]
- Inhibits other biofouling (especially in microirrigation sytems)[9]
- If used in irrigation systems, ZM-X:
  - chelates insoluble minerals such as P, Ca, and others that favorably alter soil chemistry and promote microbial activity
  - increases microbial activity in the soil leading to increased water holding capacity, which increases irrigation efficiency (saves water!)[10,11,12,13,14,15,16]
  - Makes nutrients available to plant roots improving crop health and growth which reduces fertilizer input costs[17]
  - Promotes a vigorous and healthy soil microbiome to defend against opportunistic soil pathogens[18,19,20,21]

# 4. How Does ZM-X Compare to Other Products?

# ZM-X Works Faster, is More Effective, and is Environmentally Compatible

| | ZM-X | KCl/Potash | Copper | Chlorine Bleach | Quaternary Ammonium |
|---|---|---|---|---|---|
| **Treatment Duration** | 1-3 days | 10+ days | 5+ days | 10-90 days | 5+ days |
| **Flexibility, Scalability, Consistency** | Compatible w/ materials, readily available, consistent | Sodium content of deposits vary, affecting results; mussels may revive | Consistent, regulatory restrictions | Dependent on organic loading, highly corrosive, requires quenching w/ sulfites | Requires quenching w/ bentonite clay |
| **Source** | 100% bio-based, renewable | Mined fossil resource | Heavy metal | Chemical biocide | Chemical biocide |
| **Persistent toxins or byproducts** | None; Discharge is chelated calcium | Persistent in aquatic systems | Remains in water column for weeks to months; accumulates in soil | Hazardous; Produces carcinogenic byproducts | Persists in benthos for 10,000+ years |
| **Selectivity** | Somewhat selective | Somewhat selective | Nonselective biocide | Nonselective biocide | Nonselective biocide |
| **Costs** | Moderate | Low to Moderate | Low to Moderate | Low, but “detox” costs can be more than application | Expensive |

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# 5. Is ZM-X Approved by US EPA?

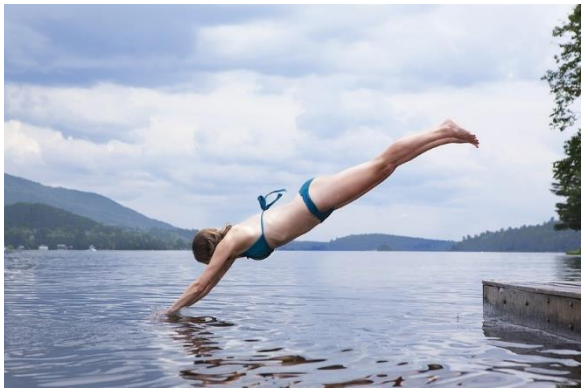
# ZM-X is *Approved* by US EPA (FIFRA 25b)

**Citric acid formulation is approved by US EPA (FIFRA 25b)[22] and approved for use in CA, MN, and TX**

We are seeking approval in more states and for two more formulations

- **No toxicity build-up**
- **Non-toxic** to mammals, birds, and most aquatic organisms
- **Non-persistent and readily biodegrades**





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# Questions?
# Come See us at Table # 12!

Contact us at Info@ZMcontrollers.com
Or visit out webpage at zmcontrollers.com

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