Recycle Water

with

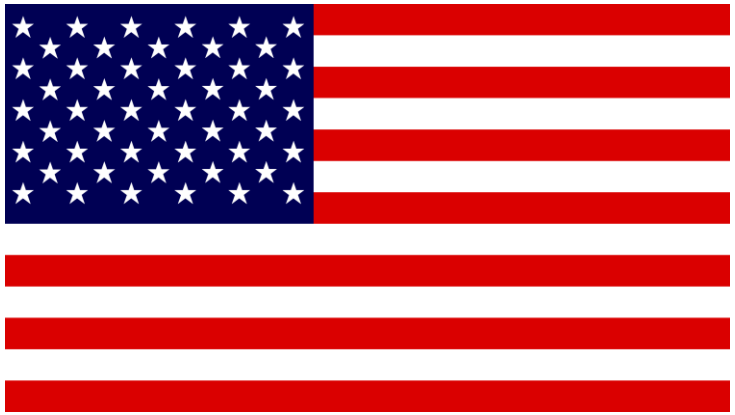
Ion Oxidation Catalyst System

Alpha Products

July 2025

Complus Trading

North America



IOC Connex System

IOC System Overview

Advanced Oxidation Process (AOP)

- Utilizes high-power cavitation, electrochemical reactions, and multi-media filtration to generate reactive oxidants directly from wastewater, eliminating the need for extra chemical additives.

In-Situ Generation of Oxidants

- Electrochemical processes induce free chlorine and chlorine dioxide generation from natural water constituents, ensuring effective disinfection and contaminant removal on-site.

Compact and Automated System

- Packaged in a 40-foot container with a fully automated control system and advanced sensors to monitor key water quality parameters for optimal operation.

Contaminant Elimination

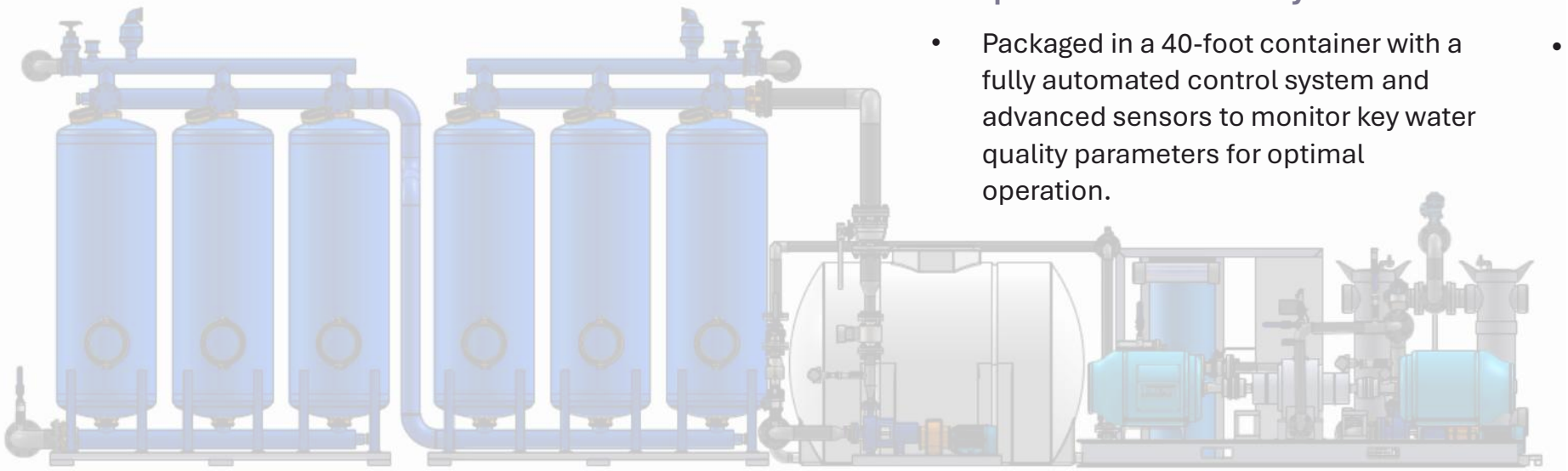
- Effectively eliminates contaminants such as iron, hydrogen sulfide, and microbial activity, improving water quality significantly.

Patented Technology

- Utilizes a unique, proprietary atmospheric chemistry process that sets it apart from conventional water treatment methods.

Energy Efficiency

- Energy and Cost per Barrel: Approximately 0.12 kWh per barrel; Cost is $0.0196 per barrel processed.



Secondary Features of the IOC System

Total Dissolved Solids Reduction

The system effectively lowers total dissolved solids (TDS), enhancing water quality and reducing scaling potential in downstream processes.

Total Suspended Solids Removal

Removes total suspended solids (TSS) to produce cleaner and clearer water, improving filtration efficiency and protecting equipment.

On-Site Disinfection

Generates chlorine dioxide and free chlorine on-site, providing powerful disinfection and biocidal action without needing external chemical additives.

Scale Prevention

Reduces hardness by lowering calcium carbonate ($CaCO_3$) levels, preventing scale formation and ensuring efficient long-term system operation.

Alkalinity Reduction

Optimizes water chemistry by lowering alkalinity, which helps maintain stable pH and improves overall treatment effectiveness.

What is Hydrodynamic Cavitation?

Bubble Formation

Hydrodynamic cavitation happens when a rapidly moving liquid experiences a pressure drop in a confined space, creating small bubbles. These bubbles collapse in high-pressure areas, releasing energy as shockwaves, heat, and microjets, influenced by the fluid's properties and flow.

Bubble Collapse

These bubbles implode violently, generating localized high temperatures and pressures that induce chemical reactions.

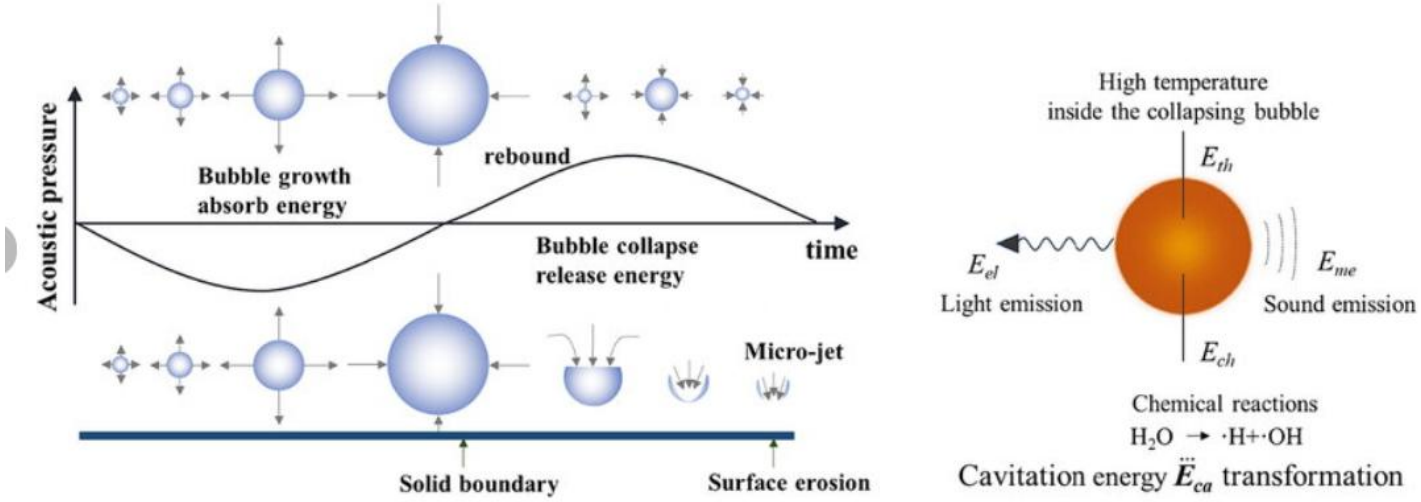
Effects on Pollutants

Collapsed bubbles cause structural damage to pollutants, increasing surface concentration and speeding up degradation.

Hydroxyl Radicals

Generated hydroxyl radicals (·OH) react with inorganic ions to form additional reactive species, further enhancing pollutant removal.

Hydrodynamics: Cavitation and Pollutant Degradation



Graphic representation of cavitational bubble dynamics during US. Content for the image modified from Wu et al. [138].

Bubble Formation

Hydrodynamic cavitation occurs when fast liquid flow through a narrow space lowers pressure, forming tiny bubbles that collapse in high-pressure zones, releasing energy as shockwaves, heat, and microjets, driven by fluid properties and flow.

Bubble Collapse

These bubbles implode violently, generating localized high temperatures and pressures that induce chemical reactions.

Effects on Pollutants

Collapsed bubbles cause structural damage to pollutants, increasing surface concentration and speeding up degradation.

Hydroxyl Radicals

During implosion, hydroxyl radicals (OH*), hydrogen peroxide (H2O2), and other reactive species form, enabling powerful advanced oxidation processes.

Cavitating Pre-Electrolysis Benefits

01

Improved Electrode Performance

Cavitation removes surface contaminants and oxides from electrodes, improving their conductivity and catalytic activity.

02

Enhanced Mass Transfer

The increased mass transfer rates promote faster reaction kinetics, leading to higher current densities and improved efficiency.

03

Enhanced Reaction Rates

Improving reaction rates and efficiency reduces the energy required for electrochemical processes.

04

Water Treatment Applications

Cavitation can be used to remove contaminants from water, such as heavy metals and organic pollutants.

05

Improved Product Quality

Localized high temperatures and pressures generated by bubble collapse accelerate chemical reactions, yielding higher product quality.

06

Reduced Energy Consumption

The combination of improved mass transfer and quicker reaction kinetics enhances current density, reduces energy losses, and boosts output, leading to greater efficiency in electrolysis processes.

Electro-Chemistry

Cathode Reactions and Role

- Cathode facilitates electron gain (reduction) reactions.
- Generates hydroxyl radicals (OH*) and hydrogen peroxide (H2O2) essential for oxidation.
- Reduces free iron and hydrogen sulfide to less harmful forms.
- Supports electro-chemical reactions that initiate advanced oxidation processes.
- Creates conditions for free chlorine and chlorine dioxide formation.

Anode Reactions and Oxidation Species

- Anode drives electron loss (oxidation) reactions.
- Produces oxidizing agents like ozone (O3), chlorine dioxide (ClO2), and free chlorine.
- Releases metal ions such as Al+ and Fe+ aiding flocculation and water clarification.
- Synergistic action with cathode enhances advanced oxidation chemistry.
- Crucial for converting radicals into disinfecting species for microbial control.

Free radicals	Oxidation potentials (E°) (V)
Fluorine	3.03
Hydroxyl radical	2.80
Atomic oxygen	2.42
Ozone	2.07
Hydrogen peroxide	1.78
Perhydroxyl radical	1.7
Permanganate	1.68
Chlorine dioxide	1.57
Hypochlorous acid	1.49
Chlorine	1.36

Oxidation potentials of major oxidants

Water Treatment

Exposing TDS: Process Overview

Oxidation of Dissolved Solids

Dissolved solids such as metal ions are reduced to an oxidized state. This chemical transformation changes the metal ions to a form that can react further with oxygen.

Binding to Oxygen

The metallic ion is tied to O2, which renders it insoluble in water. This oxygen binding is a key step in the precipitation process.

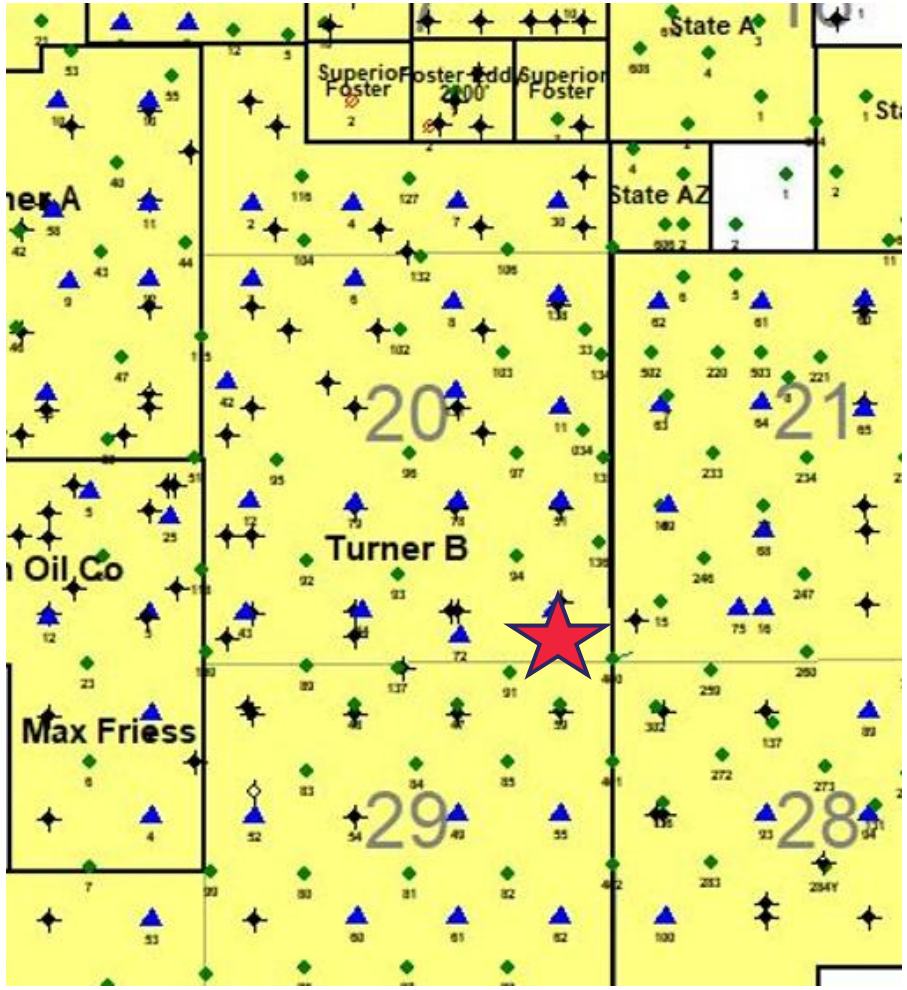
Formation of Insoluble Precipitates

The oxidized metallic ions form solid precipitates that are no longer dissolved in the water, making them removable by filtration.

Removal by Filtration

The insoluble precipitates are separated from the water using conventional filtration methods, effectively cleaning the water of metal contaminants.

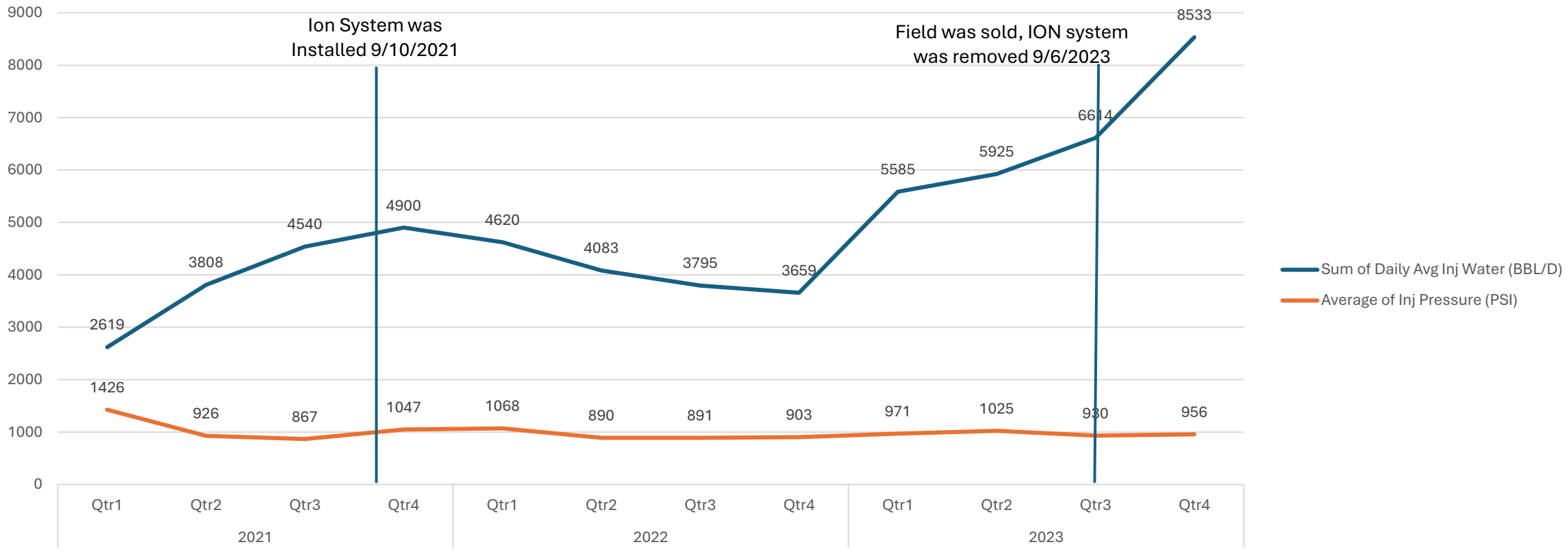
Field Testing of Waterflood in NM



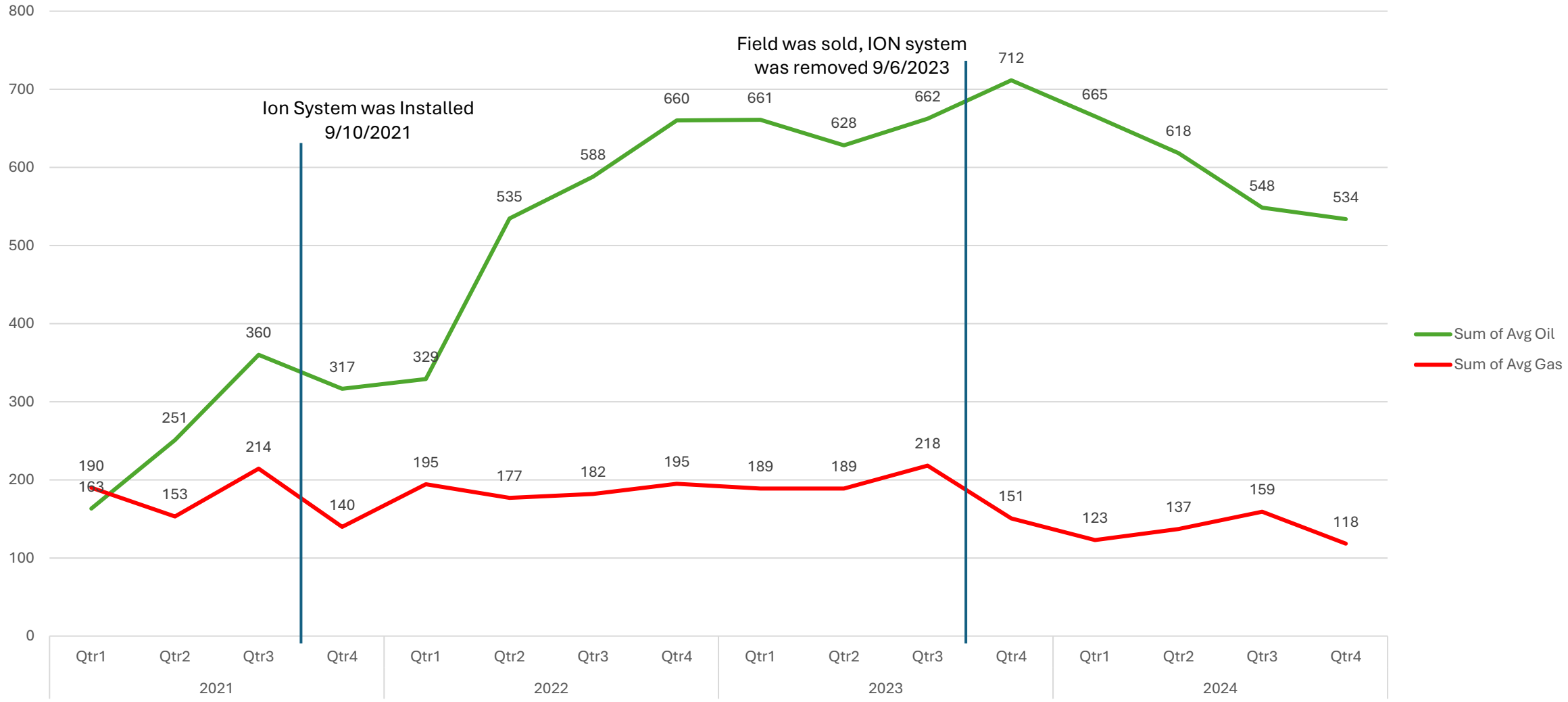
Field Testing of Waterflood Technologies

1. Assess hydrodynamic cavitation
2. Evaluate pre-electrolysis technologies
3. Remove hydrocarbon emulsions
4. Boost oil production
5. Treat produced water
6. Eliminate contaminants like heavy metals
7. Confirm laboratory results and monitor performance metrics

Water Injection & Avg Injection Pressure w/ ION Unit



Oil & Gas Production with ION Unit



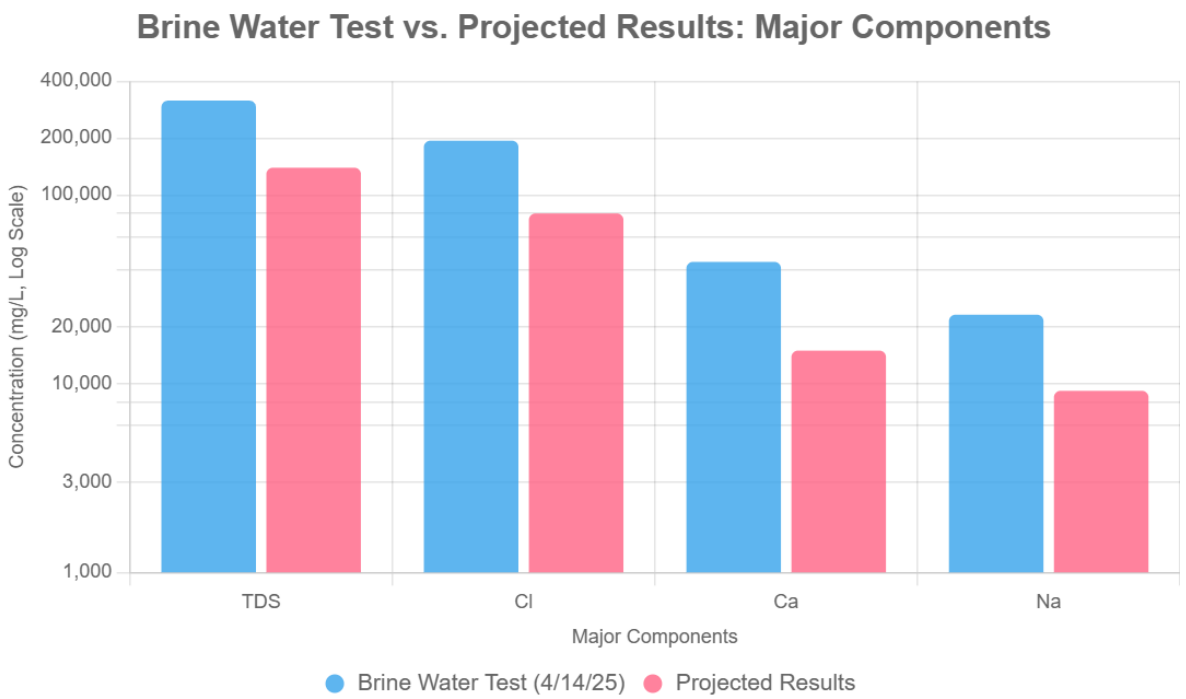
Analysis

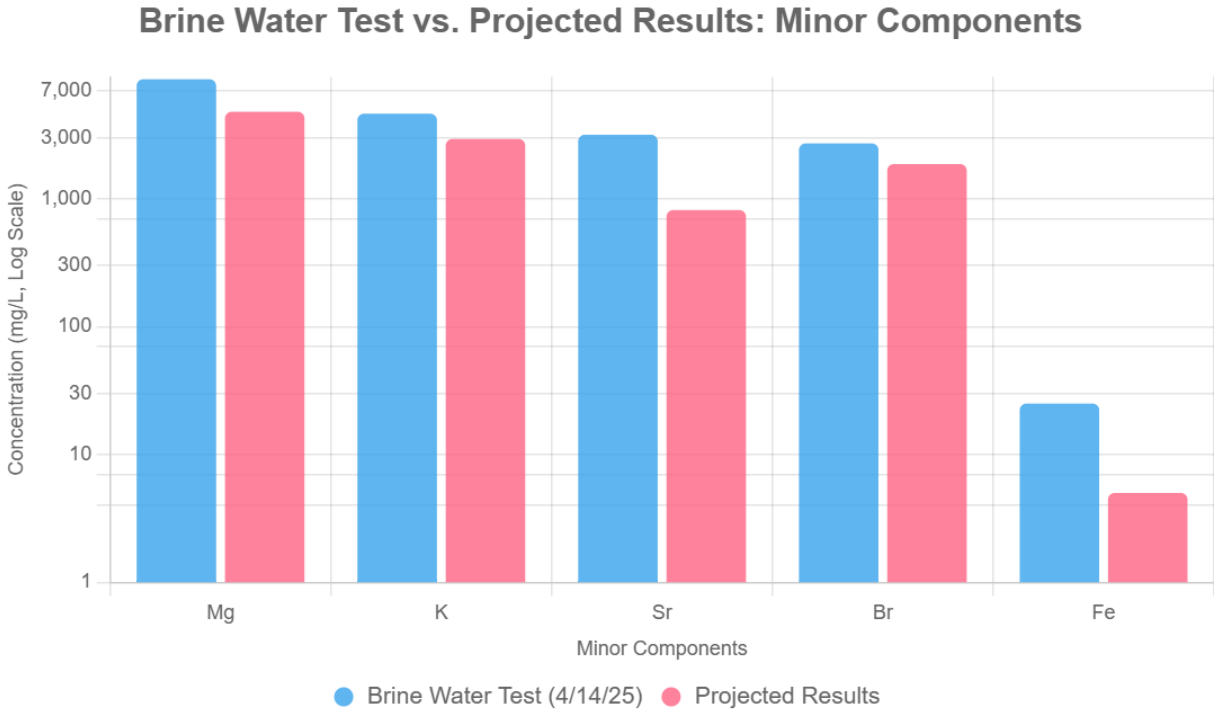
Field Testing Results

Loco Hills Results

Before		After -Post 2 months Running		
Parameter	Value	Parameter	Value	% Reduction
pH	6.86	pH	6.4	
Ca, mg/L	2380	Ca, mg/L	806	66%
Mg, mg/L	1613	Mg, mg/L	898	44%
Fe, mg/L	1.6	Fe, mg/L	0.317	80%
Mn, mg/L	0.709	Mn, mg/L	0.218	69%
Na, mg/L	34830	Na, mg/L	13758	60%
K, mg/L	1227	K, mg/L	778	37%
Ba, mg/L	2.2	Ba, mg/L	1.011	54%
Sr, mg/L	57.9	Sr, mg/L	14.9	74%
Sulfates ,mg/L	2900	Sulfates, mg/L	980	66%
Chlorides, mg/L	61055	Chlorides, mg/L	25122	59%
Conductivity, mg/L	75967	Conductivity, mg/L	53358	30%
Br, mg/L	678	Br, mg/L	466	31%
Turbidity, NTU	100	Turbidity, NTU	10	90%
Bicarbonate, mg/L	488	Bicarbonate, mg/L	292	40%
TDS, mg/L	105234	TDS, mg/L	46564	56%
H2S, mg/l	136	H2S, mg/l	17	88%
Iron Sulfide, mg/l	6.279	Iron Sulfide, mg/l	0.608	90%

Middle East Brine Projections





Projection are based of NM Field Results

	Brine Water Test (4/14/25)	Projected Results
TDS	317000	139480
Cl	194000	79824
Ca	44200	14969
Na	23200	9164
Mg	8610	4793
K	4630	2936
Sr	3170	816
Br	2710	1869
Fe	25	5

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Thank you
For your time.

Please contact us for more information and learn if our EOR Alpha products are the right choice for your oil wells.

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