



# Athena Global Energy Solutions

ELECTROCOAGULATION – VARIABLE ELECTRO PRECIPITATOR (VEP)

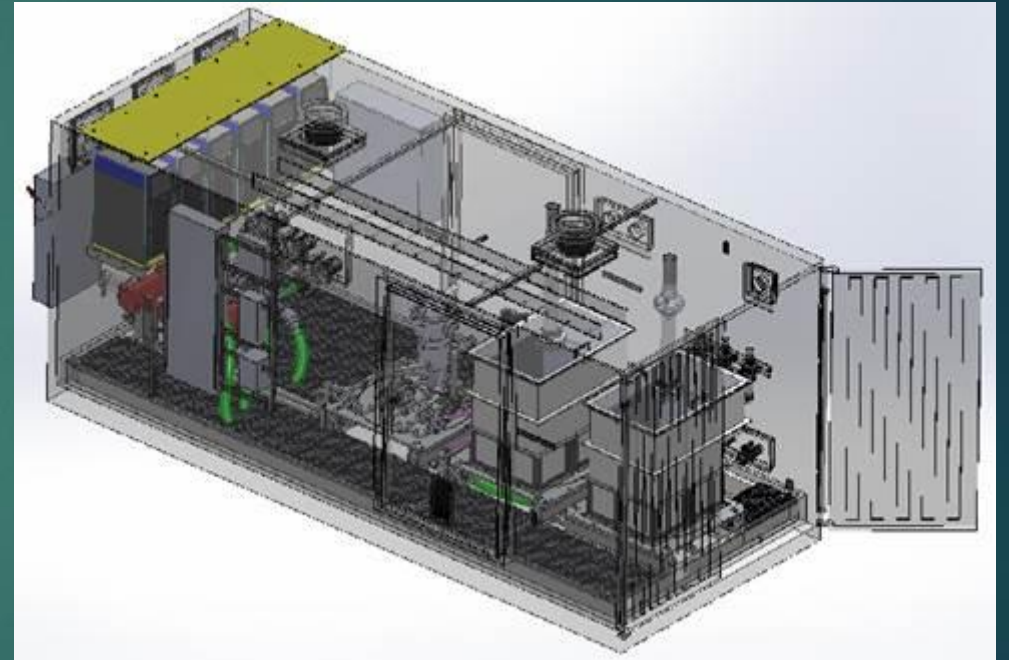
**2014**

# Commercial Equipment Footprint

Outside View



inside View

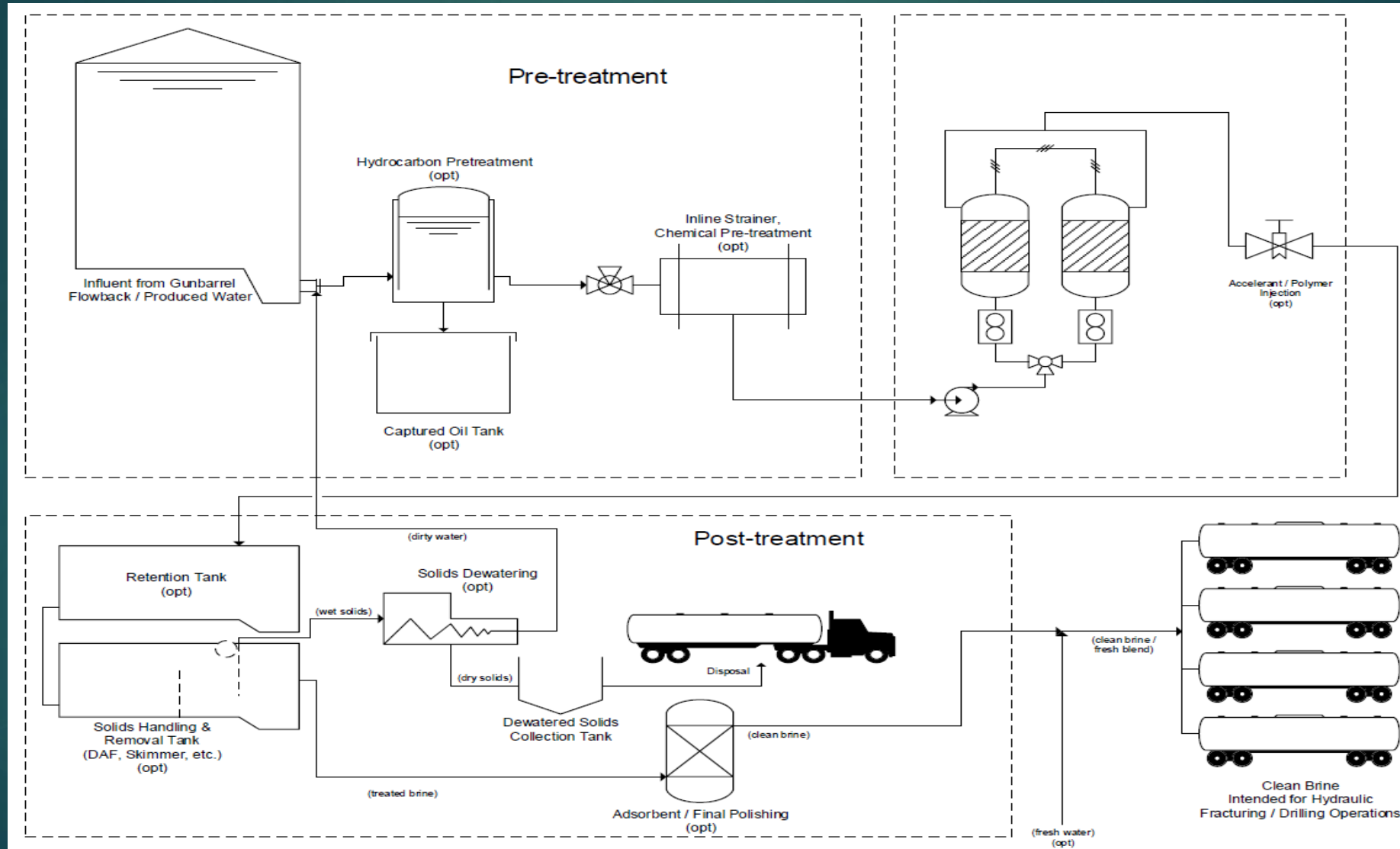


# Commercial Equipment

Flowrates from 2 GPM to 1,000,000 GPM per day



# Flow chart (configuration)





# Produced Water Treatment

## Produced Water Treatment Explained

Before disposal or proper reuse of produced water, it's required to remove the contaminants present in the water. Some of these substance are naturally occurring radioactive materials (NORMs), oil, greases, sand, metals, carbon dioxide, hydrogen sulfide, among other.

The type of produced water treatment will vary depending on the reuse purposes or disposal method in question. Filtration, cyclonic separation, flotation, evaporation and electrocoagulation are the most common water treatment techniques.

Our proprietary **Variable Electro Precipitator™** technology has proven to be a cost effective water treatment technique. We use a form of Electrocoagulation which has proven itself to be an effective and scalable solution for the reuse of produced wastewater.

Need a produced water treatment quote for your project? Stuck with old technologies like chemical coagulation? Lower your budget and treatment timeframe with our technology! Simply send us an email or give us a call at **(281) 728-8748** and we'll work together to find the produced water solution for your project.



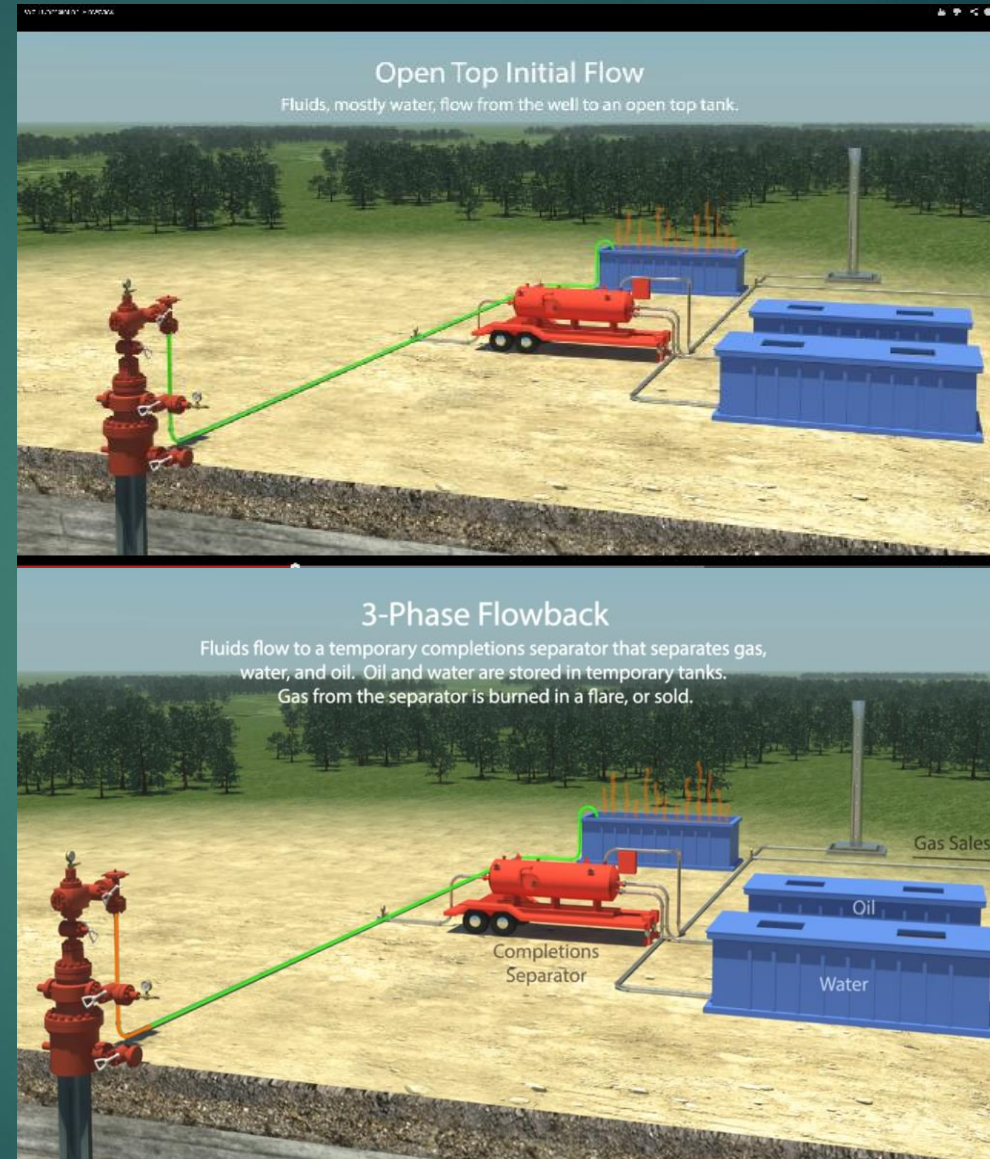
# Frac Water Treatment

## Frac Water Treatment Explained

Frac Water Treatment is a treatment that uses gel also known as a proppant. A proppant is a solid material, typically treated sand or man-made ceramic materials, designed to keep an induced hydraulic fracture open, during or following a fracturing treatment.

It is added to a fracking fluid which may vary in composition depending on the type of fracturing used, and can be gel, foam or slickwater-based. Electrocoagulation has been used as a successful treatment of fracking gels and should be considered in any water treatment management of hydraulic fracturing.

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# Test Lab Results

## Electrocoagulation : General Capabilities

The following well documented lab and field tested results are routinely attained through electrocoagulation.

Operation	% Removal
BOD	90 +
TSS (Clay, Coal, Silt, etc.)	99 +
Fats, oil and Grease in Water	93 - 99 +
Water in sludges	50 - 80 +
Heavy Metal Removal	95 - 99 +
Phosphate Removal	93 +
Bacteria, Viruses & Cysts	99.99 +

# Test Lab Results

Contaminant	Source	Raw mg/L	Treated	% Removal
Aluminum	Can Mfg.	224.00	0.690	99.70 % +
Arsenic	Steam Cleaner	0.30	<0.010	96.70 % +
Barium	Steam Cleaner	8.00	<0.100	98.70 % +
Calcium	Cooling Tower	1,321.00	21.400	98.40 %
Cadmium	Electroplating	31.00	0.340	98.90 %
Chromium	Condenser Wash	139.00	<0.100	99.90 % +
Cobalt	Steam Cleaner	0.13	<0.050	62.00 % +
Copper	Electroplating	287.00	0.480	99.80 %
Iron	Acid Mine	151.00	0.570	99.60 %
Lead	Manufacturing	8.21	0.230	97.20 %
Magnesium	Ammunition Plt.	6.40	<0.100	98.50 %
Magnesium	Ammunition Plt.	0.29	0.050	83.20 %
Mercury	Steam Cleaner	0.01	<0.002	66.60 % +
Molybdenum	Steam Cleaner	0.18	0.040	80.60 %
Nickel	Manufacturing	185.00	0.200	99.90 %
Silicon	Acid Mine	21.70	0.100	99.50 %
Vanadium	Steam Cleaner	0.23	<0.010	95.60 % +
Zinc	Plating	221.00	0.140	99.90 %
BOD	Fish Process	40,500.00	750.000	98.10 %
TSS	Municipal POTW	5,620.00	25.000	99.60 %
FOG	Food Process	18,165.00	28.000	99.90 % +
Bacteria	Municipal POTW	110MM	2,200.000	99.99 % +



# Frac Water Treatment Results

## Video clips from EC treated frac water

Video clips show we achieved flocculation in just 15 seconds on produced and flow-back water at an oil/gas disposal site in Clinton, OK on March 13th, 2014.

Ask yourself why dispose of your wastewater when you can reuse it for less cost and at the same time protect our environment.

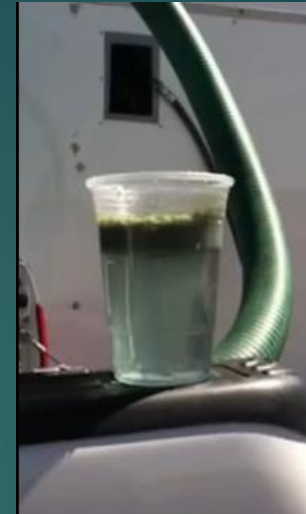
2 secs



6 secs



10 secs



14 secs



18 secs



22 secs



# Applications

Treated Frac Water – Using VEP Electrocoagulation





# Applications

Processing Produced Water in Holding Pond – Frac Site



# Typical Operational Cost

Per barrel (including electricity)

- ▶ \$0.063

Configuration

- ▶ 150 GPM system
- ▶ Processing Flow Rate:
  - ▶ - 214 bbls/hour
  - ▶ - 5,153 bbls/day
  - ▶ - 36,000 bbls/week
  - ▶ - 154,286 bbls/month
  - ▶ - 1,877,143 bbls/year



# Typical System Costs

## VEP System

- ▶ \$150,000 – 2 GPM
- ▶ \$200,000 – 30 GPM
- ▶ \$350,000 – 100 GPM
- ▶ \$450,000 – 300 GPM
- ▶ \$600,000 – 500 GPM

## Configuration

- ▶ 20 foot container
- ▶ Reactor chamber(s)
- ▶ Control panel
- ▶ Pumps
- ▶ Power supplies
- ▶ Connections
- ▶ Control valves
- ▶ Environmental system

# Typical Lease System Costs

## Lease Overview – 150 GPM

- ▶ \$ 7,500 – Monthly service fee
- ▶ \$ 1.50 – Per every 1000 gals processed

### Operate (annually)

- ▶ \$ 2,500 – Startup fee/year
- ▶ \$ 6,000 – Training/year
- ▶ \$10,000 – Site prep, engineering & test/year
- \$25,000 – Electrodes/Plates
- \$19,000 – Electricity
- \$ 7,500 – Technical Support

## Configuration

- ▶ 20 foot container
- ▶ 150 GPM Reactor chamber
- ▶ Control panel
- ▶ Pumps
- ▶ Power supplies
- ▶ Connections
- ▶ Control valves
- ▶ Environmental system
- ▶ Maintenance

# For more information



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