



Planète Clean Water Tech



Advanced Electro-Oxidation Technology

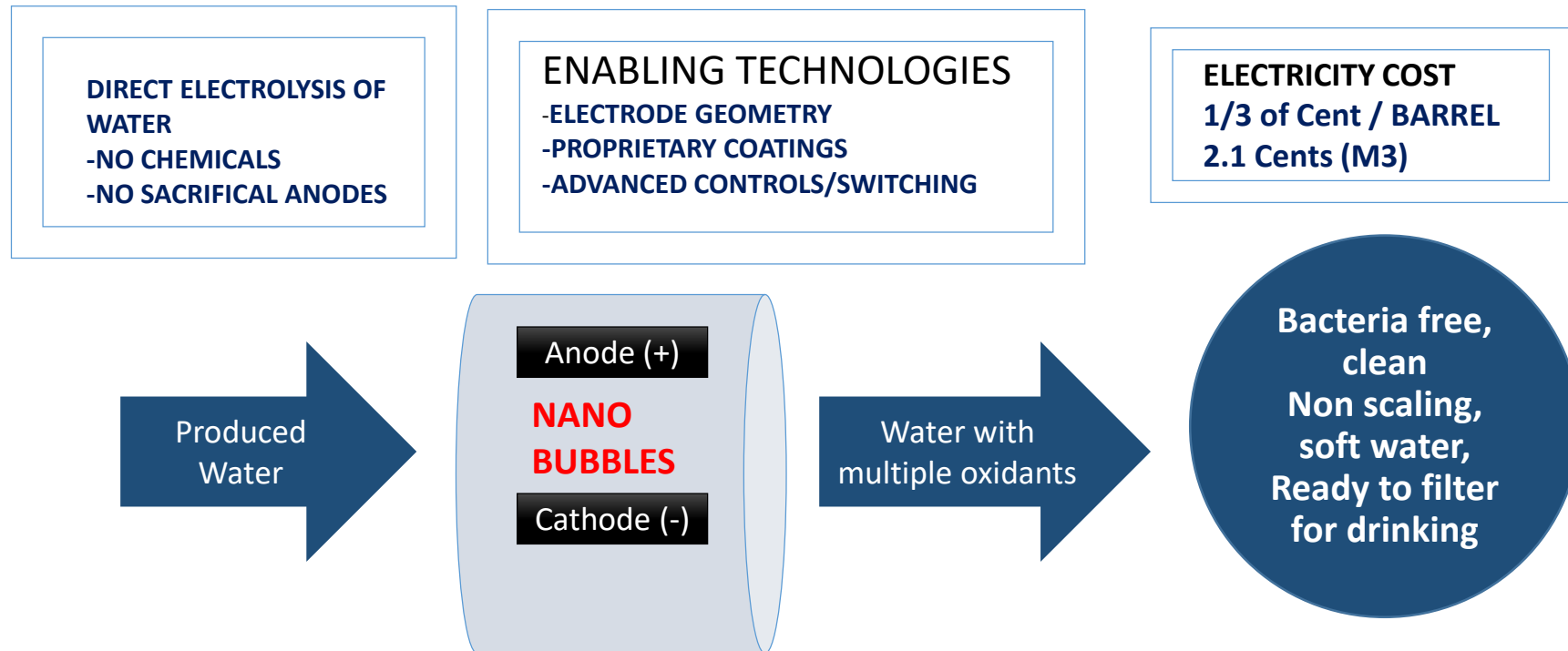
For

**Produced Water Treatment (Recycle and Re-use) and
Enhanced Oil recovery**



Advanced Electro Oxidation - The Technology

Planète Clean Water Tech is a mobile reactor that can be rapidly deployed to treat any water source regardless of the water challenges / complication. The US patented electro-oxidation process by Inventor Planète Clean Water eliminates all bacteria, H₂S, precipitates heavy metals and reduces solids to micron level. The benefits translate to enormous cost savings. The operator will no longer need to treat for scaling, corrosion, solids management or H₂S. This entire process is chemical free. Additionally, one single PCW - 1200 unit can treat up to 2,100,000 gallons (7,950 M³) per day.





Electro-Oxidation Technology

Planète Clean Water Technology

- Proprietary coatings
- Direct electrolysis of water

Oxide generation

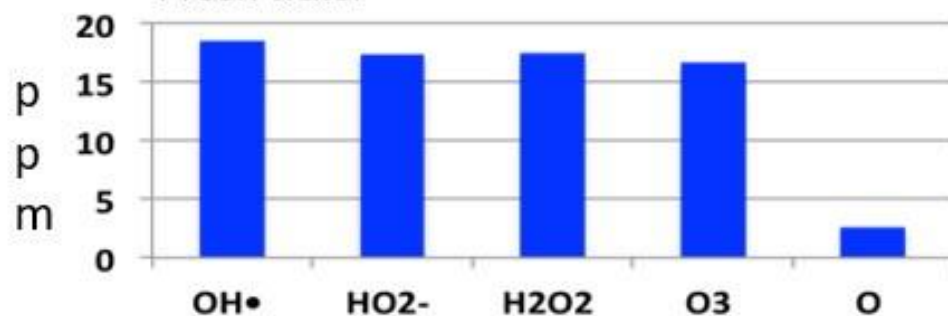
- Multiple families of oxidants
- Fresh or high salinity water
- No chemicals

Impacts

- Bacteria disinfection
- Scale reduction
- Heavy metal oxidation

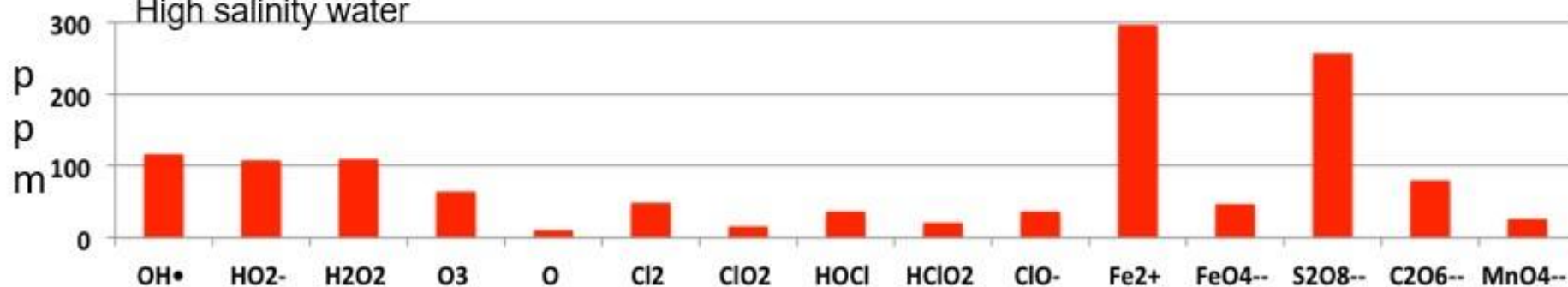
Oxidant concentration¹

Fresh water



Oxidant concentration¹

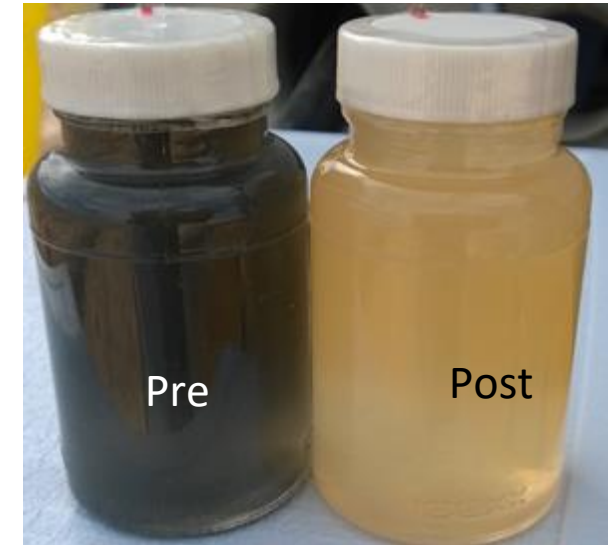
High salinity water





Why Advanced Electro Oxidation

- Eliminates H₂S to undetectable levels
- Kills bacteria and eliminates their food sources
- Precipitates scale-causing minerals ie., calcium, barium etc.
- Oxidizes Heavy Metals: iron, lead, arsenic, etc.
- Reduces suspended solids, minerals and particles to (0.005) micron size
- NO CHEMICALS required for treatment of produced water
- Softens produced water brine, with no scaling tendency with lower surface tension
- Solves compatibility issues with different waters: fresh, produced, brine, flow-back, completion water, etc.
- Solves "clay-swelling" issues with incompatible waters
- Treated brine is compatible with boron-based cross-link gels in frac operations
- Makes all contaminated waters available for reuse/recycle
- High flow rate capacity trailer mounted PCW - 1200 unit with small foot print
- Cost effective and treatment units are readily available and adaptable for each operation





APPLICATIONS (Oilfield Specific)

Hydraulic fracturing

- Cost effective treatment for reuse saves on fresh water and disposal
- Complete bacteria disinfection
- Oxidation & precipitation of boron and other divalent cations

Water flooding

- Elimination of SRB and APB bacteria
- Multiple oxidants eliminates immunity and assures complete kill
- Softened water has further reach into Shale formation

Pit, pond and tank cleaning

- Mobile unit for rapid mobilization/ demobilization
- Rapid bacteria disinfection
- H₂S smell reduction / elimination

Pretreat

- Simple pretreat for flash evaporation process
- Scale elimination allows longer run times
- VOC oxidation assures air quality
- Enhanced Oil Recovery





Alternative Water Treatment Technologies

Electro-Coagulation	Ozone	Chemicals	Planète Clean Water Electro-Oxidation PCW – 1200 System
Releases Metal ions, Iron, Aluminum etc. in the treatment effluent	Inject 93-95% pure Oxygen and 5-7% Ozone into treatment process	Need multiple chemicals based on each type of water chemistry.	Uses only Electricity (Electrons) to create powerful chemistry inside the treatment reactor.
Generates solid waste and effluent with super saturated metal ions.	Generates high Dissolved oxygen content (@ >20 ppm) in treated effluent. Increased risk of O ₂ corrosion	Based on the chemicals used: e.g. to balance pH, lower iron, lower Calcium, PCWomes a complex chemical soup.	Treated effluent remain as a original bacteria free, soft water and can be recycled.
Low to Medium Flow Rate treatment. High Energy Cost	High Capital investment for Ozone Generator. High Operation Cost. Still requires chemicals	Multiple chemicals counter react with each other and cause issues with compatibility.	Cost Effective as compared to other treatment processes. High Flow rate System.
Mostly used for high soluble organics (oil and sludge removal)	Mostly used in Wastewater and Drinking water treatment.		Bacteria Disinfection, Precipitation of scale causing minerals and oxidation of organics and inorganics.

Affordable & Environmentally Friendly Potable Water for All!



BACTERIA DISINFECTION

- Multiple oxidants generated during the treatment process go after bacteria colonies
- Process maintains 1-5 ppm of residual oxidants in the treated water to confirm the complete disinfection process and ensuring there is no regrowth of bacteria in treated water

Table 2: Acid Producing Bacteria Results

Sample	7th Day Result (cfu/mL)	Growth
CWP0317000A	NMG	No Measurable Growth
CWP0317000B	10 ² -10 ³	Low

cfu/mL = Colony Forming Unit/mL

Figure 2: Acid Producing Bacteria

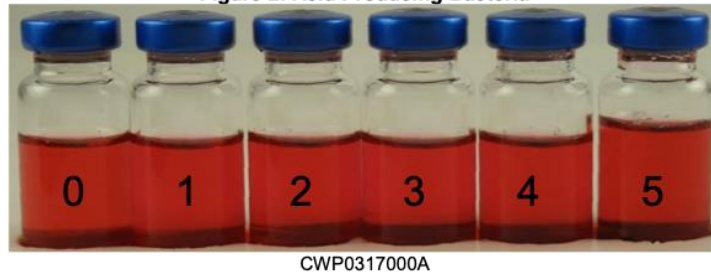


Table 3: Sulfate Reducing Bacteria Results

Sample	7th Day Result (cfu/mL)	Growth
CWP0317000A	NMG	No Measurable Growth
CWP0317000B	10 ⁴ -10 ⁵	High

cfu/mL = Colony Forming Unit/mL

Figure 3: Sulfate Reducing Bacteria



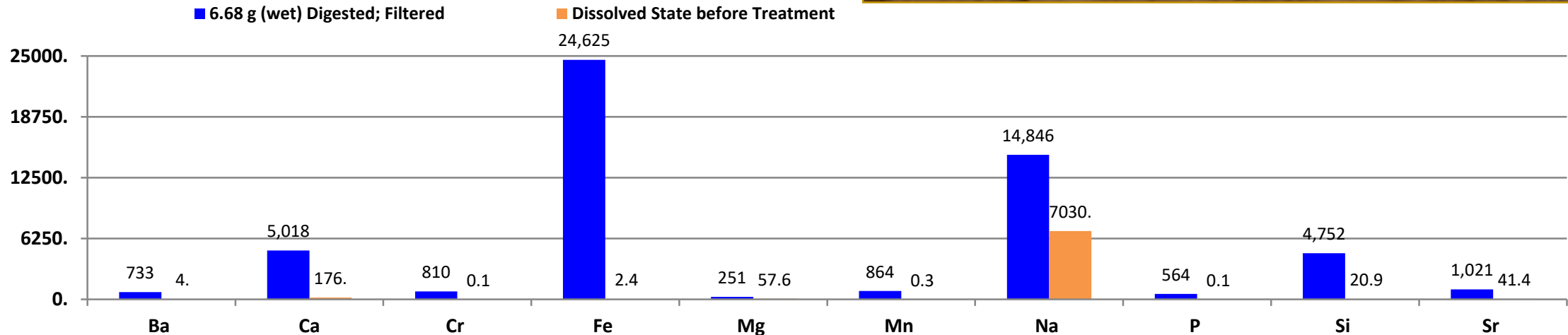
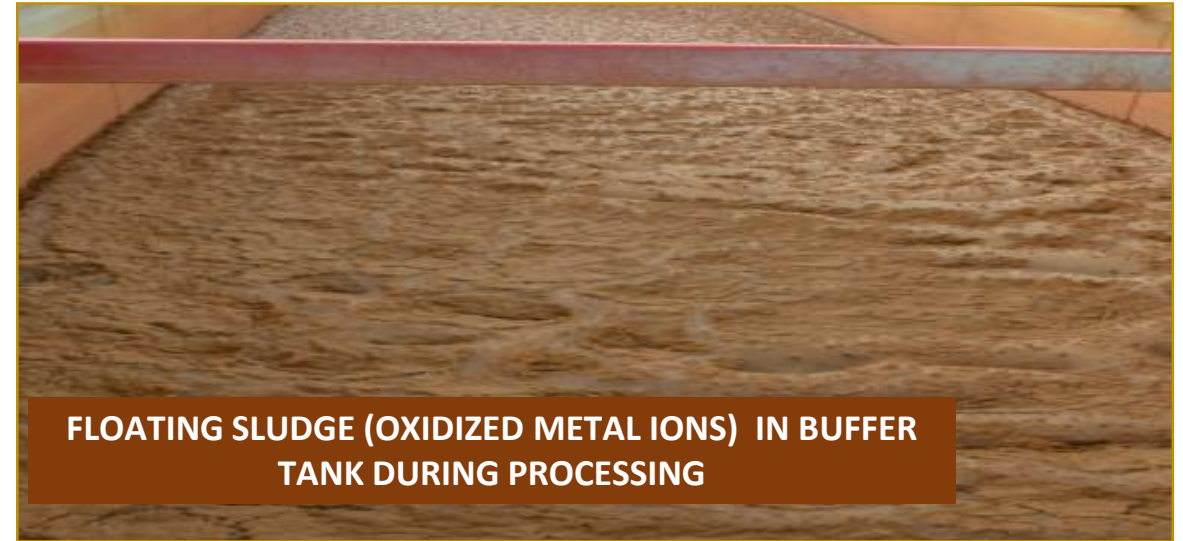
Free Chlorine Meter

Totally eliminated oilfield bacteria
 present in the untreated water
 Acid Producing Bacteria (APB) reduced to zero
 Sulfur Reducing Bacteria (SRB) reduced to zero



PRECIPITATION OF MINERALS AND OXIDATION OF HEAVY METALS

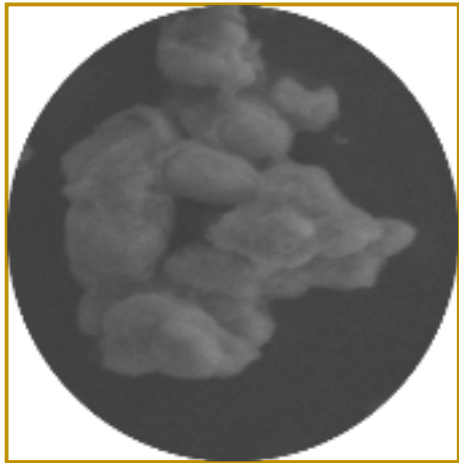
- Generated oxidants and strong electric-fields promote flocculation of suspended solids (TSS) while a portion of the dissolved solids (TDS) is converted into TSS
- Problematic metal ions are precipitated and stabilized



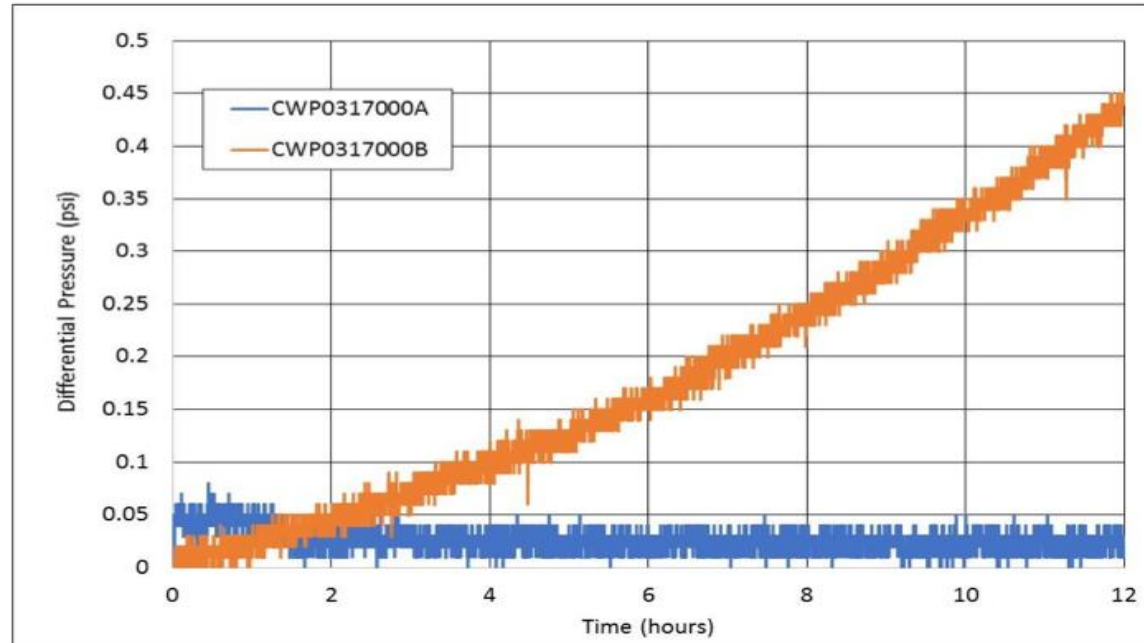


MICRO-PRECIPIATION

Micro-Precipitation: Cathode (Negatively charged electrode) attracts all divalent cations and precipitate them on the surface of the electrode in the form of carbonates and sulfates thus making treated effluent soft and non scaling



SEM Photo of
Micro- Precipitated CaCO₃
Size Approx. 0.05 micron



Dynamic Tube Blocking test were run at 180 deg F for 12 Hrs. Sample after treatment (CWP031700A) shows no scaling tendency

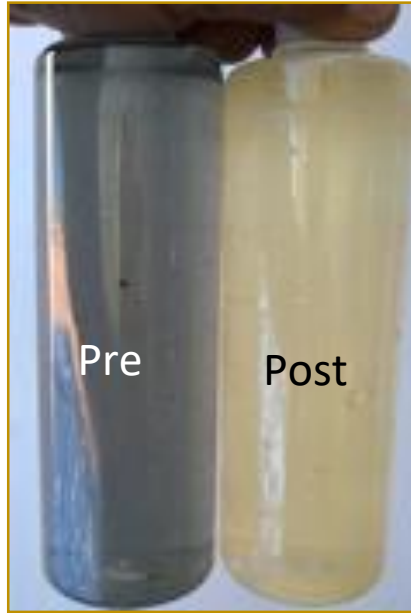
Treated Water exhibits insignificant scaling tendency based on tube blocking tests and is ideal for re-use in hydraulic fracturing and water flooding.

<i>If the Micro-Precipitants represents the tip of a needle (approx. 1230 Micron)</i>		
1230 Micron represents the micro-precipitant particle	The size of 100 mesh sand particle would be 1.21ft diameter	The size of 40 mesh sand particle would be 3.43ft diameter



Quality Product (Treated Produced Brine Water)

- 100 kw generator to run PCW – 1200 Unit
- 25~30 barrels per minute flow rate
- Real time operating data
- 10ft suction lift, 15psi discharge pressure @ 1400 GPM
- 12 X 250 amps DC total



Bacteria free, clean non scaling, soft brine with low surface tension, ready to use for frac



- Benefits**
- Complete bacteria elimination
 - Scale reduction
 - Heavy metal oxidation
 - Low surface tension

Technology Features

- **Safety:** Process is safe to operate, no hazardous operation, no risk to operator or to the environment
- **Low operating cost** since the process uses electricity as a reagent to treat effluent
- **Effective** on even low TDS (500 to 2000 ppm) water, makes electro-chemical technology applicable for vast variety of make-up water conditions
- **Technology is modular** and scalable and can be applied to small and large flow rates needs
- **Low maintenance** since it is a flow through system. Periodic inspection of electrodes and reactor helps to check on the wear and tear of the electrodes
- **Special geometry electrodes** with large surface area achieve high mass transfer rate of direct and indirect oxidation process, thus increases the overall efficiency of the process
- **Electro-chemical oxidation** process provides ability to treat and process challenging and toxic pollutants which otherwise difficult to treat with conventional biological or chemical process
- **Operator** has full control over the reaction-taking place in the reactor; current levels and oxygen gas can be adjusted for each organic or metal being treated
- **Electro-chemical reactors** operate at low temperature and pressure (near atmospheric) flow through conditions
- **Fully automatic operation** controlled by PLC and touch (HMI) screen

Technology Application



- **Oil & Gas Produced Water Treatment for Recycle and Reuse**
- **Ground Water Treatment for Drinking Water Treatment**
- **Agriculture and Hydroponics water Treatment**
- **Sewage water Treatment**
- **Cooling Tower Treatment**
- **Blue/ Green Algae, Nutrients (Phosphate/ Nitrate) water Treatment**
- **Textile Wastewater Treatment**
- **Food processing wastewater treatment**
- **Odor and Corrosion control**
- **Spent Caustic Wastewater treatment**
- **Hospital Wastewater Treatment**



Technology Options and Characteristics

Product	Flow Rate GPM	Power KW	Voltage	Current AMP	Dimension L x W x H	Total Footprint (with trailer towing tongue) L x W x H	Connections	Weight Lbs / Kg	Flowrates	
									Imperial (Gallons/day)	Metric (M3/day)
BEC - 1200	1200 - 1600	72	480V 60Hz 3 Ph	200	20' x 8' x 9'	28' x 9' x 10'	6" CamLock	8500 / 3856	1,728,000 - 2,304,000	6,641 - 8,722
BEC - 600	200 - 600	48	480V 60Hz 3 Ph	100	10' x 8' x 8'	10' x 8' x 8'	6" CamLock	4000 / 1814	288,000 - 864,000	1,090 - 3,271
BEC - 6	20 - 75	6	480V 60Hz 3 Ph	30	3.2' x 2.6' x 5.8'	4' x 3' x 6'	1" CamLock	580 / 263	28,800 - 108,000	109 - 409
BEC - 1.5 (5 Series)	10 - 15	1.5	120 - 240V 60Hz 3Ph	10	15.75" x 7.5" x 19.75"	16" x 8" x 20"	1" NPT I/O	30 / 14	14,440 - 21,600	55 - 82
BEC - 1.5 (3 Series)	05 - 10	1.5	121 - 240V 60Hz 3Ph	10	15.75" x 7.5" x 19.75"	16" x 8" x 20"	1" NPT I/O	30 / 14	7,200 - 14,400	27 - 55



PCW - 1.5



PCW - 6



PCW - 12



PCW - 600

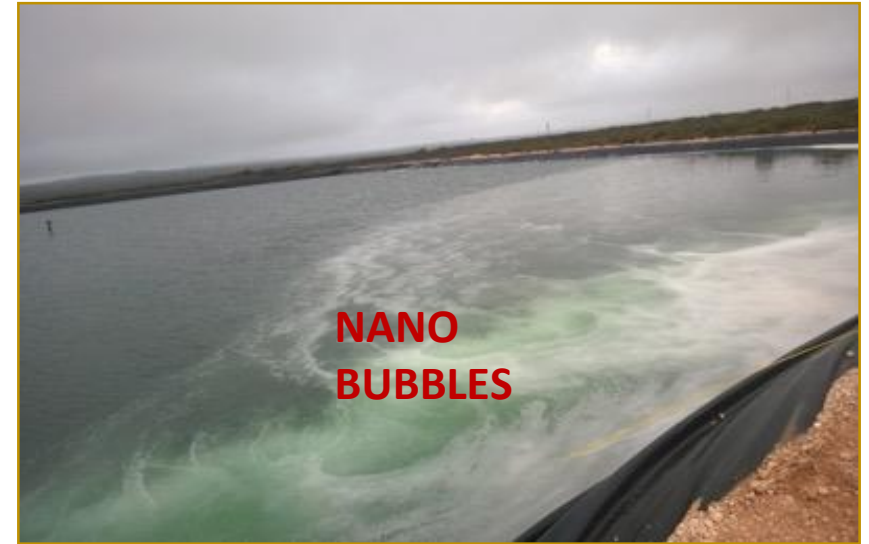


PCW - 1200





Produced Water Pit Treatment Job in New Mexico (US)



Typical Site Set up with PCW - 1200 System





WATER FLOODING OPERATION FOR ENHANCED OIL RECOVERY

Aqua Pulsar performed a project for a major E&P company for their water flooding operation

Main Task:

- Lower SRBs and APBs in the produced water
- Remove any food source for bacteria
- Low surface tension brine for shale formation

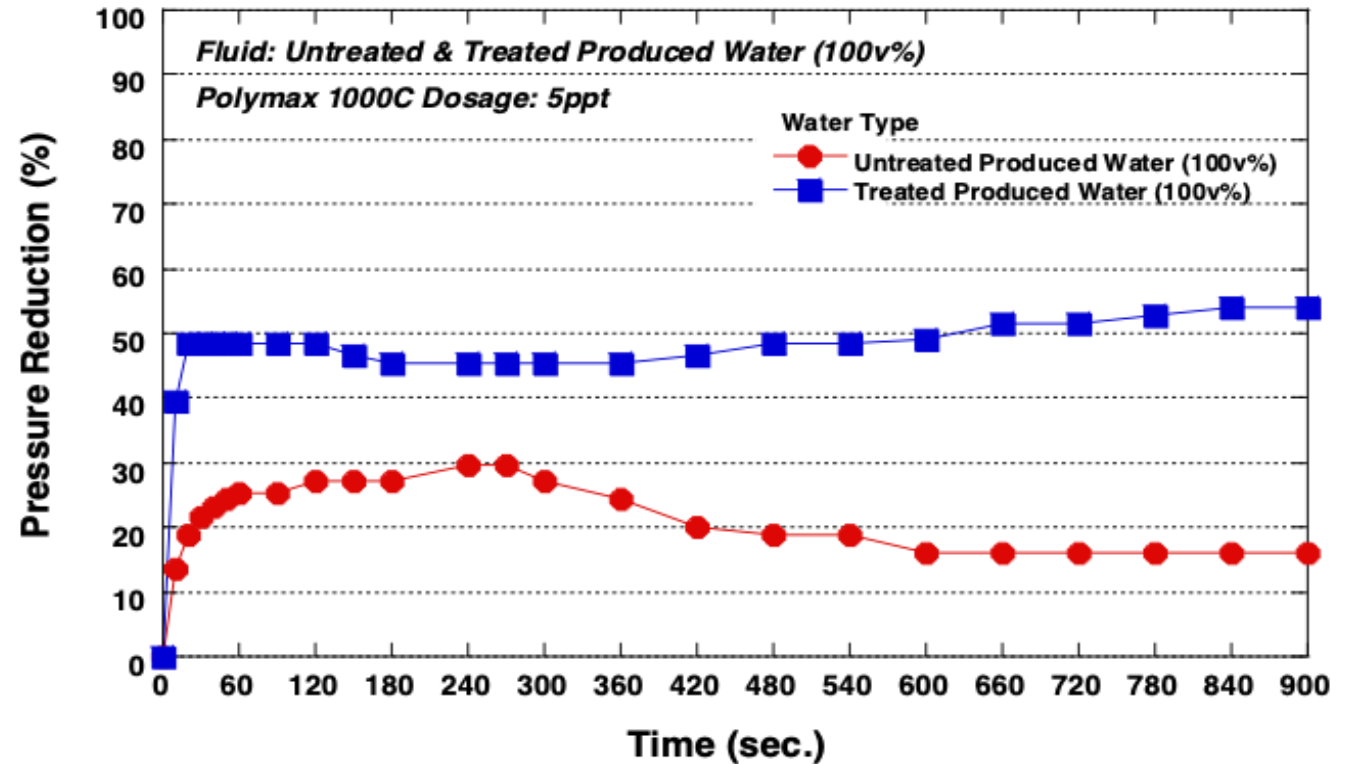


- 1.6 Million of barrels of produced water processed
- 24-7 continuous operation for 2 months
- Avg. Flow rate 25~30 BPM
- 3~7 log kill on continuous basis
- Maintained 1~2 ppm of H₂O₂ in treated water

DELAWARE BASIN (NM) – TREATED PRODUCED WATER CONTAMINATED WITH BORON-FLASH CROSSLINKING



- **Influent Conditions:** 125 K-bbl
- 47 stages Frac Job
- variable pH (6.5-11); variable salinity up to 25 k-ppm
- Boron or other ionic contaminants treated for effective cross-linking of linear gel
- 10-15 bpm Treatment flow rate





PRE-TREATMENT TO FLASH EVAPORATOR UNIT

- Pretreatment of produced water by AP48 unit before Flash Evaporator
- for VOCs, scale causing minerals
- For trouble free continuous operation of Flash Evaporator unit
- Passed PA DEQ emission quality test for VOC emission





PLANETE CLEAN WATER TECH

by



Ultra Fine Bubbles Technology

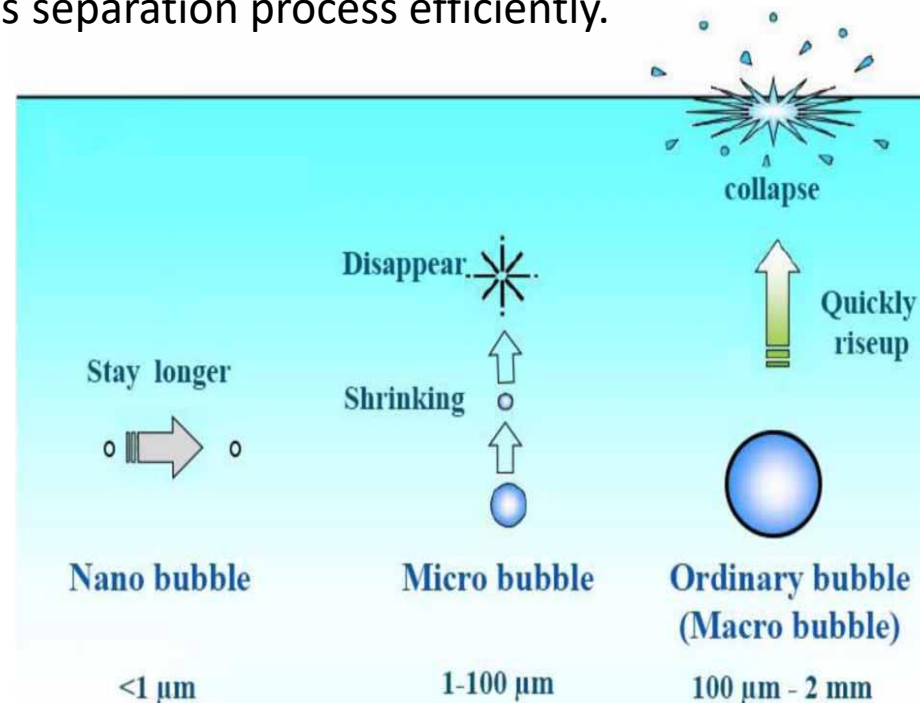
for

**Enhanced Oil Recovery &
H₂S Mitigation in Produced Water**

Properties of Ultra Fine Bubbles

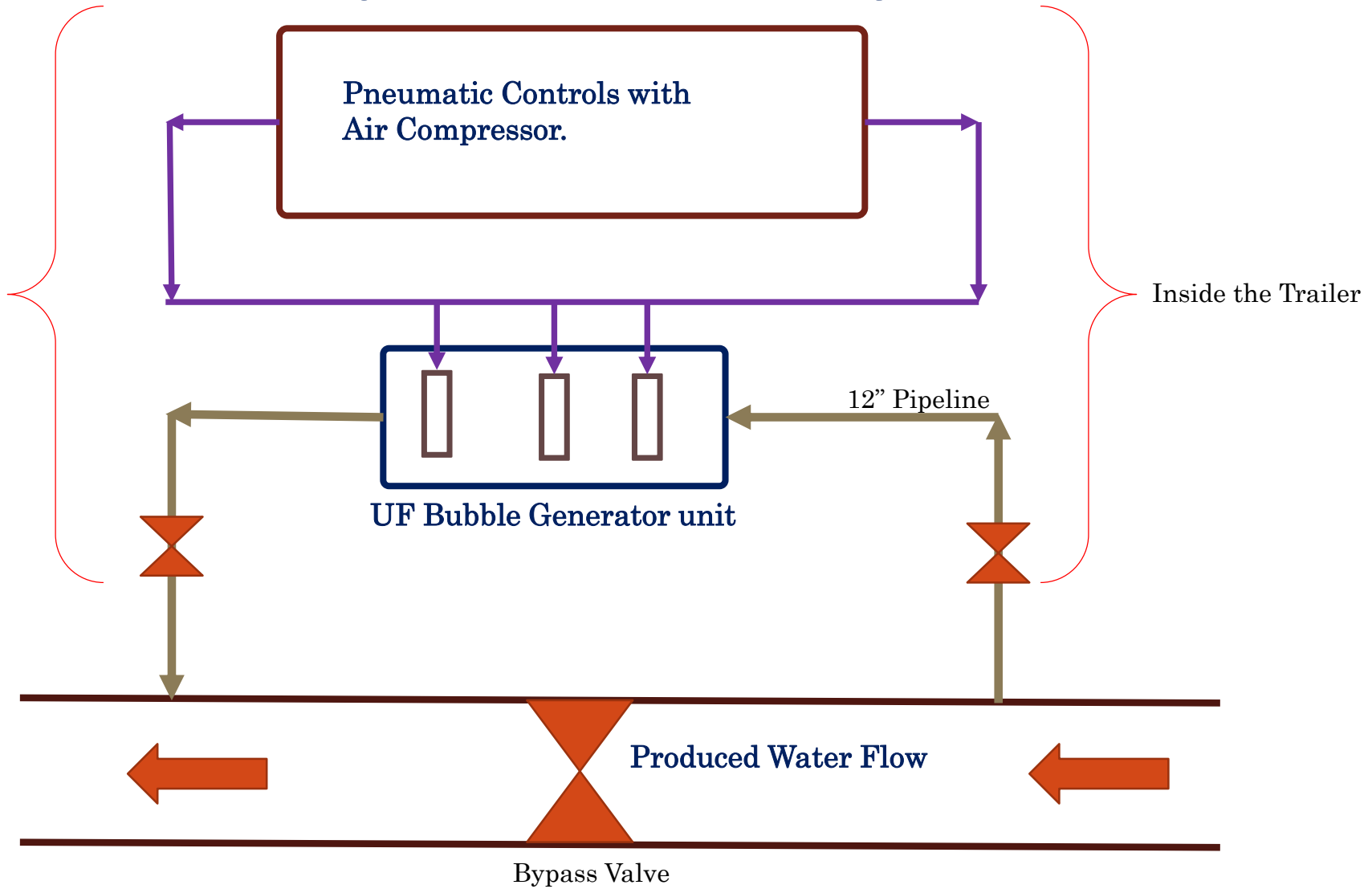
Enhance oil recovery and mitigation of H₂S and in Produced Water

- Inject Ultra fine bubbles into the produced Water Pipelines before reaching to the receiving stations
- Install modular units on a produced water pipelines at strategic locations for Ultra Fine Bubble Injection.
- Ultra fine bubbles lowers the specific gravity and surface tension and help the water/oil/solids separation process efficiently.





Proposed Installation Layout





Ultra Fine Bubble (UFB) (Nano) Approach & Advantages

Fundamentals

- Unique technology approach
- Reliable and proven technology
- **Enhances oil recovery**
- Easy to implement with current set up
- H₂S/ SRBs issues are addressed while effluent is being transported in the pipeline.
- **No chemicals**, just plain air bubbles.

Opportunities

- Produced Water pipelines carrying H₂S laden water
- SWDs dealing with corrosion and safety issues due to H₂S
- Increase oil recovery, improve revenue
- Modular design minimizes CAPEX and OPEX with ultimate market flexibility and economical advantage
- Modular design allows for scalable operations
- Mobile Option allows for better asset return.





Ultra Fine Bubble Technology Results

- Lower specific gravity and surface tension of the produce water allowing greater Oil / water separation efficiency. Enhance Hydrocarbon recovery.
- Reduction of dissolved H₂S levels in the produced water at produced water receiving stations.
- 50% or more Estimated reduction in H₂S
- Breakdown of Iron Sulfide clusters in the produced water flow thus lowering sulfur reducing bacteria count.
- Greater Solid/Liquid separation efficiency with better solid/ sludge management.
- Lower corrosion / maintenance issues.



Ultra Fine Bubbles Technology – Additional Financial Revenue Projections



Calculations for 100K Bbl. Processing Station					
Barrels Per Min	Barrels Per Day	Conventional Oil recovery in bbls	% increase in oil recovery in bbls	Increase in Revenue at oil Price	Additional Increase revenue per Year
Produced Water treatment Flow		1/2%	10%	\$75.00 / BBL	
70	100800	504	50.4	\$3,780.00	\$1,379,700.00

- It is expected to see increase in oil recovery after injection of Ultra Fine bubbles in the produced water line.
- With 10% increase in oil recovery efficiency, operator can generate additional 1.3MN revenue yearly at a 100,000 bbls Produced Water receiving station. Calculations is based on a **\$75 cost per bbl** price of crude oil.
- By lowering the risk of H2S, Cybele UF Bubble unit will also help to reduce chemical usage and infrastructure corrosion/ maintenance issues.





Application of Ultra Fine Bubble Unit in Produced Water

- Installation of Ultra Fine bubble containerized, Or Trailer based unit on the Produced Water piping network at strategic Low-pressure locations.
- Introduction of compressed air Ultra Fine bubbles in the stream of produced water with no pressure losses.
- Enhanced oil recovery at the Produced Water receiving station*.
- Enhanced Oil & water separation without the use of Chemicals.
- H₂S Scavenging.
- Iron Sulfide (FeS) mitigation.
- Paraffin control.
- Low/ less corrosion due to lower H₂S

*Produced water can be treated by Cybele's advanced Oxidation Unit to:

- i) Eliminate all bacteria
- ii) Oxidize & Precipitate heavy metals for:

Treated produced water can be:

- a) Re-used and Recycled within the oilfield or
- b) Further treated for non-oilfield applications.





Ultra Fine Bubble Implementation

Implementation

- Miles of Produced Water Pipelines
- 20ft Containerized unit Or Trailer with automation and control.
- Can work with utility power.
- SWD locations where H₂S is a main issue.
- Install Bubble units at strategic Locations to improve the quality of water.

Operational Cost For UF Bubble Unit

- Operating cost per bbl 0.1 to 0.4 USD cents per bbls
- * Cost is calculated based on the Capex + Energy+ spare parts+ labor etc.

Recommended Procedure

- Produced water flows through an Ultra Bubble unit to facilitate:
 - Enhanced Oil Recovery
 - H₂S elimination, and
 - Solids Precipitation
- The cleaner Produced water is treated in the Advanced Oxidation Unit where:
 - All bacteria are eliminated
 - All H₂S and odor eliminated, and
 - All Heavy Metals precipitated into stable compounds in an inert and harmless state
- Treated produced water is ready for re-use, recycle or disposal (SWD)



Technology Comparison / Competition

Induced Gas Floatation (for Solid Separation)	Ozone	Chemicals	Planète Clean Water Electro-Oxidation System AP72
<p>Relies on infused Gas for separation of solids Gas could be CO2 or Nitrogen at extra cost.</p>	<p>Inject 93~95% pure oxygen and 5~7% Ozone into treatment process</p>	<p>Need multiple chemicals based on each type of water chemistry</p>	<p>Uses only electricity (electrons) to create powerful chemistry inside the treatment reactor</p>
<p>Process is meant for separation of Oil and suspended solids. Efficiency is best when Infusion, separation and skimming happens in static conditions. Extra Storage infrastructure required.</p>	<p>Generates high dissolved oxygen content (@ >20 ppm) in treated effluent</p>	<p>Based on the chemicals used: e.g to balance pH, lower iron, lower Calcium, PCWomes a complex chemical soup</p>	<p>Treated effluent remain as an original bacteria free, soft brine. All frac chemicals work well since there are no interferences from any elements</p>
<p>High Flow rates but expensive Static Structural Invest. No chemical changes occurs in the process.</p>	<p>High Capital investment for Ozone Generator. High Operation Cost</p>	<p>Multiple chemicals counter react with each other and cause issues with compatibility</p>	<p>Cost effective as compared to other treatment processes. High flow rate system. Low power requirements. Modularity allows for easy upgrade. Small footprint is cheaper</p>
<p>Does not treat the water for organics or Heavy metals. Need further treatment to treat effluent.</p>	<p>Mostly used in Wastewater and Drinking water treatment</p>		<p>Bacteria Disinfection, Precipitation of scale causing minerals and oxidation of organics and inorganics</p>

Current Customer Base



SouthWest Energy
EnerGen
BC Operating Inc.
Chesapeake
Occidental (Oxy)
PeMex (Mexico)
Saudi Aramco
Equate Refinery (Kuwait)
Devon
Phoenix Global Argentina
YPF Argentina.

The central graphic displays a collection of logos for various energy and resource companies. At the top right is the 'devon' logo with three orange horizontal bars above it. Below it is the 'SWN' logo for Southwestern Energy. To the left of SWN is the 'ENERGEN' logo. Below ENERGEN is the 'Chesapeake ENERGY' logo. To the right of Chesapeake is the 'BC OPERATING, INC.' logo. Below BC OPERATING is the 'PEMEX' logo. To the right of PEMEX is the 'OXY' logo. At the bottom center is the 'phoenix GLOBAL RESOURCES' logo.



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CLEAN WATER
Technology



QUESTIONS ???

THANK YOU

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