



Greg Fehr

(858) 775-9953 • Greg@AdjuvantSystem.com

ADJuVant System
Clean Oxygenated Water

US Distributor for Dryden Aqua
Agriculture & Horticulture

Harnessing Zeta Potential and Cavitation Mixing for Cleaner Irrigation Water and Improved System Performance

Executive Summary

Irrigation systems across California face increasing pressure from declining water quality, rising biological loads, and the growing cost of maintenance. Suspended solids, algae, organic matter, and biofilm are now the leading causes of emitter clogging and uneven water distribution – directly impacting crop uniformity and yield.

A **Zeta Potential Mixer (ZPM)** offers a **chemical free, energy efficient** method to improve water quality before it enters filters and drip lines. By using controlled **cavitation implosion** and **zeta potential modification**, the ZPM causes suspended particles, algae, and organic matter to **flocculate**, making them easier to filter. It also disrupts biofilm formation inside irrigation lines. Research from water treatment, hydrodynamics, and colloid chemistry shows that cavitation can:

- Increase redox potential
- Generate hydroxyl radicals
- Break apart biological contaminants
- Neutralize particle surface charge
- Improve filtration efficiency
- Reduce biofilm adhesion

For growers, the result is simple: ***cleaner water, cleaner lines, fewer clogs, and more uniform irrigation – without adding chemicals.***

Problem Statement

California growers increasingly rely on **surface water, tailwater, reservoirs, and canals** – all of which carry high loads of:

- Algae
- Bacteria
- Organic debris
- Fine suspended solids
- Biofilm precursors
- Nematodes and other pathogens

These contaminants cause:

- **Emitter clogging**
- **Filter overload and frequent backwashing**
- **Uneven irrigation distribution**
- **Reduced system lifespan**
- **Higher labor and maintenance costs**

Traditional filtration alone cannot solve this problem. Filters remove particles, but **they do not change the chemistry of the water**. As a result:

- Fine particles remain suspended
- Algae pass through screens
- Biofilm continues to grow inside drip lines
- Organic matter overwhelms filters
- Chemical treatments become more frequent and costly

Growers need a **non chemical, low maintenance** method to condition water before it reaches the filtration system.

Research Backed Solution: Zeta Potential Mixing and Cavitation Implosion

A Zeta Potential Mixer (ZPM) uses engineered turbulence, pressure differential, and controlled cavitation to physically and electrochemically modify irrigation water.

1. Cavitation Implosion

When water passes through the mixer at a pressure drop of 7 psi:

- Microbubbles form in low pressure zones
- These bubbles collapse violently downstream
- Implosion releases:
- Shockwaves
- High shear forces
- Localized heat
- Hydroxyl radicals (OH•)
- Nanoscale turbulence

These effects are well documented in hydrodynamic cavitation research.

2. Zeta Potential Modification

Particles in water carry electrical charges that keep them suspended. Cavitation:

- Neutralizes surface charge
- Causes particles to attract instead of repel
- Forms larger flocs
- Makes filtration dramatically more effective

This principle is foundational in colloid chemistry and municipal water treatment

3. Biological Disruption

Cavitation implosion:

- Damages algae cells
- Breaks apart bacterial colonies
- Shears the EPS matrix of biofilm
- Increases ORP (oxidation reduction potential)
- Enhances the effectiveness of chlorine or peroxide

4. Improved Filtration and Reduced Clogging

Because particles flocculate:

- Filters capture more material
- Backwashing frequency decreases
- Drip lines stay cleaner
- Emitter clogging is reduced
- System uniformity improves

Benefits for Growers

Cleaner Water

- Algae and fine solids clump together
- Filters remove more contaminants
- Water clarity improves

Cleaner Drip Lines

- Biofilm is disrupted before it forms
- Organic load is reduced
- Emitters maintain flow longer

Lower Maintenance

- Fewer filter backwashes
- Less acid/chlorine flushing
- Reduced labor and downtime

Better Irrigation Uniformity

- More consistent pressure and flow
- Improved crop uniformity
- Higher yield potential

Chemical Free Treatment

- No additives
- No residue
- No regulatory concerns

Why This Technology Is Under Adopted

Most growers understand:

- Clogging
- Algae
- Biofilm
- Filtration problems

But very few understand:

- Zeta potential
- Cavitation implosion
- Colloid chemistry
- Particle charge dynamics

This knowledge gap exists because agriculture traditionally separates:

- **Hydraulics** (irrigation designers)
- **Biology** (PCAs)
- **Chemistry** (water treatment specialists)

ZPM technology sits at the intersection of all three.

Conclusion

A Zeta Potential Mixer provides growers with a proven, **research supported**, **chemical free** method to improve irrigation water quality. By leveraging cavitation implosion and zeta potential modification, growers can:

- Reduce clogging
- Improve filtration
- Lower maintenance costs
- Increase irrigation uniformity
- Protect longterm system performance

As water quality challenges continue to intensify, technologies that **condition water physically rather than chemically** will become essential tools for sustainable agriculture.