

Introducing a Revolutionary New Turbine Aerator for Frac and Produced Water Remediation



The Turbine Aerator

1. Requires no maintenance.
2. Has no internal moving parts.
3. Will not clog with tumble weeds or most other debris.
4. Aerates by thrusting air into water and not water into air.
5. Can outperform other aerators which have up to seven times the horsepower.
6. Boasts long retention time of dissolved oxygen in the water.
7. Uses only a 3 horse power hazardous duty motor.
8. Employs foam-filled, UV-resistant, polypropylene pontoons guaranteed not to sink.
9. Never needs to be “greased”.
10. Designed to run 24/7.
11. Made of corrosion-resistant materials.
12. Operates at a very low noise level.
13. Requires much less electricity than other aerators.
15. Will not overly stir up bottom sediment.
16. Designed for harsh frac pit environment.



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.
- ❖ Lowers dissolved oxides of minerals and organics, converting them to higher insoluble oxides easily removed by sedimentation.

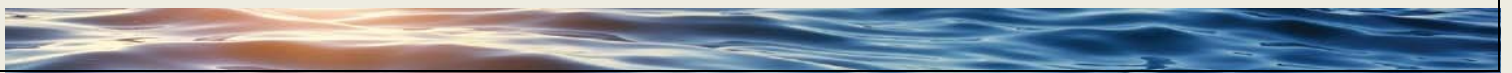


Above Water View



Below Water View

[Click on images to see video](#)



Test Tanks



Field test using the turbine aerators



Installing turbine aerator into a frac tank.

Turbine Technology

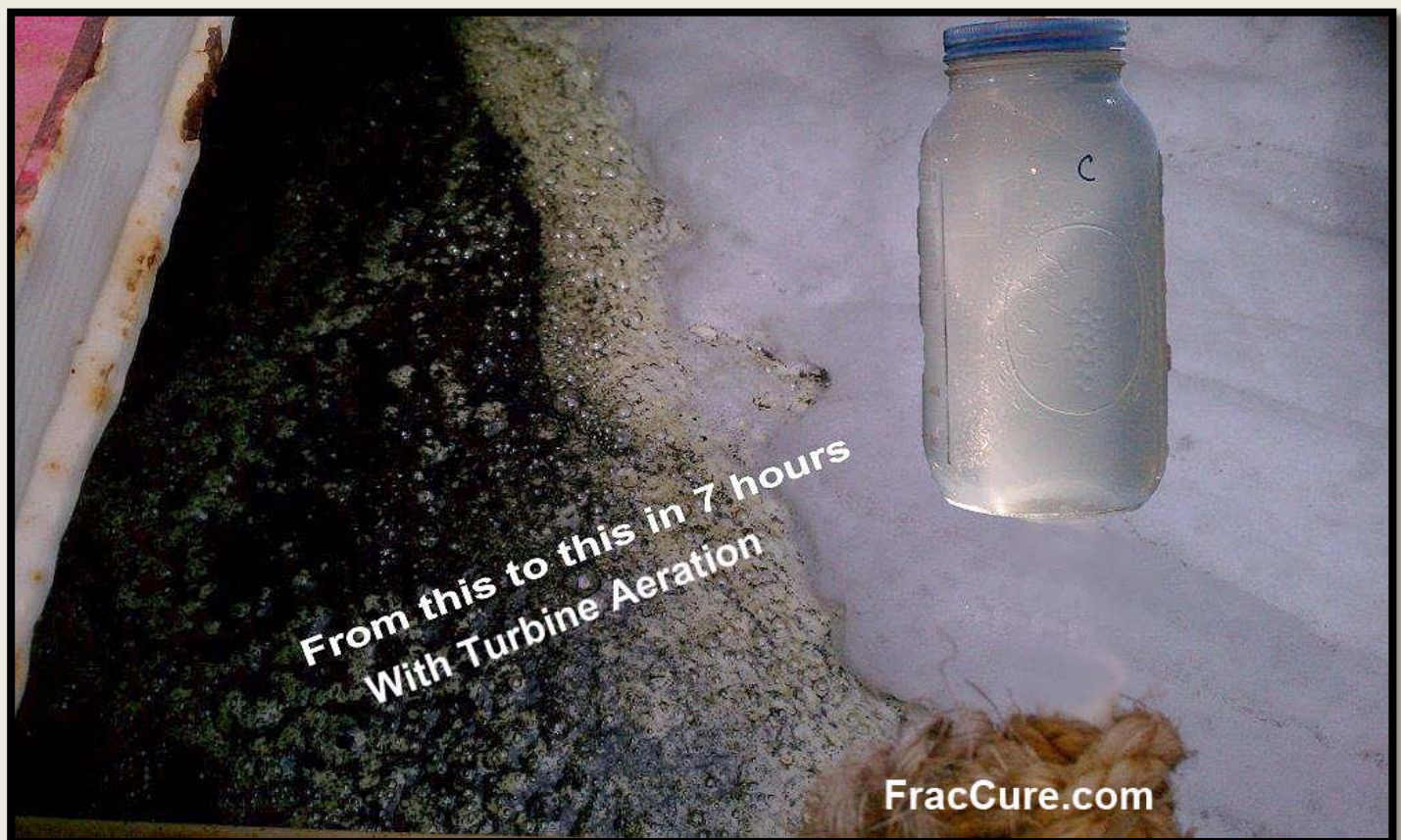


The Turbine Technology was installed in two 20,000 gallon test tanks in Oklahoma. The first tank was flow back frac water, the other was produced water.

In a 24 hour test, the contaminants were greatly reduced. Review the following pages for the test results.

Turbidity

20,000 Gallons Flow Back Frac Water



After Only 7 Hours of Turbine Aeration



Flowback Frac Water mg/l

Target	0	4 hrs.	8 hrs.	24 hrs
Sulfate	63	25	25	0
Bicarbonate	214	220	104	98
Iron, Total	35.10	19.80	13.40	5.30
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	916	186	82	50

Produced Water mg/l

Target	0 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
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
TSS	109	37	34	34
Turbidity	137	23	19	15

**20,000 Gallon Steel
Frac Tank**

**Frac Water &
Produced Water**

*Remediated with High
Intensity Turbine Aeration*

*Summary results from field
tests using the turbine
aerator in frac tanks*



24 Hours of Aeration

Reutilizing flowback and produced water can introduce aerobic and anaerobic bacteria into the wellbore and formation.

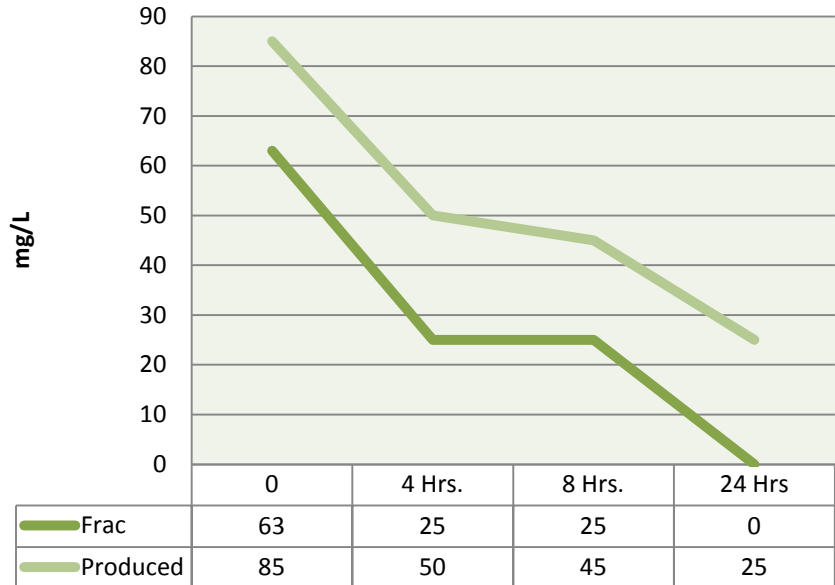
Anaerobic bacteria, like sulfate reducing bacteria, can cause localized sour gas (H₂S) production and can eventually start souring the reservoir.

Dissolved oxygen oxidizes the sulfides to settleable, insoluble sulfates which drop out of suspension.

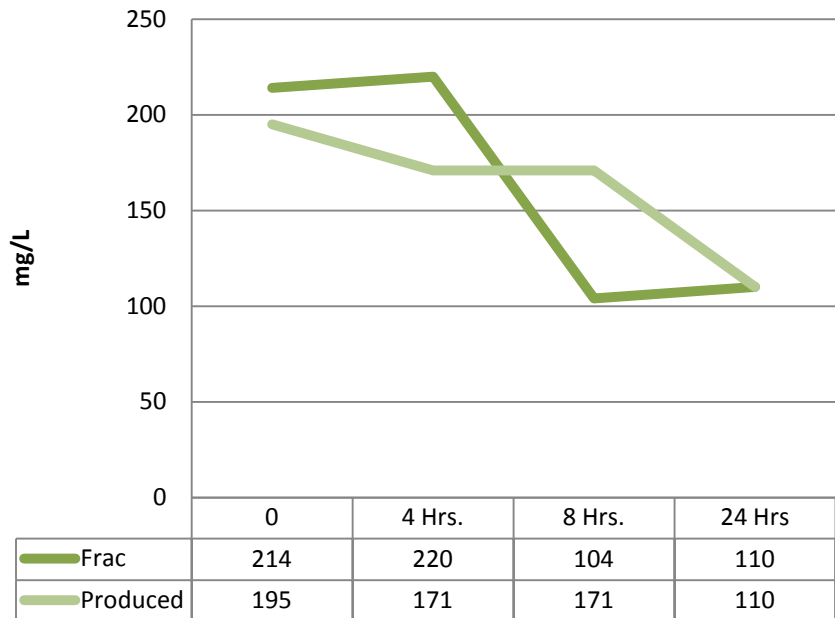
24 Hours of Aeration

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

Sulfate

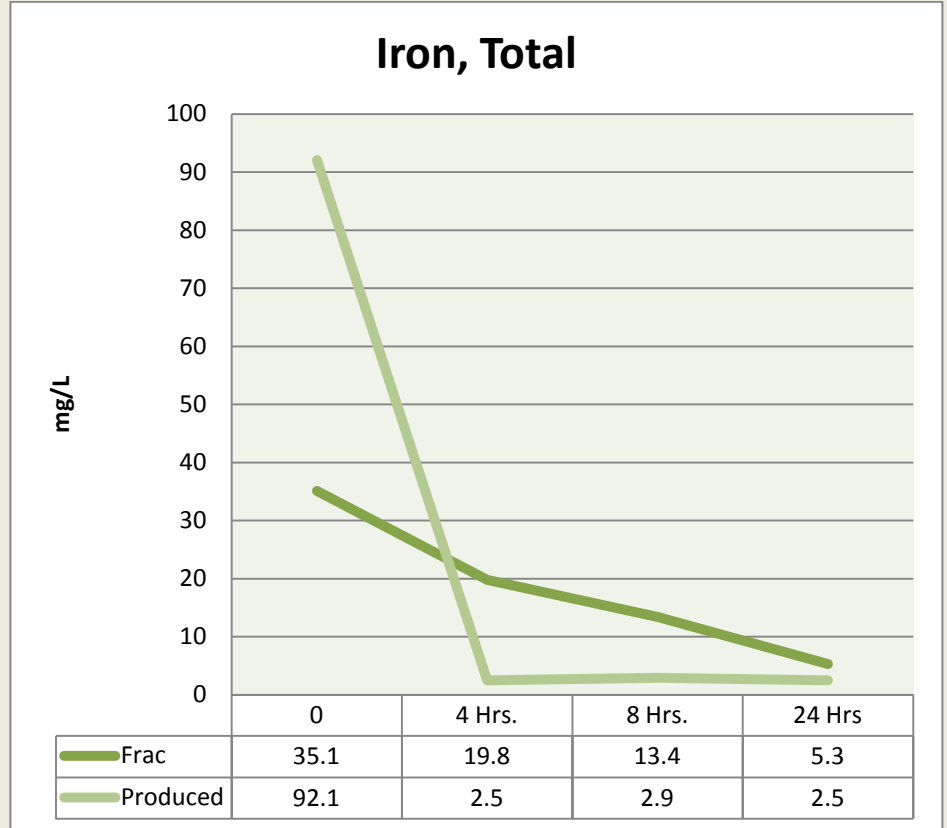


Bicarbonate



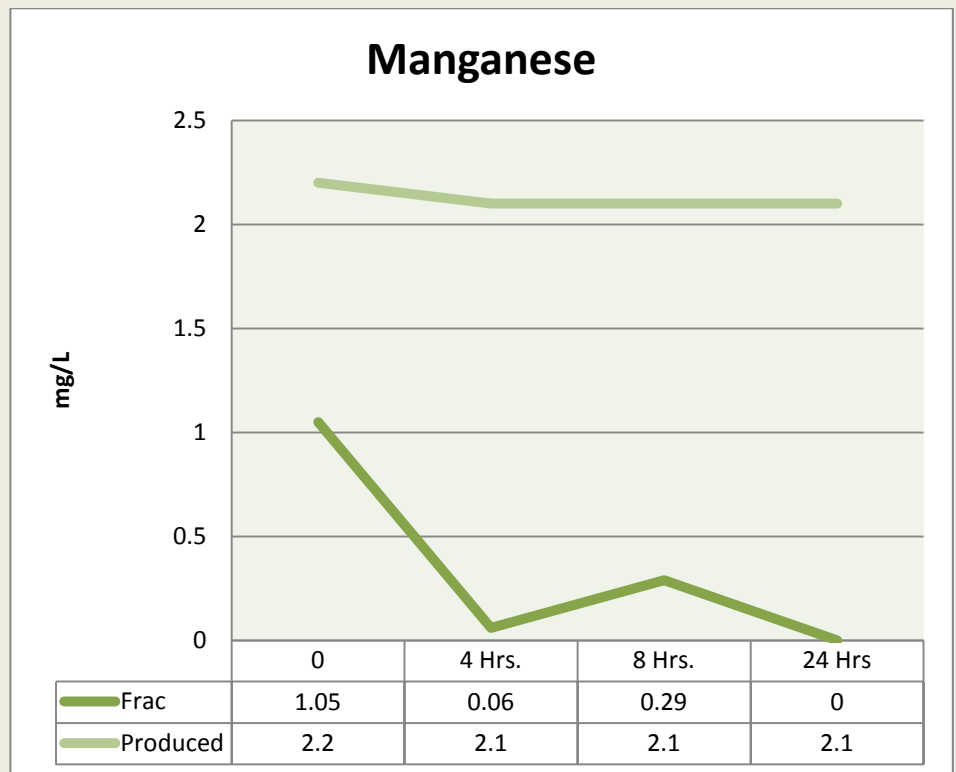
24 Hours of Aeration

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



24 Hours of Aeration

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



24 Hours of Aeration

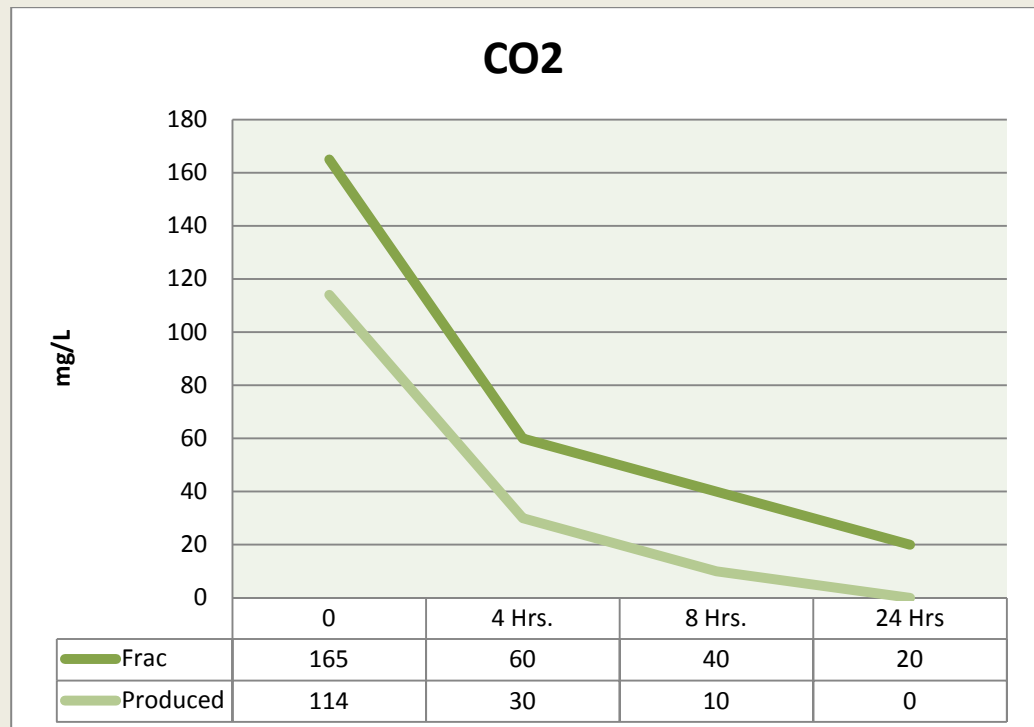
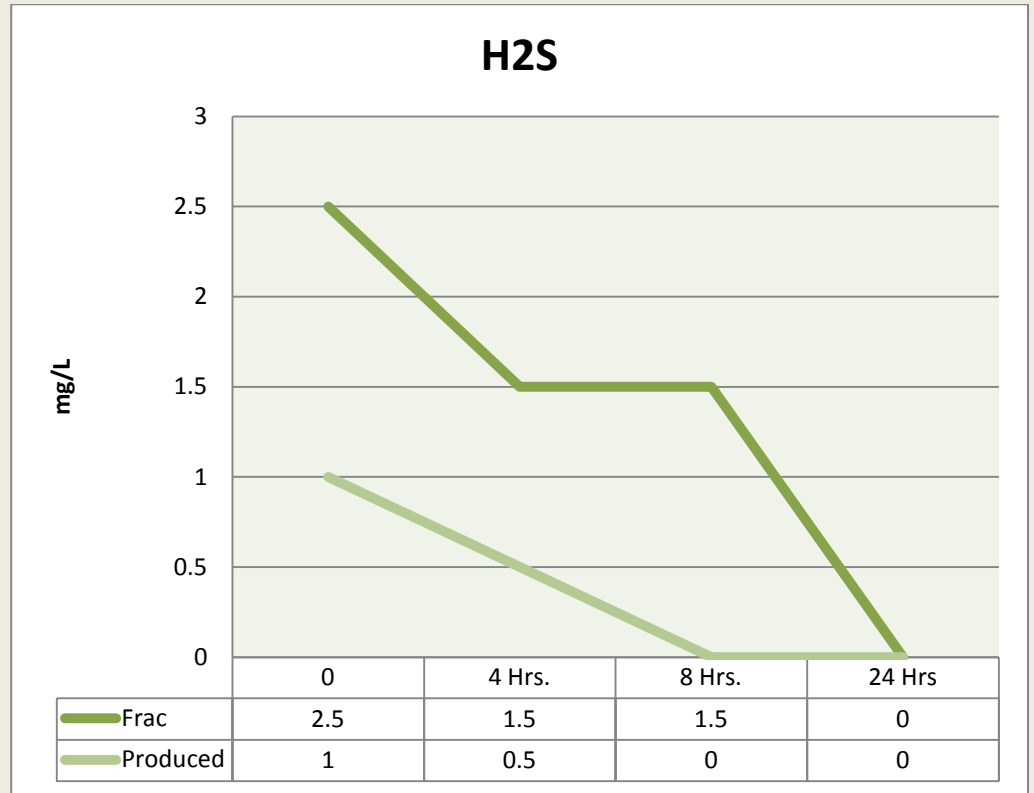
An anaerobic environment in the formation is conducive to the growth of sulfate reducing bacteria, leading to the production of H₂S.

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. Aeration provides a continuous, low cost, non-chemical means for reducing high-H₂S water problems.

24 Hours of Aeration

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



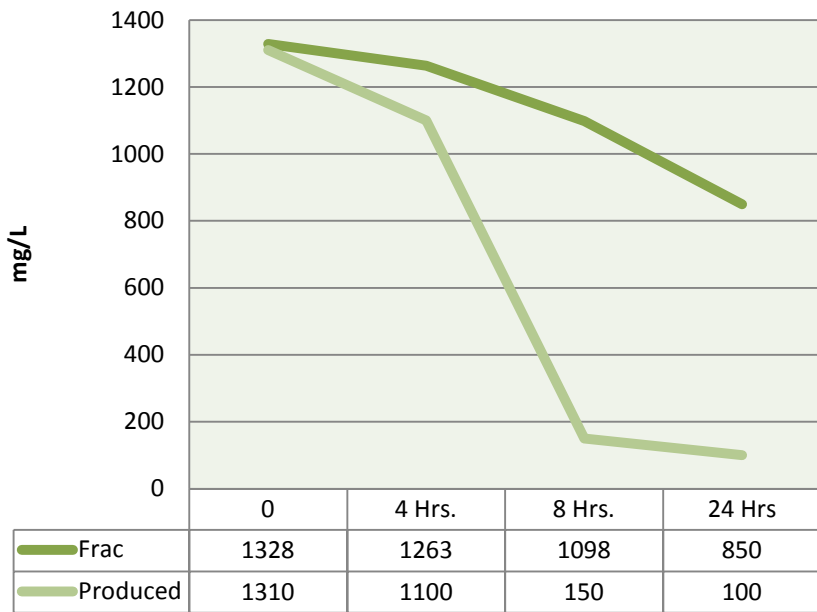
24 Hours of Aeration

Dissolved oxygen promotes the growth of aerobes which quickly consume some of the residues of gels, friction reducers, and hydrocarbons in flowback water which are known to hold solids in suspension and can form emulsions.

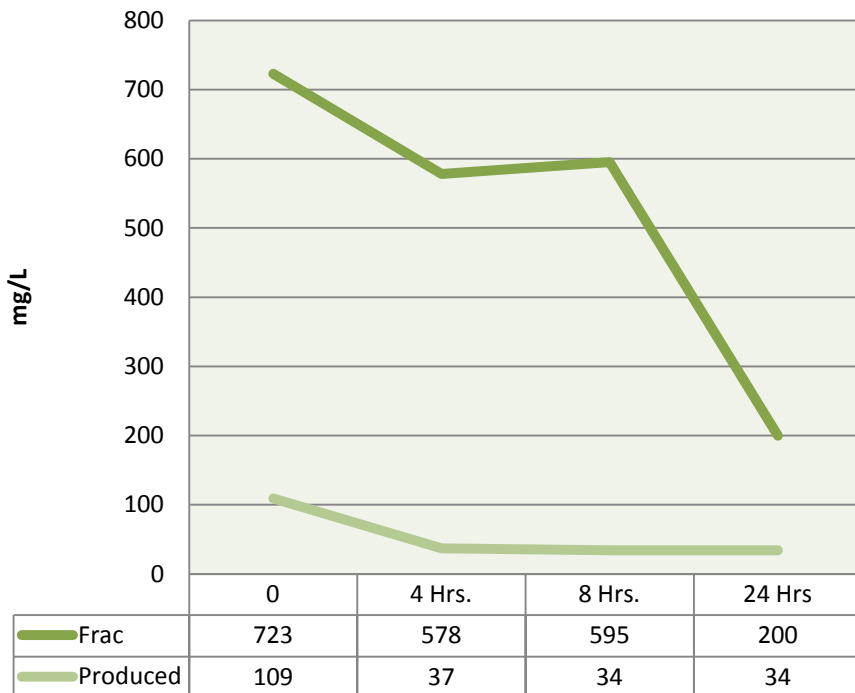
Once nutrients are consumed, the aerobic population collapses requiring fewer biocides for the final kill.

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

COD



TSS



24 Hours of Aeration

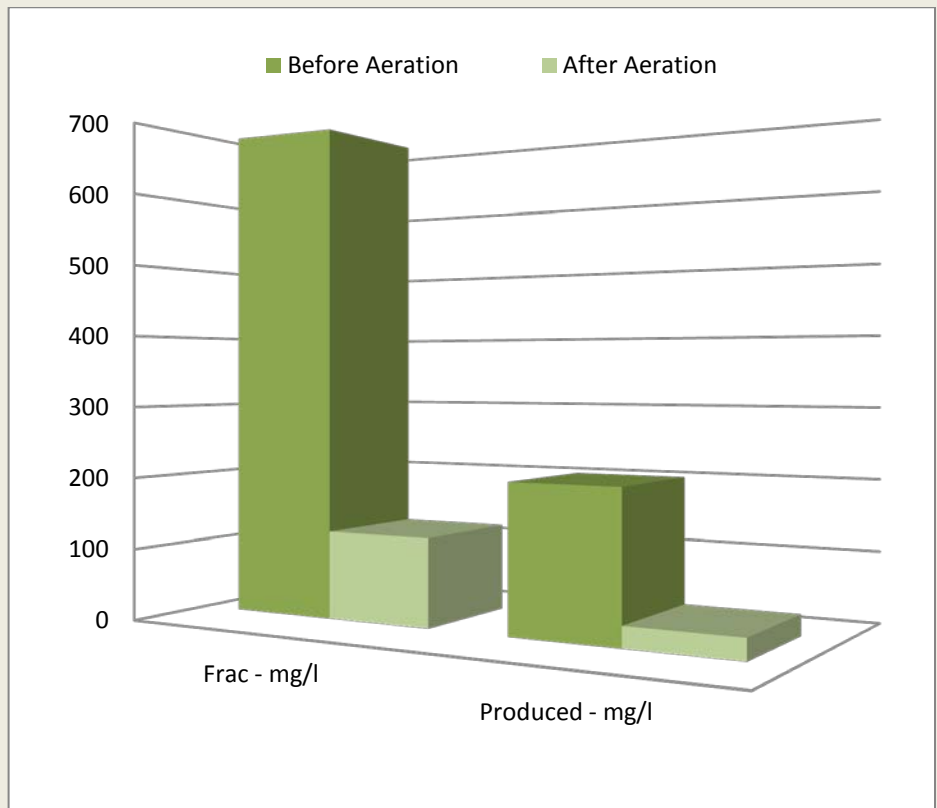
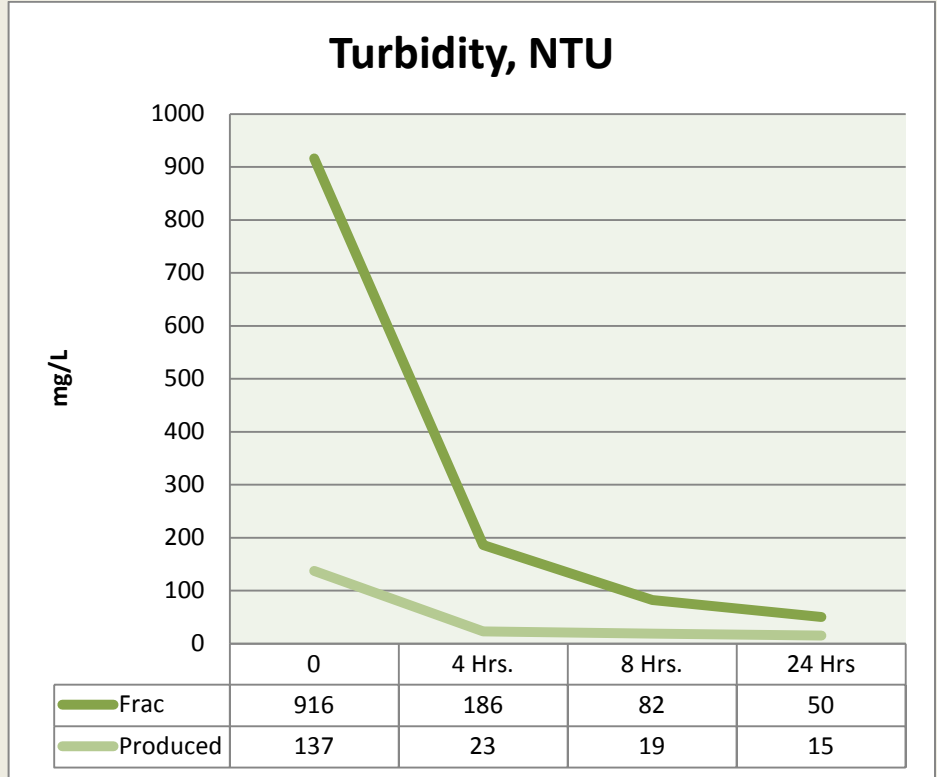
A picture shown elsewhere in this presentation shows frac water going from jet black to almost clear after only seven hours of aeration.

This picture gives visual confirmation of the impact dissolved oxygen can have on water contaminants. The image also speaks to the worries of a concerned public.

24 Hours of Aeration

This composite chart shows the cumulative reduction in all of the contaminants that have been highlighted in this presentation.

Contaminant levels in the test tanks both for frac and produced water showed an overall reduction of about 85% in 24 hours.





Biocide

Water Aeration Can Reduce Biocide Costs

- Recycled water is treated with biocides which mostly kill bacteria by acting as oxidizers.
- The challenge is that these oxidizing biocides, whether chemical or chlorine-based, often react first with debris, soluble iron, manganese, ammonia, and other organics BEFORE they react with bacteria.
- Many of these high-dollar biocides are thus lost as disinfectants in recycled water because they are needlessly consumed as oxidizers of contaminants.
- Aeration reduces the oxidative demand on biocides by oxidizing the reduced organic, mineral, and sulfur compounds in recycled water, thus reducing the amount of the biocides needed.

Frac tank field test showed that aeration can reduce biocide costs by fifty percent or more compared to the costs of non-aerated water.





There is no other aerator in the market today that is better suited for frac water aeration.



The Turbine Aerator will Outlast and Outperform Any Aerator on the Market Today.

Turbine Technology



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