MEGA-DRAIN®

ACCELERATED EVAPORATION SYSTEMS(AES) WATER VOLUME REDUCTION MANAGEMENT OPERATIONAL, REMEDIAL AND CLOSURE

Micro-Bubble Evaporation Technology:

- Maintains or Reduces the Levels of Water in Wastewater Ponds and their required footprints
- Can Eliminate Any Need for Expansions

MEGA-Drain®
Turbines generate Micro-Bubbles, accelerating the evaporation of water

- Rapidly Deployable
- Configurable & Adaptable
- Low Capex & Low Opex
- Low Energy Consumption
- Environmentally Sustainable
- Zero Wind Blown Surface Spray
- Year-round Operation Potential

Units may prevent complete freeze-overs pending location and typical winter conditions

MEGA-Drain® AES Value Proposition

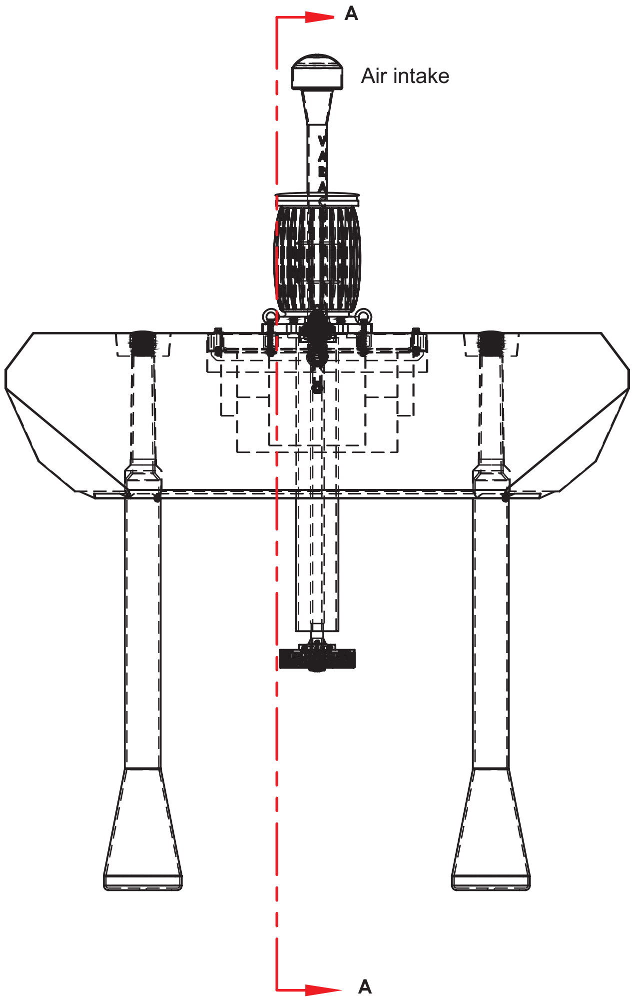
Our system does the same work as land based nozzle ejectors at 26% of the capital cost and 12% of the operating cost

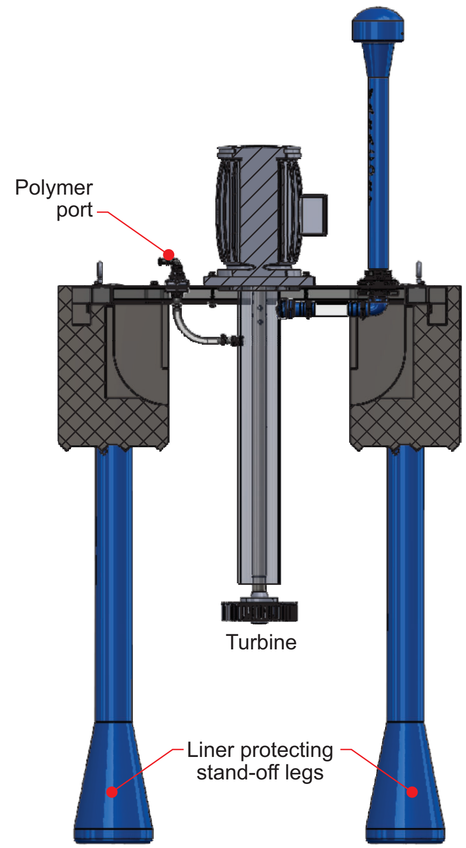
Co-Located Case Study of Comparative Evaporation System Costs

	Land Based Nozzle Ejector Evaporator System (Technology is re-purposed snow making machines used in ski resorts)	**MEGA-Drain®** FracCure In-pond Evaporation System	Notes
▼ Pond Footprint Area (in Acres)	85	85	
▼ Gallons (US) Evaporated	24,000,000	24,000,000	
▼ Days of Duration	120	25	
▼ Units Used	2	12	Just 3 **MEGA**-Drain® rax %Note Object 527.34699 305.81235 765.01276 332.15471 E /$fm 1 de same volume as the land based nozzle ejector systems in 102 days. In 120 days 3 MEGA-Drain® units would have evaporated 28.8 MG
▼ Evaporation Per Unit Per Day (US Gal)	100,000	80,000	
▼ Total kWh Used	216,000	27,000	Over 85% less energy consumption
▼ Capital Cost Per Unit	$137,000	$25,000	
▼ Total Capital Cost	$289,000 (with 2 feed pumps factored in at $7,500 ea.)	$300,000 for 12 or $75,000 for 3 SEE NOTE	Just 3 **MEGA**-Drain™ Systems would have performed the same work as the two (2) land based nozzle ejector systems in 101 days vs. 120 days at a capital cost of **$75,000 vs. $289,000**
▼ Total Operating Cost Per Pond	$19,440	$2,400	Power to operate these units was generated on-site. The cost per kWh was $0.09.
▼ Unit Operating Cost Per 1,000 Gal	$0.81	$0.10	The **MEGA**-Drain® systems operating cost was 12.35% that of the land based nozzle ejection systems

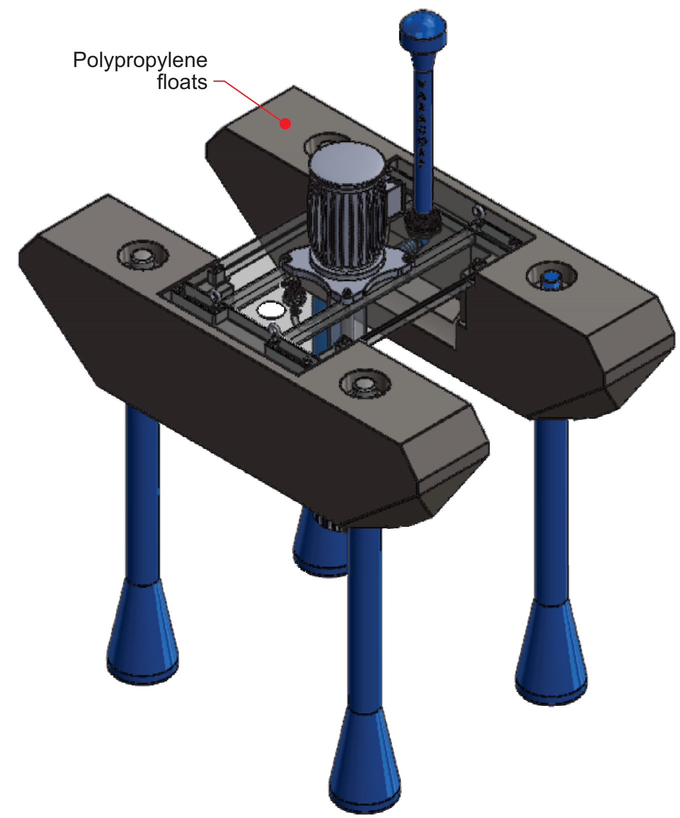
MEGA-DRAIN™

MEGA-Drain® AES Unit Technical Drawings





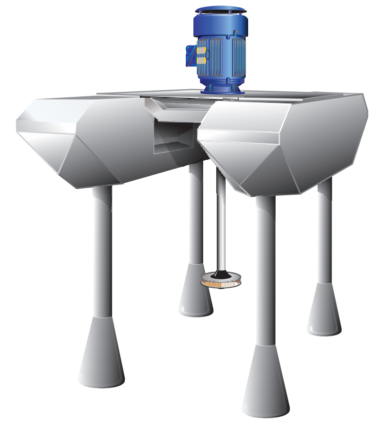
Section View A-A



Performance Envelope Comparison

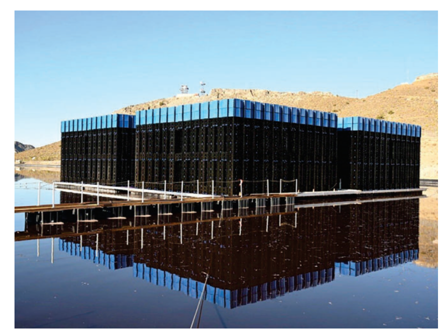
	MEGA-Drain™ Evaporation	Spray Nozzle Fan Ejector Evaporator System	Ecovap Sprayed Block Matrix Evaporation
Associated Power Demand	Low	High	Lowest
Shipping Costs	Medium	Medium	Very High
Airborne Contamination	N/A	High	Low
Loss of Containment Risk	N/A	Potentially very high with wind	Moderate
Water Treatment Benefits	Offers all benefits afforded by aeration treatment	N/A	N/A
Seasonal Limitations	Potential to Operate 365 Days Per Year	Seasonal/cannot operate in freezing weather	Seasonal/may not operate in freezing weather
Construction time	Minimal time and effort	Moderate time and effort	Intensive construction requirements
New infrastructure Improvement Requirements	Minimal (Mostly power related)	More Demanding	Significant site modifications required
Installation Labor Intensity	Lowest (Significantly)	More Demanding	Requires significant advanced staffing and management
Installation scheduling	Rapid	More Demanding	Requires significant advanced planning
Wind Risk	N/A	Wind Will Prevent Operation	N/A
Maintenance	Lowest	System & piping may freeze/nozzles clog	System & piping may freeze/nozzles clog
Water Level Fluctuation	Occasional tethering slack adjustments Req'd.	Piping modifications are required	Occasional tethering slack adjustments Req'd.
Clogging and Corrosion	N/A	System piping may freeze and clog	Moderate
Value Proposition	Maximum	Lowest	Moderate

MEGA-Drain™ Evaporation



Spray Nozzle Fan Ejector Evaporation System

Ecovap Sprayed Block Matrix Evaporation



Performance Envelope Comparison

Requires no maintenance

Has no internal moving parts

Will not clog with tumble weeds or most other debris

Aerates by thrusting air into water and not water into air

Can outperform other aerators which have up to seven times the horsepower

Boasts long retention time of air bubbles in the water

Uses explosion-proof motors in the two to five-horsepower range

Employs foam-filled, UV-resistant, polypropylene pontoons guaranteed not to sink

Never needs to be "greased"

Designed to run 24/7

Made of corrosion-resistant materials

Operates at a very low noise level

Requires much less electricity than other aerators

Priced to be cost-competitive with other aerators

Will not stir up bottom sediment

Ideally suited to the harsh frac pit environment

How The Evaporator Works

The key element of **MEGA**-Drain® Vara Corp evaporators are their turbines. These turbines are essentially a hollow submerged rotating cylinder with a solid upper "roof" and lower "floor" discs. The rotating shaft is hollow to allow air ambient ingestion that displaces the water. The turbine's outer perimeter features vertical fins with small slots to allow the initial displacement of water to be followed by the continuous passage of air. The turbine's slots, vanes and the drive shaft's air transfer porting are designed to uniformly eject air bubbles from the top to bottom edges of the turbine.

Upon start-up, spinning of the turbine acts like a centrifuge that purges the heavy resident water that also creates a low-pressure wave drawing atmospheric air into it through the breather replacing the water. Ejected air bubbles around the turbine's perimeter create another low-pressure zone by the Bernoulli Principle. The bubbles eject at high speed and create low pressure around the turbine. In effect, the outer surface of the turbine acts much like an airplane wing creating lift. The low pressure helps draw more air in akin to a form of supercharging, creating a positive air flow with the energy input being the powered rotation of the turbine.

At operational speed, other fluid dynamics take effect forming a large volumetric cloud of air bubbles of various diameters that disperse in a zone up to 100' in diameter from the turbine. Numerous variables have been isolated and tuned in the development of the turbine. Some examples include turbine thickness, diameter, rotation speed, the number and size of fins/slots and submersion depth. All of these factors have a combined effect on the generated air bubble diameter, shearing potential and induced pressure oscillation between air and water. Turbine operating depth affects hydrostatic resistance acting against air exiting the turbine. By design, the turbines induce fluid pressure oscillations between air and water at the boundary layer proximal to the perimeter discharge interface generating high shear which creates more bubbles within this zone of smaller size.

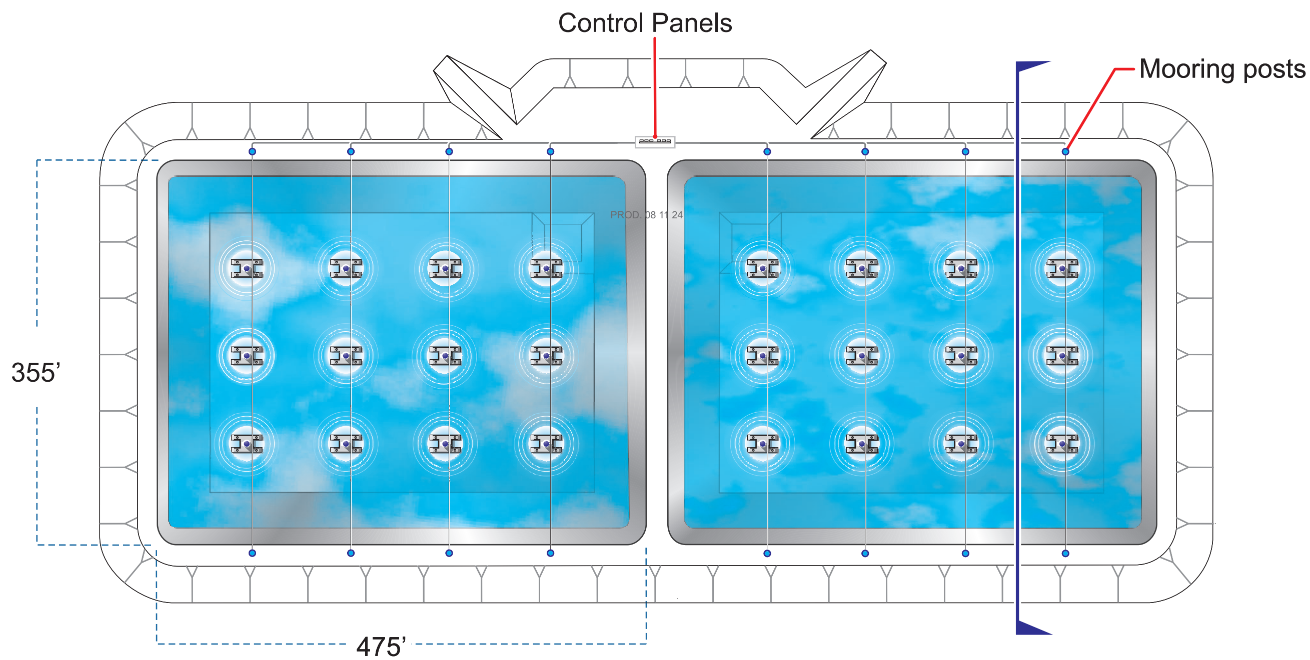
So How Does Any Of This Cause Evaporation?

Quite literally, it is all about bursting bubbles. Once bubbles surface, they burst. Released bursting energy is transferred into the water causing micro water droplets to be propelled into the air. When viewed at a micro level, the bursting process is actually quite violent. In essence, the bursting of bubbles causes water to vaporize above the surface promoting greatly accelerated evaporation. Size directly correlates with the energy density of the bubbles. Micro bubbles are much more desirable as they:

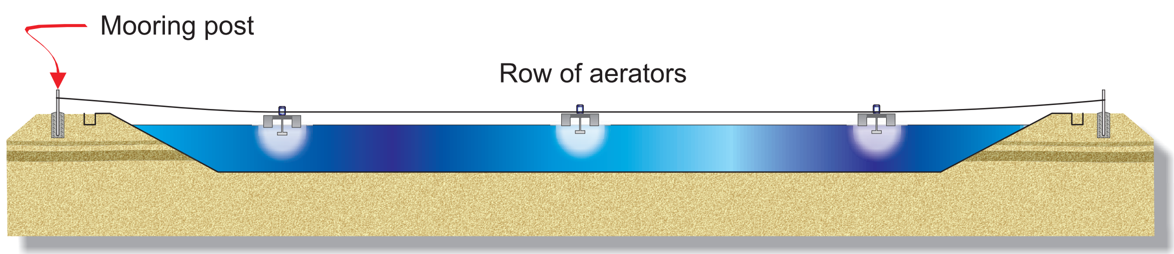
- Contain more internal pressure enhancing burst energy,
- They drift dramatically further before surfacing reducing atmospheric localized saturation/evaporation capacity,
- They create hydroxy radicals and negative charges that help treat pollutants/wastes.

The bubble size range of our turbines range from 0.0001 to 3 mmm with greater than 50% ranging between .001 and .01 mm (1 to 10 microns). Other factors affecting the evaporation rates are water and air and temperatures along with wind speed and ambient humidity. These fine bubbles and their large footprint of evaporation area are made possible by the Vara Corp turbines and their pre-set optimized operating depth.

Sample Installation Layout



Plan View



Section View

AES Benefits of Dissolved Oxygen in FRAC Pits

- **Stimulates growth of aerobic bacteria that will "feed" off the nutrients needed by Sulfate Reducing Bacteria (SRB) and Acid Forming Bacteria (APB)**
- **Builds a population of aerobes that will reduce available hydrocarbon and guar residues**
- **Reduces the level of iron, manganese, and organics**
- **Reduces turbidity and suspended solids**
- **Strips H2S and CO2 from the water**


PHOTO: MLADEN ANTONOV/AFP/GETTY IMAGES

- **Lowers the level of dissolved oxides of minerals and organics, converting them to higher insoluble oxides easily removed by sedimentation**
- **Reduces the chlorine demand of the water (thus reducing the cost of disinfection by chlorination) by oxidizing reduced organic and sulfur compounds**
- **Drastically reduces all bacterial populations as the organic compounds are consumed.**

ROCKWATER ENERGY SOLUTIONS Site Installations

Sample turbidity difference after 7 hours of aeration

AES Frac and Produced Water Remediation Results

Flowback Frac Water Field Testing Data

From frac tank installation

Target	No Aeration	4 Hrs Aeration	8 Hrs Aeration	24 Hrs Aeration
Sulfate	63	25	25	0
Bicarbonate	214	220	104	98
Iron, Total	35.10	19.80	13.40	5.30
Barium	8.49	7.83	6.85	3.86
Manganese	1.05	0.61	0.29	0.00
H2S	2.50	1.50	0.50	0.00
CO2	165	60	40	20
COD	1328	1263	1098	850
TSS	723	578	595	200
Turbidity (NTU)	916	186	82	50

Produced Water Field Testing Data

From frac tank installation

Target	No Aeration	4 Hrs Aeration	8 Hrs Aeration	24 Hrs Aeration
Sulfate	85	50	45	25
Bicarbonate	195	171	171	110
Iron, Total	92.10	2.50	2.70	2.50
Barium	---	---	---	---
Manganese	2.20	0.00	2.1	2.1
H2S	1.0	0.5	0	0
CO2	114	30	10	0
COD	1310	1100	150	Below 150
TSS	109	37	34	34
Turbidity (NTU)	137	23	19	15

AES Bacteria Reduction with Dissolved Oxygen

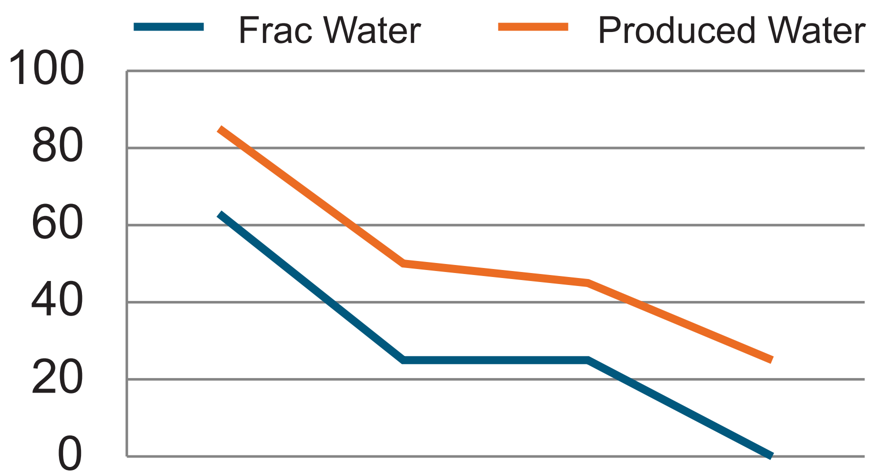
Re-use of flow back and produced water can introduce aerobic and anaerobic bacteria into the wellbore and formation.

Sulfate reducing anaerobic bacteria can cause localized sour gas (H_2S) production and can eventually start souring reservoirs.

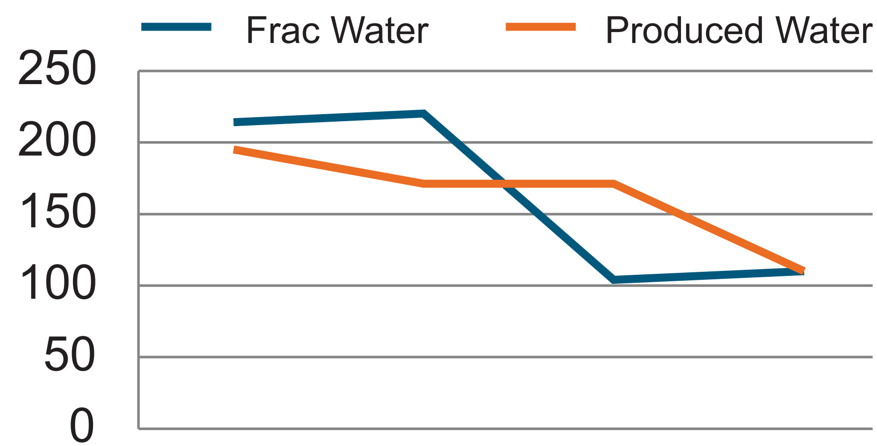
AES systems can wor around the clock imparting dissolved oxygen reducing the need for oxidizers prior to water re-use.

Bicarbonate levels in both frac and produced water are reduced significantly after 24 hours of aeration

Sulfate After 24 Hours



Bicarbonate After 24 Hours

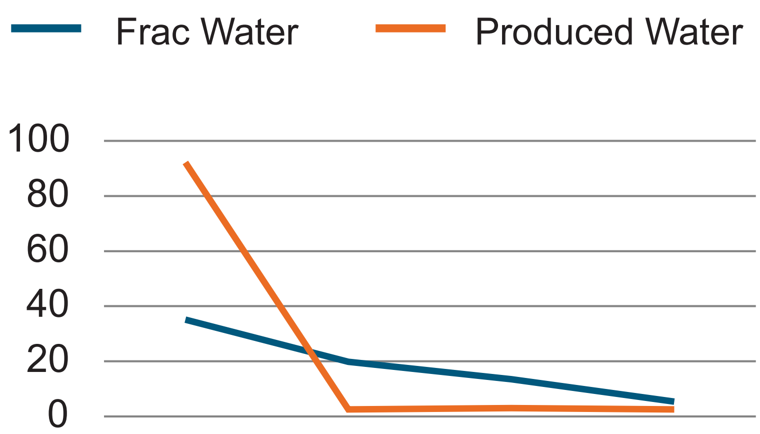


AES Metals Reduction with Dissolved Oxygen

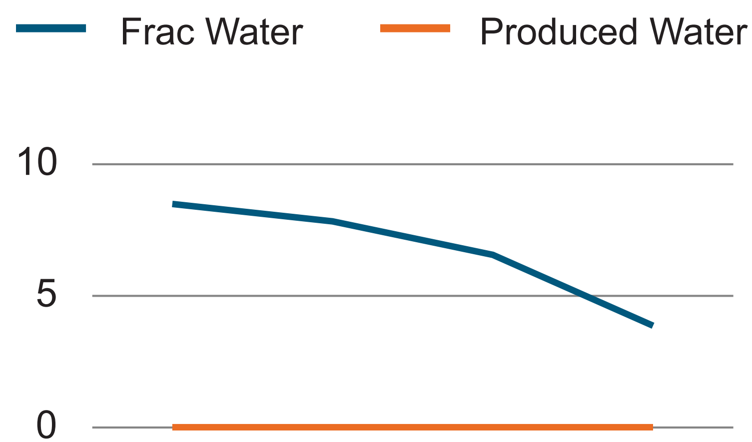
Increasing dissolved oxygen levels converts minerals to higher insoluble oxides causing them to drop to the bottom of the pit as sediment.

Barium levels in frac water showed a significant decrease after 24 hours of aeration. Barium sulfate can create an almost irreversible scale.

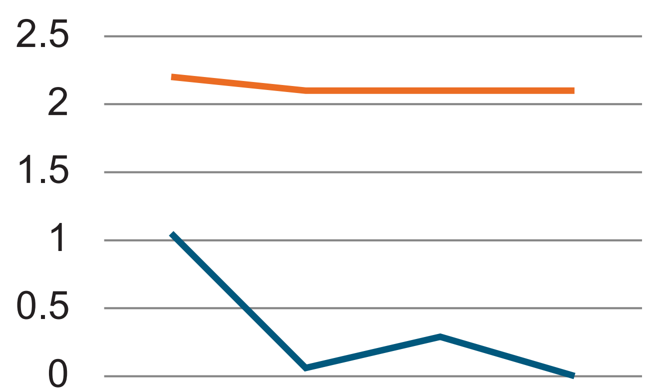
Suspended Iron After 24 Hours



Suspended Barium After 24 Hours



Suspended Manganese After 24 Hours



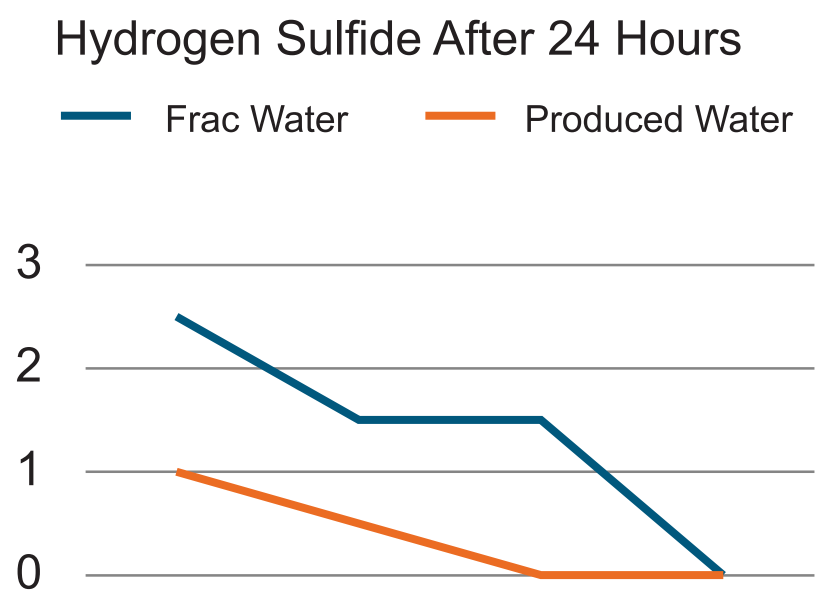
Overall, manganese levels will drop with aeration in the same manner as iron.

AES Hydrogen Sulfide Reduction with Dissolved Oxygen

An anaerobic environment in the formation is conducive to the growth of sulfate reducing bacteria, leading to the production of H_2S.

If organics are not removed, they will decompose using up oxygen and creating byproducts such as ammonia, nitrogen, and soluble phosphates.

Aeration takes away the organic food from the anaerobes and prevents their growth and reproduction. Dissolved oxygen thus provides a non-chemical solution to high H2S.

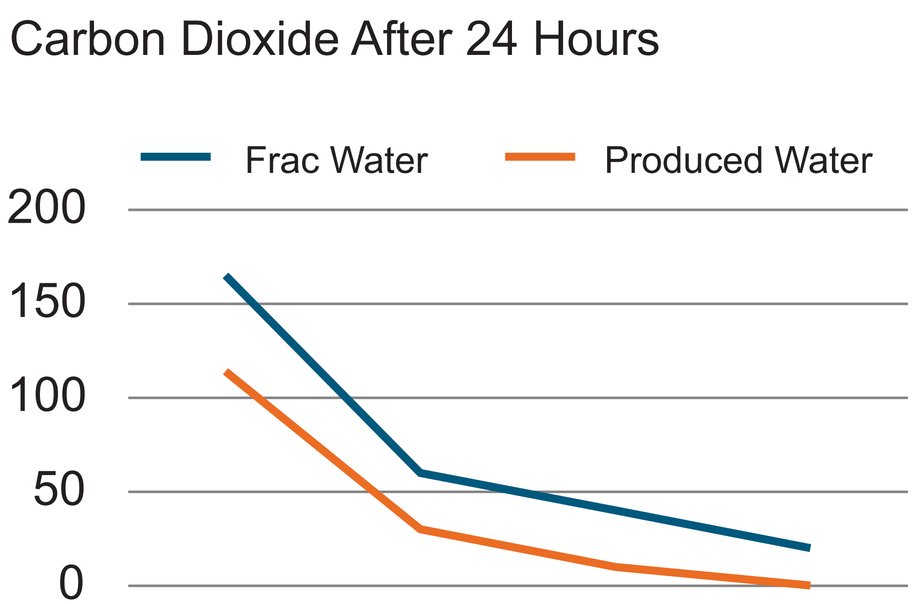


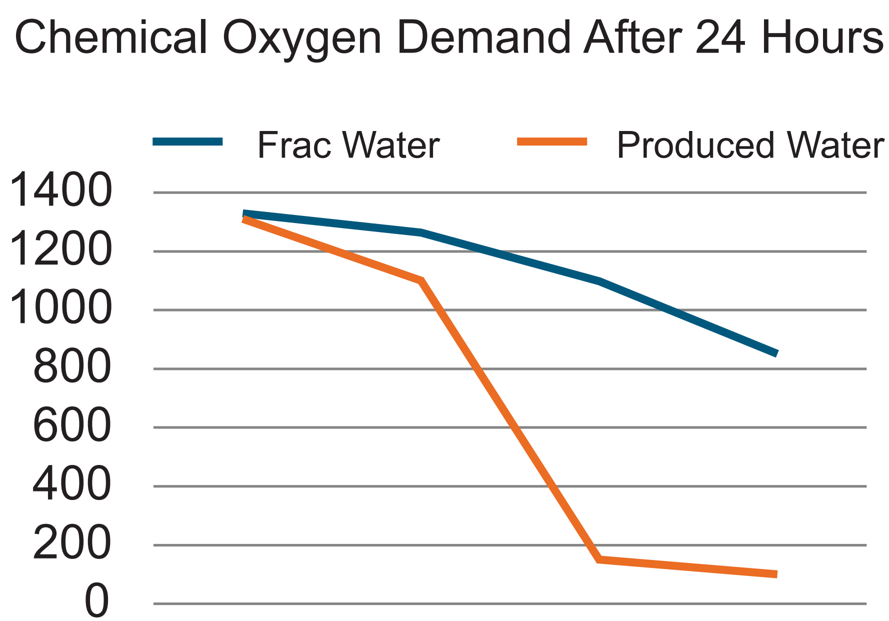
AES Dissolved Gases Mitigation Benefits

Raising O_2 levels stresses existing anaerobic, acid-producing and sulfate-reducing bacteria. Beneficial aerobes will begin to grow and outcompete well-souring APB and SRB anaerobes for nutrients in the water.

COD levels will also be reduced resulting in even better water quality.

The below chart provides a clear picture of the ability of dissolved oxygen to strip CO2 immediately from both frac and produced water.



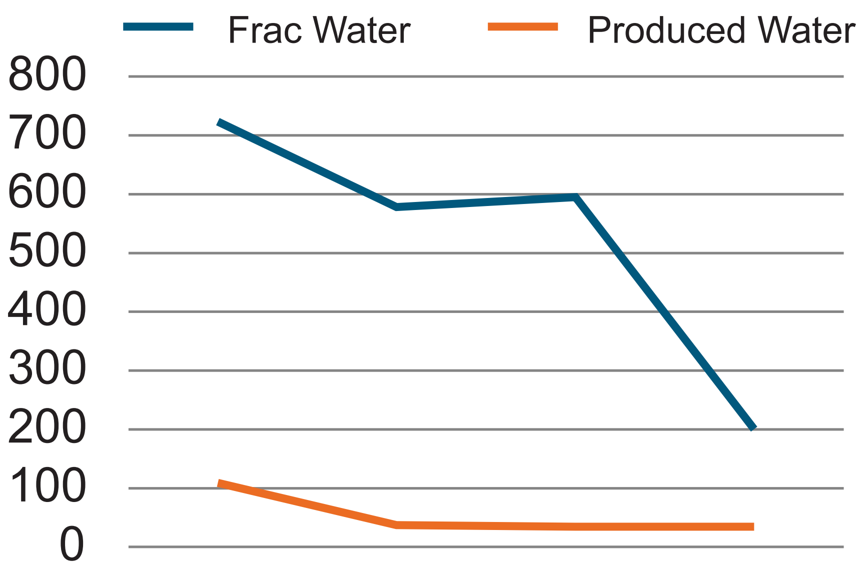


AES Water Quality Benefits

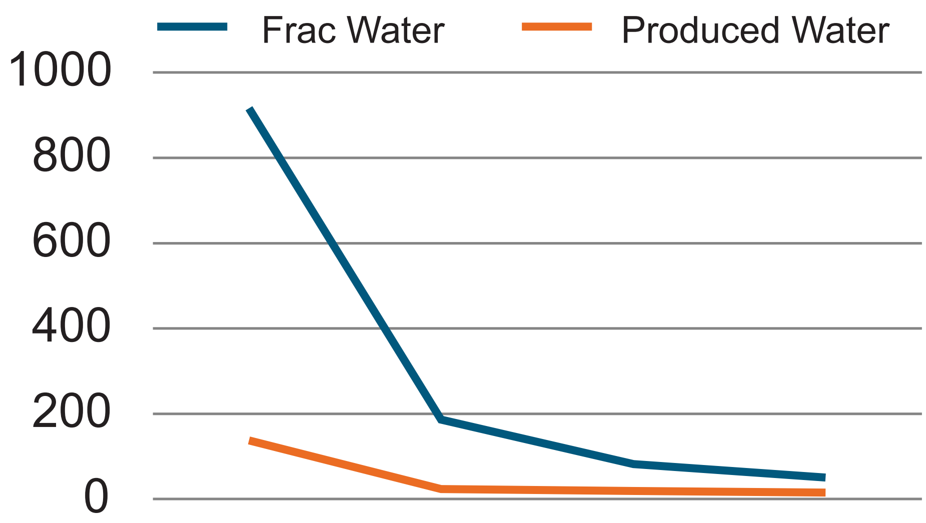
In addition to its other abilities, dissolved oxygen can dramatically reduce TSS in both frac and produced water.

While the benefit of a reduction in turbidity is open to debate, it, nevertheless, gives visual confirmation that dissolved oxygen is having a dramatic impact on both frac and produced water.
A picture shown elsewhere in this presentation shows frac water going from jet black to almost clear after only seven hours of aeration. This visual alone can speak to the worries of a concerned public.

Total Suspended Solids After 24 Hours



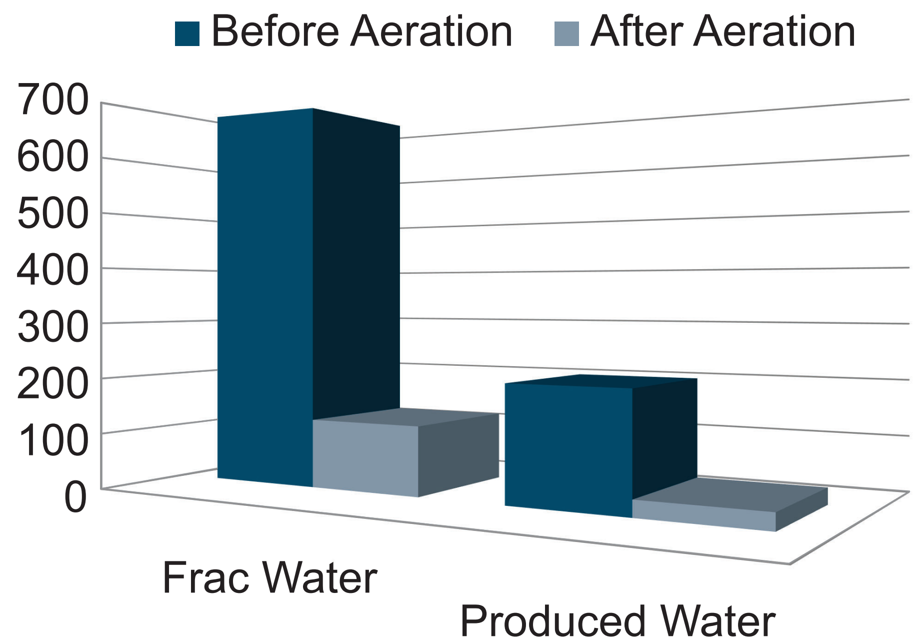
Turbitity (NTU) After 24 Hours



AES Overall Reduction of Contaminants

These graphs show a composite reduction of over 85% in the measured contaminants after only 24 hours of operation in a frac tank.

With adequate contact time the turbine can improve the condition of some very nasty, high-sulfide, solids-loaded frac and produced water. The goal is to treat this water with low-cost dissolved oxygen in preparation for more effective recycling



AES Partial Installation References by Industry

Oil & Gas

New Field Energy Inc., OK **
PureStream Enviro Inc., TX **
QEP Energy Inc., TX ***
Rio Resources Inc., TX **
Rockwater Energy, UT ****
R360 Inc, CO
Danlin Oil Services, OK ****
ExxonMobil, via XTO Subsidiary,
NM Coil Chem, OK*
Continental Oil, TX
Devon Oil and Gas, TX
FDL Operating, TX
FlexChem Inc., OK ********
Linch Environmental, WY

Industrial

Advanced Team USA, MI
Affordable Waste, KY *
Atlantic Industrial Electric, WI
Broadbent, WY
Bunge, IN
Cassella Waste Inc., PA
DRA Global, PA
Equipsa Enterprises, TX
Grupo Acuicola, Mexico
HED Environmental, TX**
Heilae Development, AZ
Jim Green Jr. Co., MI
Lonza, Inc., PA
Mercer Controls, TX
Motion Ind., FL
NRG Energy, PA
Patriot Coal, Canada
Pond Management Inc., TX
PrideChem Inc., Singapore
Rangy Inc, FL
R.S. Gordon, CA
Santo Lubes, SC
Solfuel, CA
Wallbridge Mining Co., CA
WSA Compliance, CA

*Repeat Purchases of Aerators Indicated by: **

Municipal Wastewater

Ambient H2O, Peru
Aquas Latinas, Mexico*********
Austin Armature, TX****
Bell Wastewater Design, WA
Belle Vista, WV
CIAM, Mexico
City of Ash Creek, UT *
City of Biggs, CA *
City of Cordell, TX ***
City of Council, ID
City of Evart, MI **
City of Gunter, TX
City of Hemet, CA
City of Lexington, TX **
City of Norwalk, OH
City of Steward, AK **
City of Weslaco, TX
Corix Wastewater Management, TX*
Don Skaggs, TX
Girl Scouts of Northeast Texas, TX
Idaho Department of Corrections, ID
Johnson Utilities, AZ
Muckerheide, MA
STAT Waste Stream Services, LA
Taversiers Bourbonnais, Canada
Texas Parks and Wildlife, TX
Town of Colebrook, NH
Town of Imboden, AK
Town of Paonia, CO
Town of Thatcher, AZ
Trinity Bay Conservation, TX
Union Parish Police, LA
U.S. Army Corps of Engineers, Kingdom of Jordan and Kingdom of Kuwait
Department of Energy, Washington State *
Department of Transportation, CA
Gypsum, MD
Village of Bolingbrook, IL
Weyerhaeuser, MT

Farm Operations

Conlee Haustein Farm, Canada
Harrison Farms, NC
Martin Farms, MO
Milk Unlimited Dairy, IA
Mosiac Fertilizer, FL
OmniLyte Enviro, Canada ***
Somnio Global, MI
Stahlbush Farms, OR***
Taylor Brother Farms, CA
Valley Beef, CA

Wineries & Breweries

Airfield Estates, WA
BJ Brewery, TX
ClearBlu Inc., CA********
Coors Beer, via Revolver Brewery, TX
Cougar Cleaning, Mexico***
14 Hands Winery, CA
Fextex Systems, Inc., WA
Hall Wines, CA
Parducci Winery, CA
Real Ale Brewery, TX ****
Revolver Brewery, TX ****

Food Processing

Michigan Sugar Company, MI********
Minsa Corporation, TX***
National Frozen Foods, WA
Oakrun Bakery, Canada*
Omega Protein, LA
Pangea Waste Systems, MI
Pepsico, via Kevita Pro-Biotics, CA ***
Aquabest Seafood, FL
Arysta, Canada
Aviana Estebanez, FL
Boar's Head, AR
Cape May Foods, NJ
Dalles Fruit, WA
El Milagro, TX
Enviropure Systems, SC ****
Induaqua S.A.S., Mexico/CA
Kellogg Company, KY
LaMonica Fine Foods, NJ

Aquaculture

Arizona Fish & Game Dept.,
AZ Ekstrom Fish Farm, TX
Farallon Aquaculture, FL
Pacific Corp., WA
S&K Catfish, MS
Shasha Mendoza, FL
Walls Gator Farm, LA

Greenhouse Nurseries

Seville Farms, TX
Sun Nursery Inc., FL**

U.S. Army Corps of Engineers
Kingdom of Jordan and Kingdom of Kuwait

California Department of Transportation

Deli Cheese and Meat

Via Revolver Brewery, Texas

State Corrections

via XTO Subsidiary

U.S. Department of Energy Washington State

Pepsico
Via Kevita Pro-biotic Drinks

Michigan Sugar

U. S. Gypsum