

### **Frac Water Treatment with Bioxy's Aqua Detoxifier**

#### **A Case Study Conducted by Bioxy's Technology Partner 3 Tier Technologies, LLC in Conjunction with Triad Forensics Lab**

##### **Introduction**

Produced water or frac flowback water management is becoming more and more of an issue. While economics have historically favored produced water disposal by deep well injection, now induced seismicity and water conservation concerns are driving operators and their contractors to re-use and recycle produced water. In some cases where produced water is still sent to disposal wells the water is so contaminated, pre-treatment is required to reduce scaling, injection formation damage and corrosion. This study presents the case for the use of Bioxy's Aqua Detoxifier to eliminate some of the problem-causing contaminants.

##### **Trial Structure**

Independent laboratory testing was conducted by 3Tier Technologies and Triad Forensics Lab over a five-day period, using both synthetic and real world frac water matrices, to evaluate the Aqua Detoxifier product (also branded by 3Tier as H2O Restore). To demonstrate that analyte reductions were due to the Aqua Detoxifier product, a frac water matrix of known analytical composition was prepared and tested. A real world sample was collected from an operation in Pennsylvania and synthetic frac was developed by method of Hayes (Hayes et al 2009).

The over all testing process involved five samples with sub samples taken and analyzed every 24 hrs over a five day test period. Primary challenges tested were sodium, electrical conductivity (EC), total suspended solids (TSS), metals, and toxicity.

##### **Trial Observations**

A definite improvement in frac water quality was observed for samples treated with Aqua Detoxifier when compared to an untreated sample over the same 5-day test period. ICP-MS and chromatography tests were conducted to measure the level of various metals. Reductions for all metal analytes were observed as early as day one. It is clear that Aqua Detoxifier is not merely precipitating metals out of solution. Rather than precipitation, which increases solution's total suspended solids, Aqua Detoxifier acts as a sequestering agent, enveloping and holding harmful metal ions in a stable and soluble complex. By acting as a chelating agent, Aqua Detoxifier detoxifies poisonous metal agents by converting them to their chemically inert form. Therefore metals chelated by Aqua Detoxifier are converted to a biochemically inert form, at least from a toxicological standpoint. Naturally derived metal complexes are bound in some form of a chelae ring by humic acid or a protein. Virtually all biochemicals exhibit metal cation dissolution capabilities. Many affect

solution pH to precipitated metals complexes. However, these metal salts are problematic in that they form scale deposits and are reactive. In an industry application, scale is a significant problem for machinery equipped with moving parts. Thus, by utilizing a treatment such as Aqua Detoxifier, scale formation is avoided altogether. Both the real-world and simulated water treatment with Aqua Detoxifier delivered reductions in all analytes studied. It was further noted that water treated by Aqua Detoxifier has significantly less visual turbidity within the water column. This is an added benefit for flow-back water recycling because contaminants such as TSS and metal salts can be pumped from holding tanks without centrifugation when tanks are treated with Aqua Detoxifier. The benefits of using the Aqua Detoxifier product include rapid water column clearing, reduced total suspended solids, scale minimization and inhibition, as well as reductions in metal and mineral salts.

### Trial Results

Water Quality in Simulated Frac Water Matrix Pre- and Post-treatment

MB= Matrix Blank (no product added)

AD = Aqua Detoxifier added

Product Treatment Applied	Sample ID	Treatment Time Elapsed(hrs)	Temp (F)	PH	Conductivity	TSS (mg/L calculated)
MB	Sam C	0	71	8.4	>300,000	160000
MB	Sam C	24	71	8.6	>300,000	159020
MB	Sam C	48	71	7.9	>300,000	159879
MB	Sam C	72	71	7.9	>300,000	159985
MB	Sam C	96	71	7.9	>300,000	160000
MB	Sam C	120	71	7.9	>300,000	159989
AD	WB A	0	71	7.1	280,000	158000
AD	WB A	24	71	6.3	140,000	130000
AD	WB A	48	71	6.3	80,000	124000
AD	WB A	72	71	6.3	54,000	123500
AD	WB A	96	71	6.3	42,000	123000
AD	WB A	120	71	6.3	40,000	123000

## Water Quality in Real-World Pennsylvania Frac Water Matrix Pre- and Post-treatment Using Aqua Detoxifier Product

MB= Matrix Blank (no product added)

AD=Aqua Detoxifier added

Product Treatment Applied	Sample ID	Treatment Time Elapsed(hrs)	Temp (F)	PH	Conductivity	TSS (mg/L calculated)
MB	Sam C	0	71	7.9	280000	2800
MB	Sam C	24	71	7.9	280000	2800
MB	Sam C	48	71	7.9	280000	2800
MB	Sam C	72	71	7.9	280000	2800
MB	Sam C	96	71	7.9	280000	2800
MB	Sam C	120	71	7.9	280000	2800
AD	WB A	0	71	7.9	280000	2800
AD	WB A	24	71	7.4	140000	600
AD	WB A	48	71	7.4	60000	500
AD	WB A	72	71	7.2	26000	430
AD	WB A	96	71	7.2	12000	430
AD	WB A	120	71	7.2	2000	410

### Conclusions

Treatment of both the synthetic frac water and the real-world frac water resulted in significant reductions in chlorides, electrical conductivity, total suspended solids and heavy metals.

#### Reductions in Synthetic Frac Fluid after 5 days

Chloride: From 35,450 to 17.3 or a reduction of **86%**

Electrical Conductivity (EC): 280,000 to 40,000 or a reduction of **86%**

Total Suspended Solids (TSS): From 158,000 to 123,000 or a reduction of **22%**

23 Heavy Metals: Average reduction for metals was **22.5%**

#### Reductions in Pennsylvania Frac Fluid after 5 days

Chloride: From 72,000 to 55,618 or reduction of **24.3%**

Electrical Conductivity (EC): 280,000 to 2000 or a reduction of **99.3%**

Total Suspended Solids (TSS): From 2800 to 410 or a reduction of **85%**

23 Heavy Metals: Average reduction for all metals was **32.6%**

The Triad Forensics Lab report and follow-on field trials conducted by 3Tier are attached in their entirety. For more information, please visit our website at [www.bioxyresearch.com](http://www.bioxyresearch.com), call us at 855-55-BIOXY, or email us at [info@bioxyresearch.com](mailto:info@bioxyresearch.com).