

# CTI Water Treatment Process



From Science to Technology

# Introduction

- Water management has always been a vital step in the development and production of oil/gas resources. Moderate volumes of water are required as an input for multiple activities in conventional oil/gas development. Additionally, water is produced by all oil/gas wells, ranging from minimal volumes early in the life of a well to large volumes late in the life of a well. However, clean water's importance has increased dramatically with emergence of wide-scale development of shale resources for oil and gas production.
- The innovation that has been most critical in making the development of shale resources economically viable, multi-stage hydraulic fracturing ("fracing"), has also dramatically changed water needs. Fracing requires large volumes of water as an input into the well (volumes vary, but typical jobs are often in the 10,000-200,000 barrel range). Roughly 10-40% of the water pumped into the well during hydraulic fracturing returns to the surface ("flowback water") in the first 30-60 days of the life of the well. In order to maintain efficient production rates over the life of a well, it is common practice to refrac wells one or more times, typically at 3- to 5-year intervals. Additionally a larger number of wells must be drilled to effectively drain a shale field than a conventional oil/gas field. All of these factors amount to a massive volume of water that must be managed over the life of a shale field, significantly more than is typical in the development and production of a conventional field.
- Between 2 and 6 million gallons of water are needed for each frac.

## Objective



- ✓ Reduce demands for freshwater
- ✓ Reduce environmental impact of brine disposal
- ✓ Ensure supplies of water for well drilling and completions for natural gas development in the Shale
- ✓ Develop water management methods and technology

GreenHunter is estimating that the 2011 water disposal market in the Marcellus alone was \$1.3-\$1.7 billion, and in 10 years the market will be \$15-22 billion. In the Eagle Ford shale play in Texas, disposal fee cost as much as \$0.80+/bl and an average \$3.00 – \$6.00 /bl hauling fee. And with an estimated 800 new oil & gas wells drilled there in 2011, the market just keeps getting bigger. In 2011 the water disposal market was estimated to be \$500-\$800 million, and in 10 years they are guesstimating that local market will be worth \$6-9 billion.





# Applications

## Recycling – Oil and Natural Gas Industry

- ❖ Treat fracturing fluids onsite to control bacteria, scale, biofouling and corrosion
- ❖ Treat flowback and produced waters to be reused in hydraulic fracturing operations
- ❖ Recycle 100% of production, flowback and petroleum industry wastewaters to be reused in current and future operations
- ❖ Reduce or eliminate water acquisition, transportation, treatment and disposal costs
- ❖ Increase production efficiencies by effectively destroying bacteria and eliminating the potential for scale, biofouling and microbiologically induced corrosion (MIC)
- ❖ Eliminate the use of toxic chemicals, further eliminating health, safety and environmental issues associated with chemical consumption, transportation and handling
- ❖ Preserve vital natural water resources for current and future generations

## Coal-Fired Power Plant Wastewater Treatment

Coal continues to remain one of the world's primary resources for producing electricity. It also has a much-debated reputation for being an unclean energy source and is highly regulated. One of the greatest challenges facing Coal-fired power plant operators is how to minimize the environmental impact of their operations while increasing production output.

With its chemical-free wastewater treatment technology, we can help operators increase production capacity, while adhering to environmental regulations.

## Refinery Water Treatment

Petroleum refineries rely on clean water sources for a variety of processes, from crude oil desalting to hydroprocessing units and cooling towers. Effective operation of systems is critical to sustainable and reliable operations, and today's water treatment challenges can directly impact the effectiveness of bacteria and corrosion control, compromising the integrity of key pieces of heat transfer equipment and negatively affecting the energy efficiency of process units. Cavitation is a chemical-free, wastewater treatment technology from CTi that will help refinery operators meet ever more rigorous refinery effluent water quality standards.

## For Agriculture

In California alone, some 200 waste treatment facilities produce approximately 4.0 million acre-feet of treated wastewater annually (CA State Water Resources Control Board survey). There is widespread and increasing interest in reusing treated wastewater for beneficial and environmentally safe purposes. Currently, only about 10% (400,000 acre-feet) of this resource is directly reused. Of the 10% reused, 48% (193,500 acre-feet) is used for agricultural irrigation, and another 20% (78,500 acre-feet) for landscape irrigation and impoundment.





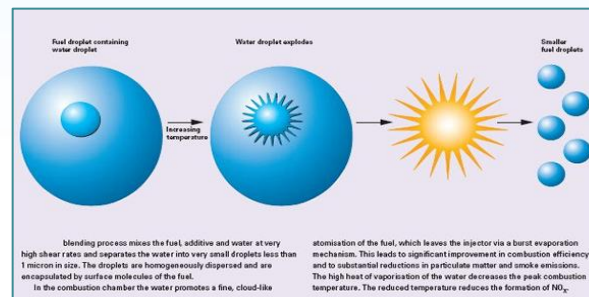
# Applications cont.

## Industrial Wastewater Treatment Solutions

- Food and Beverage
- Pharmaceutical
- Pulp and Paper
- Textiles
- Manufacturing Process
- Marine Industry
- Mining Process Water
- Municipal Water Management
- Automotive

**Our Cavitation waste water system reduces:**

- ❖ Biochemical Oxygen Demand
- ❖ Total Suspended Solids
- ❖ Phosphorus
- ❖ Several types of dissolved metals
- ❖ Fats
- ❖ Oils
- ❖ Grease



# Patented Technology

**MULTI-STAGE CAVITATION DEVICE** - The flow-through cavitation device is provided for mixing and manipulating fluids that comprises feeding a fluidic mixture in a multi-stage flow-through hydrodynamic cavitation system, subjecting said fluid to a controlled multi-stage cavitation and continuing the treatment for a period of time sufficient for obtaining desirable changes in the physical and/or chemical properties and generating upgraded products

**Patent # 20100290307**

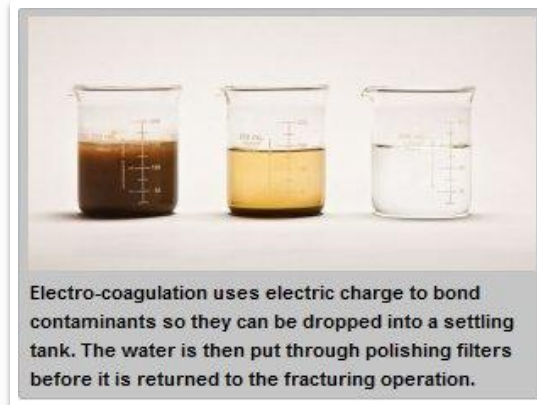
**CAVITATION GENERATOR** - A method and device are provided for mixing and manipulating fluids that comprises feeding fluid in a multi-stage flow-through hydrodynamic cavitation system, subjecting said fluid to a controlled multi-stage cavitation and continuing the treatment for a period of time sufficient for obtaining desirable changes in physical and/or chemical properties and generating upgraded products.

**Patent # 20100103768**

**HIGH-THROUGHPUT CAVITATION AND ELECTROCOAGULATION APPARATUS** - The invention relates to a cavitation and electrocoagulation reactor comprising a hollow cylindrical cathode having a cylindrical anode coaxially disposed therein to form an annular interelectrode gap between the contact surfaces.

An inlet sleeve and an outlet sleeve disposed in the respective inlet and outlet of the cathode and abutting against opposite ends of the anode seal the interelectrode gap from the respective inlet and outlet of the cathode. A set of channels disposed in the wall of the inlet sleeve connect the inlet to the interelectrode gap. Similarly, a set of openings disposed in the outlet sleeve connect the interelectrode gap to the cathode outlet. An electrical source has first and second terminals respectively connected to the anode and the cathode. The method for removing contaminants from a contaminated fluid flow involves the simultaneous application of hydrodynamic cavitation and electrocoagulation to the contaminated fluid flow.

**Patent Appl. # 20110147231**



**PROCESS TO REMOVE IMPURITIES FROM TRIACYLGLYCEROL OIL** - The present invention is directed to a process to remove impurities from triacylglycerol oil including mixing the oil and a fluidic agent, pumping the mixture through a flow-through hydrodynamic cavitation apparatus at a pre-determined inlet pump pressure, creating hydrodynamic cavitation in the mixture, maintaining the hydrodynamic cavitation for a pre-determined period of time, moving the impurities from the oil to the fluidic agent, and then separating the fluidic agent from the oil. The impurities can include phytosterols, sterol glucosides, acylated sterol glucosides, in which case the fluidic agent is water, an alkali hydroxide, an inorganic base, an organic base, phosphoric acid, citric acid, acetic acid or a mixture thereof. The impurities may also include phosphatides, in which case and the fluidic agent comprises water and an enzyme such as phospholipase, a lipid acyltransferase or a mixture thereof.

**Patent Appl. # 2011/079276**

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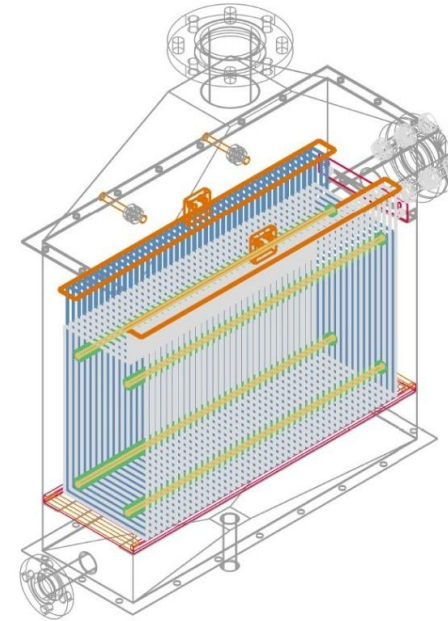
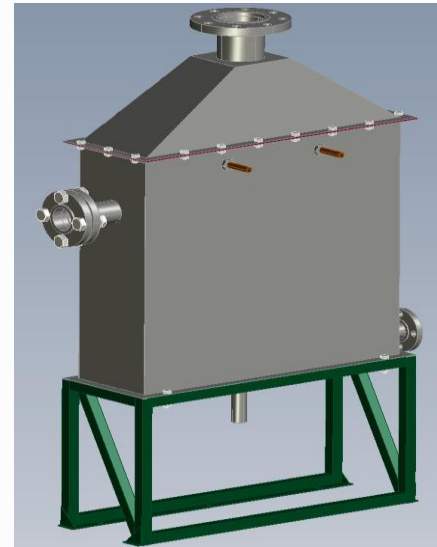


# BACKGROUND OF THE INVENTION

The invention relates to an apparatus and method of purification and treatment of potable water, ground water, industrial water, sewage water, etc. and has numerous applications in drinking water production, food, chemical, oil, energy, wood, pulp and paper industries, mining and metal-processing and similar industries. Removable contaminants include metals, petroleum products, colloidal particles, living species, organics, dyes, polymers, surface-active compounds and other matter whose concentration can be decreased to the allowable levels in one pass through the apparatus. The proposed water treatment method and the device generates changes in the fluidic flow's velocity, pressure, temperature, voltage, resistance and chemical composition and physical properties in order to reduce the concentration of impurities. The simultaneous action of hydrodynamic cavitation, electrocoagulation and the coagulants and active chemical species formed in situ provide a unique synergistic effect that results in a highly efficient purification process.

- Proprietary coating non-sacrificial anode
- Long Life - minimum 2 to 5 years life span
- Low maintenance cost

## ❖ Propriety Nano Water Treatment EC Unit



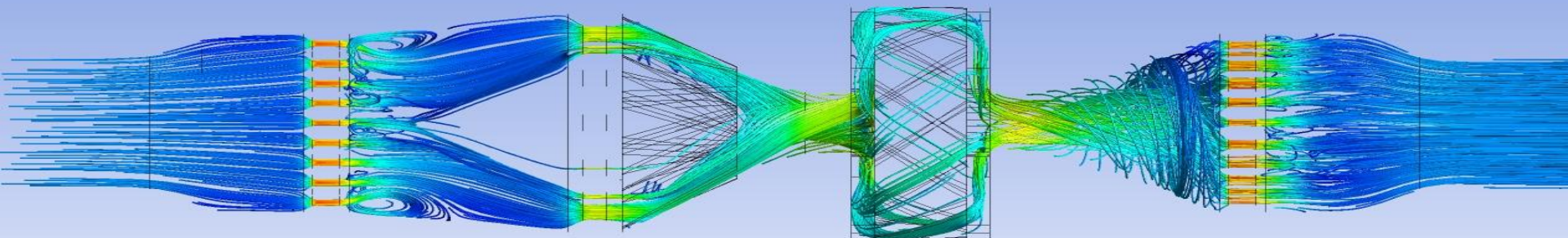
## ❖ Patented Multi-Stages Cavitation Reactors



# ADVANTAGES AND BENEFITS

CTI Cavitation Electrocoagulation system designed to reduce electricity requirements, and miniaturization of the needed power supplies. Both the treatment of wastewater prior to discharge and the reuse of wastewater have become absolute necessities. There is, therefore, an urgent need to develop innovative, more effective and inexpensive techniques for treatment of wastewater.

Our patented technology and patent pending cavitation-electrocoagulation process presents the opportunity to maximize the beneficial re-use of resource materials, minimize transportation and disposal costs, as well as their associated liabilities.



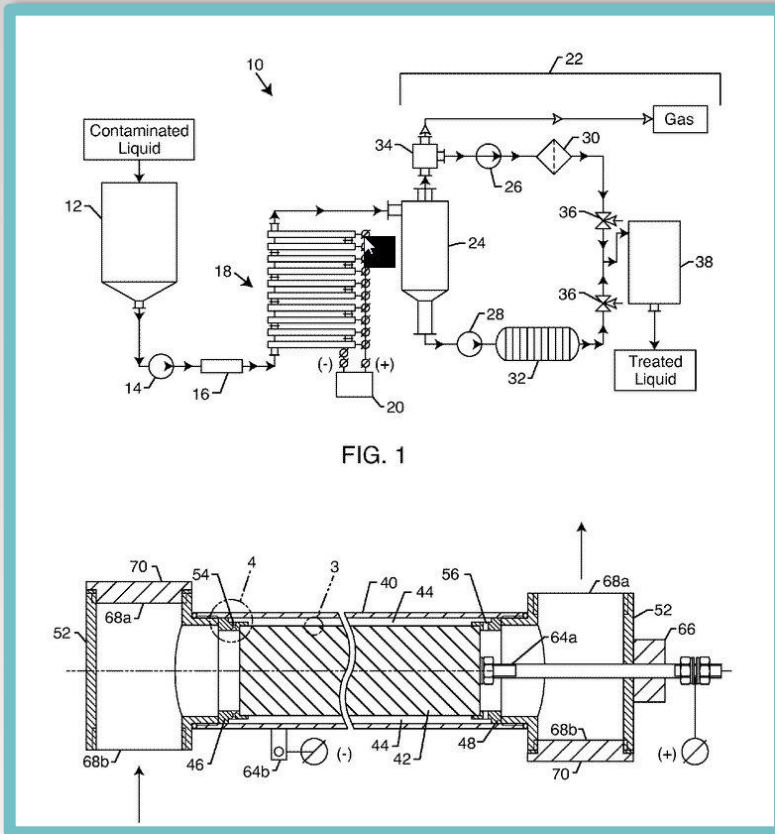
Operating costs can be dramatically reduced. No longer need to pay for reagent chemicals, can reduce polymer consumption, reduce filter press operations, reduce solid sludge generation. Lower (or zero) use of reagents dramatically reduces the amount of sludge produced resulting in lower disposal costs. Could be 40% to 60% reduction in sludge over chemical methods.

## System Capabilities

- ✓ Removes heavy metals
- ✓ Removes suspended and colloidal solids
- ✓ Breaks oil emulsions in water
- ✓ Removes fats, oil, and grease
- ✓ Removes complex organics
- ✓ Destroys & removes bacteria, viruses, and cysts
- ✓ Processes multiple contaminants

- Low capital costs
- Low operating costs
- Low power requirements
- No chemical additions
- Low maintenance
- Minimal operator attention
- Handles a wide variation in the waste stream
- Sludge minimization
- Treats multiple contaminants
- Water reuse- resulting in zero discharge

# MOBILE CAVIGATION WASTE WATER TREATMENT SYSTEM



The method for removing contaminants from a contaminated fluid flow comprises the steps of generating hydrodynamic cavitation in the contaminated fluid flow. Such contaminated fluid flow is simultaneously exposed to an applied electric field from a non sacrificial titanium anode. Radicals of the contaminated fluid flow and its constituents are formed by the simultaneous hydrodynamic cavitation and exposure to the electric field. The contaminants in the contaminated fluid flow are coagulated as a result of the radical formation. The coagulated contaminants are then separated from the contaminated fluid flow resulting in a purified fluid flow.

## Process Cost

The overall costs of recycling one barrel of water once we are in full production will be equal 25%-28% of the cost of cleaning that same barrel via conventional methods.

## Scalability

Capacities from 20GPM to 500GPM  
700 barrel day to 17000 barrel/day. Multi-systems for larger capacities.

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