

**AguaRaider, LLC
Direct Evaporation Technology
Wastewater Pretreatment Module
'Clean Brine' Production**

Introduction

AguaRaider, LLC will integrate wastewater pretreatment module (WPM) into the AguaRaider Direct Evaporation Technology Unit (ARU) for pretreatment of wastewater to be the influent into the ARU. The WPM is intended to reduce the concentrations of total suspended solids, hydrocarbons, organics, inorganics, metals and total dissolved solids from the wastewater to be disposed of in the ARU. The purpose of the WPM is two-fold; (1) reduce the organics in the wastewater to reduce the total VOCs in the evaporated water (steam); (2) reduce hydrocarbons, metals and dissolved solids to improve evaporation efficiency and reduce fouling & deposition in the brine concentrate section of the ARU.

Wastewater Pretreatment Module (WPM)

The WPM process uses no chemicals, with the exception of potentially pH adjustment to achieve the results for pretreating the source wastewater to the ARU. The only waste stream is from the filtration section in the range of a few % of the total flow. The waste stream from the filtration section would be recycled to the source wastewater storage tank or with the brine concentrate stream from the ARU for disposal.

The WPM is comprised of (1) advanced oxidation section and (2) filtration section in a proprietary and patent pending process. The advanced oxidation section is the primary 'reaction' section for the WPM. The filtration section removes the resulting particulate from the treatment stream. The combined process may result in the reduction values below.

ARU Influent from WPM

WPM will pretreat the source wastewater to the ARU. The WPM unit, as configured will process approximately 2,000, +/- 400 barrels per day (BPD) effluent, thus providing an influent to the ARU of as much as 2,400 BPD. The volume per day of water treated and the subsequent waste stream volume will be dependent on the quality, predominantly total dissolved solids (TDS), organics, inorganics and other physical/chemical parameters of the source wastewater. The system will significantly reduce the % concentrations of parameters in produced water or flowback generated by the oil & gas producers and industrial wastewaters.

| | |
|---|----------------|
| % Reduction of Organics | as much as 90% |
| % Reduction of Metals | as much as 50% |
| % Reduction of Hardness | as much as 50% |
| % Reduction of Oil & Grease (HEM) | as much as 90% |
| % Reduction of Total Suspended Solids (TSS) | as much as 90% |
| % Reduction of Total Dissolved Solids (TDS) | as much as 50% |

Each water source will present a differing set of values that can be attained. The above values will cover a much broader spectrum of sources from different basins/ shale plays. These values above would vary based on each source water, side effect of pretreatment for that source and the individual characteristics of the source.

Greater % Evaporation Efficiency with WPM

The ARU's % evaporation efficiency without pretreatment is limited on source wastewaters with high TDS. Integration of the WPM could increase the % evaporation efficiency by 50% or greater. The improved quality of the wastewater to the ARU will reduce the potential for fouling and deposition. The reduce metals in the wastewater to the ARU could alter the character of the deposition making it easier to 'sweep' the concentrated brine liquid solution in the brine concentrate section of the ARU. The reduced organic concentrations (both volatile and semi-volatile) could result in significantly lower stack emissions for environmental compliance.

'Clean Brine' Production

The concentrated brine liquid solution can be used as 'Clean Brine'. 'Clean Brine' is used during the oil or gas well drilling and fracking operations. The quality of the 'clean brine' needs to be low suspended solids, low metals, low hardness and high dissolved solids (primarily sodium and chlorides). The AguaRaider Evaporation Technology in concert with the Wastewater Pretreatment Module can produce 'Clean Brine' as a by-produce of the evaporation process. Depending on the TDS of the produced water, AguaRaider and produce the #10 Brine ('Clean Brine'). **Please note Appendix A** for a representative West Texas produced water treated with the AR Wastewater Treatment Module. The lists are parameter analytical results for the produced water Pre (prior to treatment) and Post (after the treatment). This sample's source concentration of total dissolved solids (TDS) is 99,900 mg/L. After treatment, the Post water sample contained 50,400 mg/L TDS, with the resulting TDS reduction of 49.5%. The predominate anion and cation remaining TDS are Chloride (Cl⁻) and Sodium (Na⁺). The Post results 97% reduction of Volatile Organic Compounds (VOCs) and 97% reduction of Semi-Volatile Organic Compounds. The organics will be contained in the evaporated water/steam and drafted to the atmosphere at significantly reduced concentrations. Concentrations well below the state air emissions standard limits, even in the most stringent states standards. Note Appendix A for additional parameter results with the AR/WPM.

The potential volume of 'Clean Brine' produced is directly related to the % evaporation efficiency of the ARU. If the ARU influent is 100,000 ppm of TDS, 2,400 BPD and 50% evaporation efficiency, 1,200 barrels per day of water will be evaporated as steam. The remaining 1,200 barrels per day will be the 'Clean Brine' with 200,000 ppm TDS concentration in the brine, equating to 20# Clean Brine. Adjusting the % evaporation efficiency will produce more or less volume of 'Clean Brine'.

Summary

AguaRaider, LLC offers a sustainable solution to reduce the volumes of E&P wastewaters and produce a reusable, beneficial 'Clean Brine' for E&P operations. Integration of the Wastewater Pretreatment Module adds significant potential for the AguaRaider Direct Evaporation Technology to successfully and efficiently dispose of wastewater with high total dissolved solids, produce a high quality 'Clean Brine' and expand the technology's application in the shale basins in the U.S. The Wastewater Pretreatment Module operational configuration can deal with wastewater quality that could vary from the source or sources, with the WPM's system proprietary and patent pending process control configuration.



AguaRaider's ARU, with the WPM, can produce a 'Clean Brine' used by the O&G E&P Producers in the drilling and fracking of oil and gas wells. The 'Clean Brine' will have very low suspended solids, very low metals concentration, very low organics and high salt concentration. Depending on TDS of the source water, the 'Clean Brine' weight would be in excess of 10# brine. The jar of liquid to the far right would be the treated wastewater (Post) from which water would be extracted (evaporated) resulting in high TDS 'Clean Brine'.

Appendix A

**AguaRaider (E&P West Texas {Produced Water} Test
Pre / Post Wastewater Pretreatment Module (WPM)
'Clean Brine' Projected Quality**



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AguaRaider (E&P West Texas Produced Water) Test (Pre/Post Wastewater Pretreatment Module)
'Clean Brine' Projected Quality

Method: 8260B - Volatile Organic Compounds (GC/MS)

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|------------------------|------|------------|-------------|-------|
| 1,2,4-Trimethylbenzene | ug/L | 103 | ND | 0.170 |
| 1,3,5-Trimethylbenzene | ug/L | 39.3 | ND | 0.170 |
| 2-Butanone (MEK) | ug/L | 127 | 12.5 | 2.64 |
| 4-Isopropyltoluene | ug/L | 7.80 | ND | 0.170 |
| Acetone | ug/L | 2070 | 719 | 2.66 |
| Benzene | ug/L | 1590 | ND | 0.200 |
| Carbon disulfide | ug/L | 0.512 | ND | 0.220 |
| Cyclohexane | ug/L | 1400 | ND | 0.130 |
| Ethylbenzene | ug/L | 62.3 | ND | 0.190 |
| Isopropylbenzene | ug/L | 13.7 | ND | 0.330 |
| m,p-Xylene | ug/L | 238.00 | ND | 0.38 |
| Methylcyclohexane | ug/L | 3290 | ND | 0.09 |
| o-Xylene | ug/L | 106.00 | ND | 0.2 |
| sec-Butylbenzene | ug/L | 7.98 | ND | 0.17 |
| Toluene | ug/L | 1220.0 | ND | 0.17 |
| Xylenes, Total | ug/L | 344.00 | ND | 0.58 |

% Reduction

| |
|--------|
| 99.8% |
| 99.6% |
| 97.9% |
| 97.8% |
| 99.9% |
| 100.0% |
| 57.0% |
| 100.0% |
| 99.7% |
| 97.6% |
| 99.8% |
| 100.0% |
| 99.8% |
| 97.9% |
| 100.0% |
| 99.8% |

Average 96.7%

Conc in Clean Brine
Based on 50% Evaporation Eff

Organics will remain in the steam out the AguaRadier Evaporation Unit Stack

Method: 8270D - Semivolatile Organic Compounds (GC/MS)

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|---------------------|------|------------|-------------|-------|
| 2-Methylnaphthalene | ug/L | 29.60 | ND | 0.302 |
| 3 & 4 Methylphenol | ug/L | 93.60 | ND | 3.23 |
| Naphthalene | ug/L | 9.25 | ND | 0.386 |
| Phenanthrene | ug/L | 5.08 | ND | 0.333 |
| Phenol | ug/L | 94.50 | ND | 3.35 |

% Reduction

| |
|-------|
| 99.0% |
| 96.5% |
| 95.8% |
| 93.4% |
| 96.5% |

Average 96.3%

Conc in Clean Brine
Based on 50% Evaporation Eff

Organics will remain in the steam out the AguaRadier Evaporation Unit Stack

AguaRaider (E&P West Texas Produced Water) Test (Pre/Post Wastewater Pretreatment Module)

'Clean Brine' Projected Quality

Method: 8015B - Nonhalogenated Organic Compounds - Direct Injection (GC)

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|----------|------|------------|-------------|-------|
| Methanol | mg/L | 6.74 | ND | 4.000 |

% Reduction

40.7%

Conc in Clean Brine
Based on 50% Evaporation Eff

<8.0 mg/L

Method: 300.0 - Anions, Ion Chromatography

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|----------|------|------------|-------------|-------|
| Bromide | mg/L | 525 | 242 | 10 |
| Chloride | mg/L | 61,000 | 30,400 | 1,400 |
| Sulfate | mg/L | 311.0 | 147.0 | 12 |

% Reduction

53.9%

50.2%

52.7%

Conc in Clean Brine
Based on 50% Evaporation Eff

484 mg/L
60,800 mg/L
294 mg/L

Average

52.3%

Method: 200.7 Rev 4.4 - Metals (ICP)

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|-----------|------|------------|-------------|-------|
| Barium | mg/L | 2.63 | 1.88 | 0.025 |
| Boron | mg/L | 36.9 | 15.60 | 0.02 |
| Calcium | mg/L | 1490 | 658 | 0.5 |
| Iron | mg/L | 67.4 | 0.275 | 0.05 |
| Lead | mg/L | 0.0355 | 0.0100 | 0.01 |
| Lithium | mg/L | 33.6 | 15.60 | 0.02 |
| Magnesium | mg/L | 207 | 95.40 | 0.25 |
| Manganese | mg/L | 2.18 | 1.8100 | 0.025 |
| Potassium | mg/L | 565 | 255 | 2.5 |
| Sodium | mg/L | 36,400 | 16,300 | 20 |
| Strontium | mg/L | 486 | 248 | 0.3 |

% Reduction

28.5%

57.7%

55.8%

99.6%

71.8%

53.6%

53.9%

17.0%

54.9%

55.2%

49.0%

Conc in Clean Brine
Based on 50% Evaporation Eff

3.76 mg/L
31.2 mg/L
1316 mg/L
0.55 mg/L
0.02 mg/L
31.2 mg/L
190.8 mg/L
3.62 mg/L
510 mg/L
32,600 mg/L
496 mg/L

Average

54.3%

Method: 200.7 Rev 4.4 - Metals (ICP) - Dissolved

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|-----------------|------|------------|-------------|--------|
| Iron, Dissolved | mg/L | 52.0 | 0.264 | 0.0500 |

% Reduction

99.5%

Conc in Clean Brine
Based on 50% Evaporation Eff

0.528 mg/L

Method: SM 2340B - Total Hardness (as CaCO3) by calculation

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|-------------------------------|------|------------|-------------|------|
| Hardness as calcium carbonate | mg/L | 4,570 | 2,040 | 5.00 |

% Reduction

55.4%

Conc in Clean Brine
Based on 50% Evaporation Eff

4,080 mg/L

AguaRaider (E&P West Texas Produced Water) Test (Pre/Post Wastewater Pretreatment Module)

'Clean Brine' Projected Quality

General Chemistry

| Analyte | Unit | Pre-Result | Post-Result | MDL |
|------------------------|----------|------------|-------------|--------|
| Specific Conductance | umhos/cm | 137 | 73.7 | 10.0 |
| HEM (Oil & Grease) | mg/L | 68.9 | ND | 1.27 |
| Acidity as CaCO3 | mg/L | 338 | 79.7 | 10.0 |
| Alkalinity | mg/L | 353 | 192 | 5.00 |
| Total Dissolved Solids | mg/L | 99,900 | 50,400 | 700 |
| Total Suspended Solids | mg/L | 143 | 9.80 | 0.700 |
| Ph | SU | 6.5 | 7.200 | 0.100 |
| Ammonia (as N) | mg/L | 210 | 120 | 1.20 |
| Chemical Oxygen Demand | mg/L | 2,110 | 438 | 40.0 |
| Nitrite as N | mg/L | 0.0800 | ND | 0.0400 |

| % Reduction | Conc in Clean Brine Based on 50% Evaporation Eff | |
|-------------|---|------|
| 46.2% | | |
| 98.2% | 2.54 | mg/L |
| 76.4% | 159.4 | mg/L |
| 45.6% | 384 | mg/L |
| 49.5% | 100,800 | mg/L |
| 93.1% | 19.6 | mg/L |
| 42.9% | 240 | mg/L |
| 79.2% | 876 | mg/L |
| 50.0% | 0.8 | mg/L |