



Electrocoagulation (EC) Systems

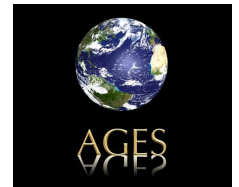


Presentation Overview

- What is electrocoagulation ?
- Treatment of Produced & Frac Flowback Water
- Advantages of using Electrocoagulation
- Drilling site concerns
- Typical operating costs
- Recycle drilling water with Electrocoagulation (EC)
- EC - Key Benefits
- EC – Simple process flow
- EC – Treatment percentage of removal
- EC – Small & Large Systems
- Variable Electro Precipitator (VEP)
- VEP: Electrodes
- AGES & F&T - Manufacturing Certifications
- Water sample profile worksheet
- How do you get started using EC technology?
- Sales contact information



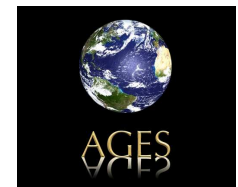
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Water Treatment Systems using EC (Electrocoagulation)



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What is Electrocoagulation ?

Electro coagulation ("**electro**", meaning to apply an electrical charge to water and "**coagulation**", meaning the process of changing the particle surface charge, allowing suspended matter to form an agglomeration) is an advanced and economical water treatment technology.

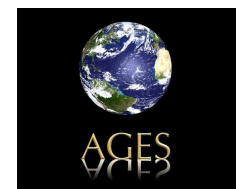
The technology removes contaminants that are impossible to remove by filtration or chemical treatment systems, such as emulsified oil, total petroleum hydrocarbons, suspended solids, and heavy metals.

A fully automated modular system has no filters to clean or replace and does not require the use of chemicals.

EC Systems can be deployed very easily



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Treatment of Produced & Frac Flowback

Electro-coagulation is a very effective technology that can treat produced and flowback water, making it available for re-use in hydraulic fracturing operations.

This process is fully scalable and can treat flow rates from as little as **2 gallons per minute** up to **1000 gallons per minute**.

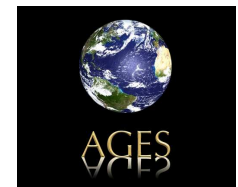
See examples below of typical treated flow rates per day with our EC systems:

Typical treatments flow rates

| Flow Rate (gpm) | Gallons Per Day | Barrels Per Day | Flow Rate (gpm) | Gallons Per Day | Barrels Per Day |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 2 | 2,880 | 69 | 100 | 144,000 | 3,429 |
| 10 | 14,400 | 343 | 500 | 720,000 | 17,143 |
| 30 | 43,200 | 1,029 | 1000 | 1,440,000 | 34,286 |



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Advantages of using Electrocoagulation

Treating Produced Water & Frac Flowback

Efficiency Process averages 95% efficiency, whereas, for every 100 trucks needed for disposal can be reduced down to just 5 trucks being required for post treatment disposal.

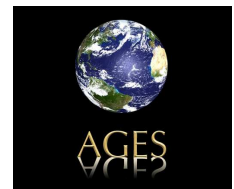
Affordability Treatment clean up price per barrel is competitive with cost of disposal and savings associated with decreased water sourcing.

Resource Intensity EC process reduces the need for new sources of fresh water and eliminates the amount of wastewater injected into saltwater disposal wells.

System Footprint EC systems are mobile or can be setup as a permanent installation



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Drilling Site Concerns

Treating of Produced Water & Frac Flowback

Produced Water

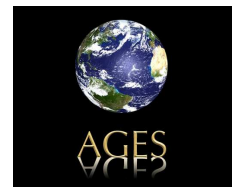
Oil and gas wells all over the world are injecting water continuously to improve productivity. What comes back up along with natural water from deep aquifers, is a flood of “produced water” that must be managed. Over the life of a well, about eight barrels of this produced water are brought to the surface for every barrel of oil. In the United States, this is referred to as Water-To-Oil Ratio (WOR) which can reach upward to 50:1.

Frac Flowback

This water represents 15 to 30 percent of injected frac water that flows back to the wellhead in the few weeks following a frac job. This frac flowback water is often more contaminated than produced water because of the chemicals added to the frac water before it is injected.



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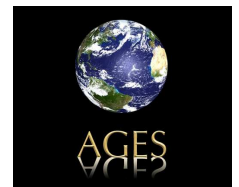
Typical containerized and trailer mounted systems



We specialize in the treatment of produced, frac flowback, food processing and industrial waste waters !

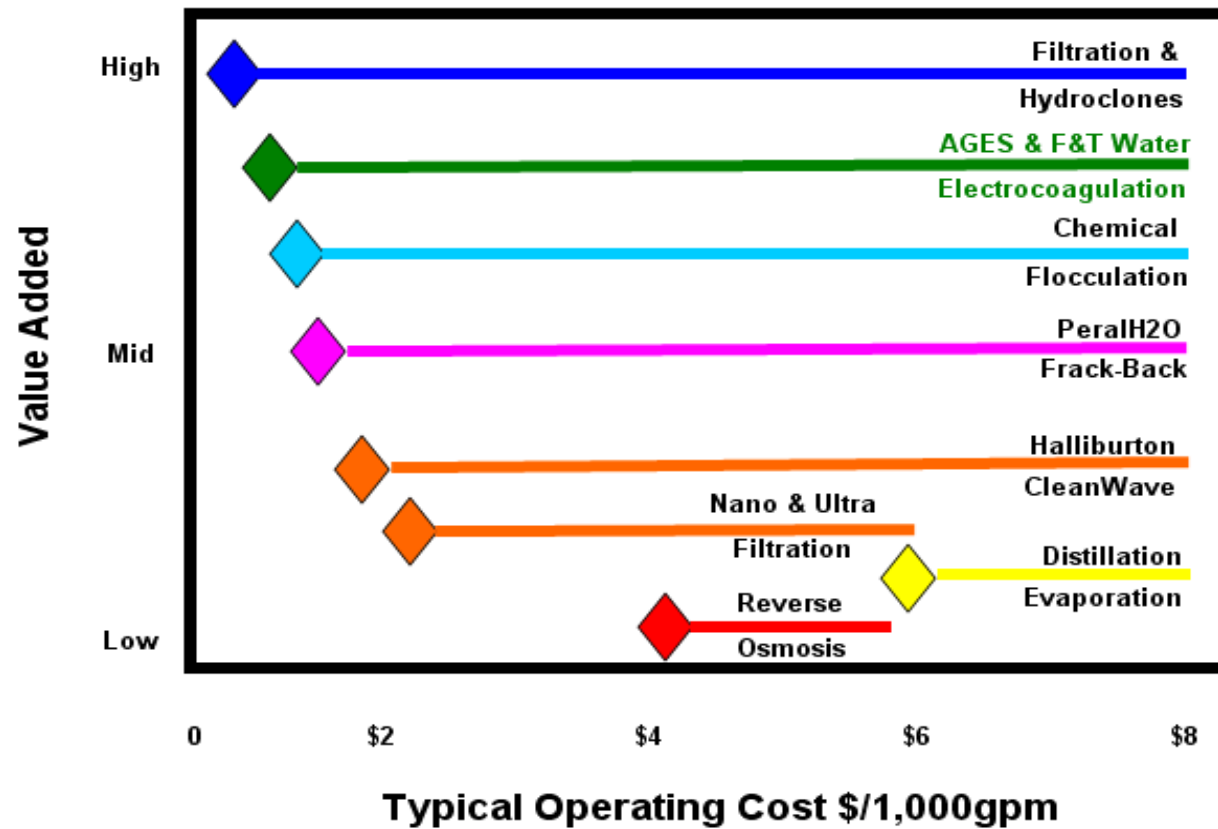


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Typical Operating Costs for Electrocoagulation

Water Treatment Technologies Operating Cost vs Value Added



Recycle drilling water with Electrocoagulation

Recycling is the trend of the future

Because of recent environmental pressures from the US government and the high cost of disposal - recycling of produced & frac flow back water will be the trend for the future.

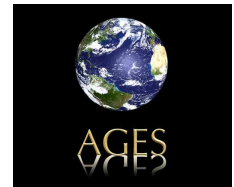
The industry practice of disposal will decrease as regulatory pressures increase and water treatment technologies become more effective and less expensive.

By use of recycling you will realize:

- Reduction in cost per barrel of handling produced & flow back water
- Significant reduction in field and long haul truck traffic at the site
- Increased profitability at each drilling site



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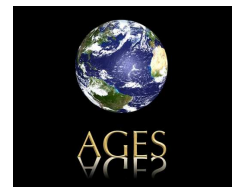
500 gal/min Field Unit - Trailer Mounted Systems



EC System can significantly reduce bacteria, suspended solids, heavy metals, fats, oil and grease



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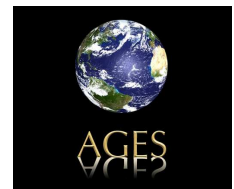
Electrocoagulation: **Key Benefits**

Key benefits associated with the EC system:

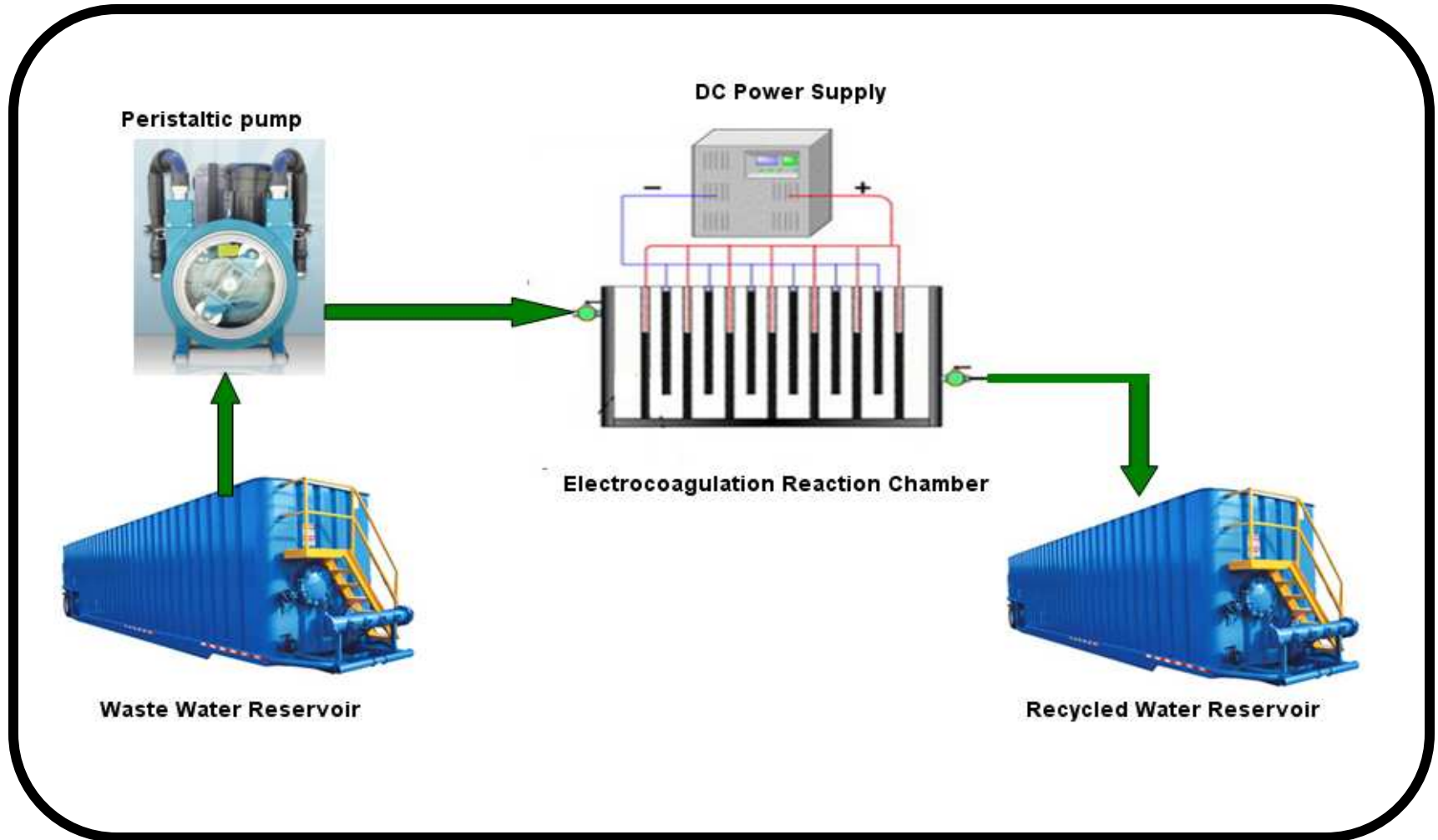
- Ideally suited for high total dissolved solids (TDS) water and hydrocarbon contaminated production and flowback fluids
- Service is flexible with regard to fluctuations to inlet volume and TDS/TSS (total suspended solids)
- Easily scalable technology -small footprint and quiet operation
- Mobile skid mounted, portable trailer mounted and permanent EC systems available
- Eliminates bacterial growth and renders H₂S non-detectable
- Remote communication, monitoring and troubleshooting



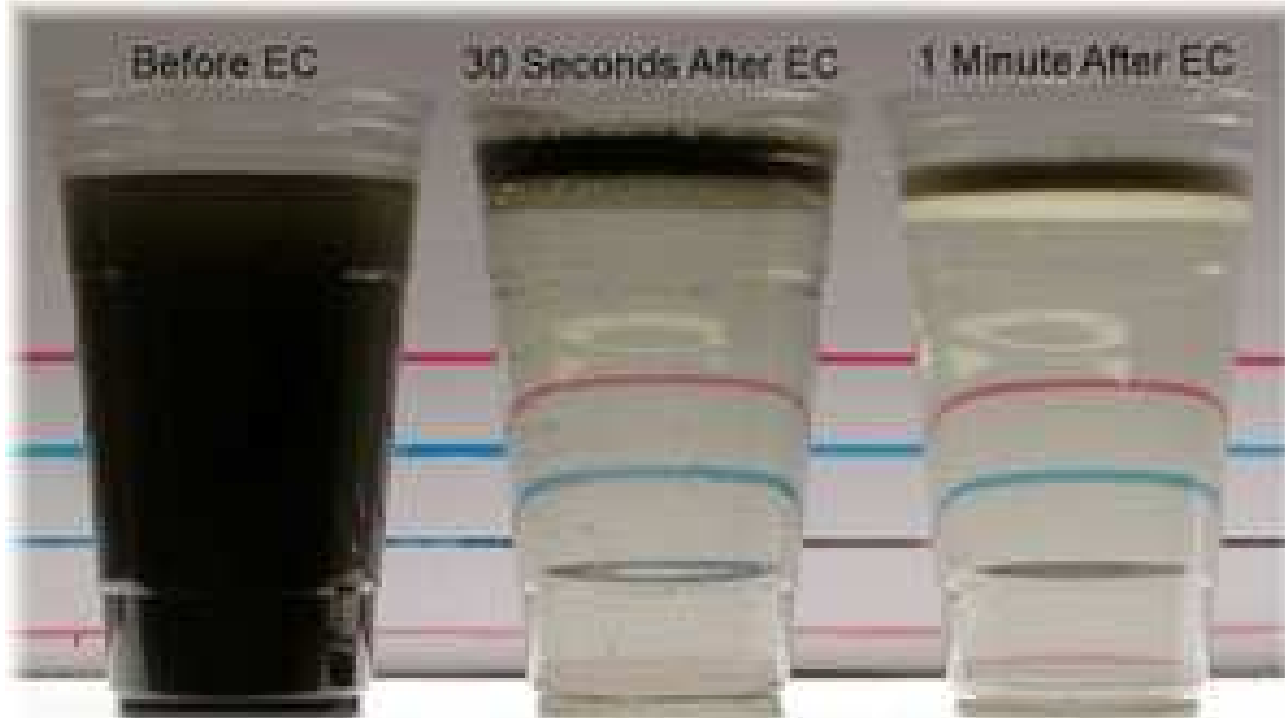
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Electrocoagulation: Simple Process Flow



Electrocoagulation: Treatment Results



Electrocoagulation: Treatment Results



Water Test Results from a Colorado Energy Company in May 2013

Frac Flowback



Featured Case Study from a Colorado Energy Company in May 2013



Results from a Utah Produced Water Treatment Facility in April 2013

Produced Water



Electrocoagulation: **Capabilities**

- Removes heavy metals as oxides that pass TCLP
- Removes suspended and colloidal solids
- Breaks oil emulsions in water
- Removes fats, oil and grease
- Removes complex organics
- Destroys & removes bacteria, virus & cysts
- Processes multiple contaminants

Toxicity characteristic leaching procedure (**TCLP**) is a soil sample extraction method for chemical analysis employed as an analytical method to simulate [leaching](#) through a [landfill](#). The testing methodology is used to determine if a waste is characteristically hazardous (D-List). The extract is analyzed for substances appropriate to the protocol.

EC treatment percent (%) of removal

| 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% |

EC treatment percent (%) of removal

| Contaminant | Source | Raw mg/L | Treated | % Removal |
|-------------|-----------------|-----------|-----------|-----------|
| 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 | 96.60% |
| 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% |



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EC treatment percent (%) of removal

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

| Operation | % Removal |
|---|-----------|
| BOD (Bio-chemical Oxygen Demand) | 90+ % |
| TSS (Clay, Coal, Silt, etc.) (Total Suspended Solids) | 99 % |
| Fats, oil and Grease in Water | 93 - 99 % |
| Water in sludges | 50 - 80 % |
| Heavy Metal Removal | 96 - 99 % |
| Phosphate Removal | 93+ % |
| Bacteria, Viruses & Cysts | 99.99+ % |



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EC Systems - Small Systems

F&T Commercial Water Treatment Systems



2 GPM Variable Electro Precipitation™
Commercial Test System



2 GPM Variable Electro Precipitation™
Commercial Test System



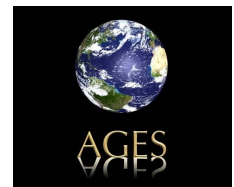
10 GPM Variable Electro Precipitation™
Commercial Test System

Flow rates: 2 gallons/min to 10 gallons/min

Very portable, can be moved very easily !



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EC Systems – Large Systems

VARIABLE ELECTRO PRECIPITATOR™

Commercial Production Systems



Flow rates: 500 gallons/minute & Larger Flow Rates Systems

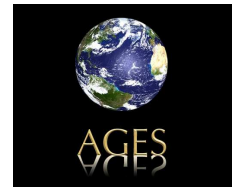
The difference between a standard electro coagulation (EC) unit and a Variable Electro Precipitation unit are in the enhanced flow path and the unit electrode connections.

The Variable Electro Precipitators flow path has been designed to maximize retention time and to increase the turbulence of the water within the unit.

This design greatly aids in increasing the amount of effective treatment per gallon of water.



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Variable Electro Precipitator (VEP)

Our **Variable Electro Precipitator (VEP)** is a waste water remediation unit utilizing electro-coagulation (EC) technology.

The major design weakness of typical EC systems are the methods used in connecting the electrodes to the power source.

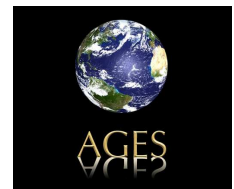
Those designs cause overheating resulting in premature failure of the electro-coagulation reaction chamber.

Variable Electro Precipitators reaction chambers are designed to resolve these performance issues by changing all electrode connections from the standard wet connection (inside the chamber) to an external dry connection.

The Variable Electro Precipitator operates much cooler and has a longer chamber life than typical EC unit.



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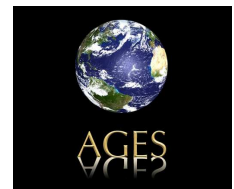


Variable Electro Precipitator (VEP): Electrodes

- Core component of the VEP is the electrodes
- Design allows electrical connection outside reaction chamber
- Allows selection of physical plates to be adjusted
- Significant differentiator compared to other manufacturers
- Traditional designs will weaken or corrode and cause hot spots or arcing
- This design provides consistent current density & appropriate turbulence
- Reactor will typically use 6 – 13 plates
- Plates may be all metals (Zn, Al, Al) or combination of metals & carbons



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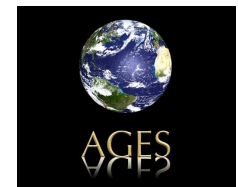
AGES & F&T - Manufacturing Certifications

Manufacturing Capabilities

F&T Water Solutions is proud to partner with IP Automation as our premier Manufacturer. IP Automation provides us with the highest quality products and services that are necessary to meet and exceed our customers expectations through continuous improvements to our processes. IP Automation provides engineering and design, robotics, electromechanical engineering, pneumatics, and automation.



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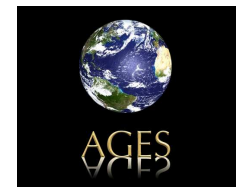


Electrocoagulation (EC) Systems

Environmentally Safe Water Treatment Solutions



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How to get started using EC technology ?

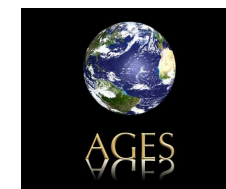
Sample Collection & Packing Instructions for Water Characterization Test




After the water analysis has been completed, our manufacturing team will design the EC reaction chamber based on the specific water chemistry in order to optimized our EC system for best water treatment.



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Water Sample Profile Worksheet



FACILITY WATER PROFILE INFORMATION
F&T Water Solutions, LLC.

(Information used for questions on the Green Card profile by connecting to facility)


Company Contact Information

Contact Name: _____
 Title: _____
 Company Name: _____
 City: _____ State: _____
 Zip: _____
 Phone: _____
 Cell Home: _____

Put in three sentence summary of the problem or treatment desired and the results:

Read history of their problem so that it is fully understood the very special circumstances or history issues. (For example were EPA regulations given or other fact 1, 2, 3 or other way. Usually 4 or more treatment TDS or BODing 5)

Formal 111-000




1. Please describe the characteristics and description used for the water water profile in any manner.

a. Source of the water (local description used to describe the water used or "long water", "groundwater", "spring water")
 1. _____
 2. _____

b. Current treatment technology or equipment being used to treat the water coming into the treatment step
 1. _____
 2. _____
 3. _____
 4. _____

c. Water conditions or characteristics of the water that need to be improved (provide color (For example "color 150 to 200mg/L", "turbidity 100 to 150mg/L")
 Turbidity: _____
 Color: _____
 TDS: _____



2. Please list all water to be treated in gallons per minute:


| Flowline No. | Flowline | Maximum | Average |
|--------------|----------|---------|---------|
| | | | |

Priority Parameter Treatment goals that need to be achieved now or in the future for each condition for each equipment or treatment technology to be of economic value

| Priority Parameter | Treatment Goal | Current Maximum | "Historical" Maximum Average (Maximum Average Discharge Concentration mg/L) |
|--------------------------|----------------|-----------------|---|
| Example: Turbidity (NTU) | 10 NTU | 100 NTU | 100 NTU |
| | | | |
| | | | |
| | | | |

Operational Approval of State Commission Approval

| Concentration | State Limits (by the Percentage) |
|---|----------------------------------|
| Example: Water quality of Impact Source | 100% |
| | |
| | |
| | |



Water Characteristics

Grasses/Crude: None Bad

Dish Volume: _____

Algae: None Bad

* 1000 LBS. - Average amount. 100 LBS. - Sample per Day. 100 LBS. - Average Week

Peak Flow Rate

Is there any spikes in flow? No Yes

What Storage Method? Tank Pond Pit Other _____

State Volume of Production Storage: _____

Overflow Information

Is overflow of water facilities with capacity? No Yes

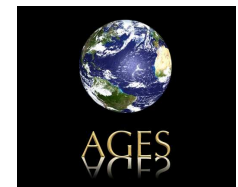
Is the company being changed for discharge or this site? No Yes

If Yes, what are you? _____


Can there discharge into be eliminated? No Yes



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Sales Contact For More Information



AGES

WORLDWIDE

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