

## **OriginClear technology decontaminates Produced water rapidly and economically in the nation's most productive oil county**

### ***Summary***

A demonstration system based on OriginClear™ technology effectively decontaminated Produced water in a pilot program at a storage and disposal site in Kern County, California.

The client, a regional water treatment entity, commissioned the 60-day test, which began in July, 2016.

OriginClear licensee, ECT Services & Solutions, built and operated the complete water treatment system. The central component was an OriginClear Electro Water Separation™ demonstration scale prototype.



Figure 1: Test site, with ECT/EWS demonstration system

At the completion of the pilot, the system demonstrated the ability to safely and reliably treat the Produced water to below the limits specified by the client for treated water.

Extensive third-party testing demonstrated that the technology was a technical success.

### ***Problem/Solution***

Oil and gas production waters are high in suspended solids and oils. These contaminants easily foul final-stage membranes and filters, driving up operating costs.



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Therefore, a mid-stage solution is essential. But existing systems often use coagulating agents and flocculating chemicals, making for heavy consumables expense. Intense chlorination is used to reduce bacteria. Treatment media needs to be replaced frequently, and at great expense.



Figure 2: ECT unit with EWS system

Thus, treating water for reuse is typically an uneconomic proposition, leading most producers to dispose of their water instead of cleaning it.

But in California, the pressures of regulation, litigation and droughts are fast eliminating disposal as an option.

Inevitably, the industry must clean its water for reuse, and needs to do it economically.

OriginClear technology makes this goal attainable. It removes contaminants continuously, with a minimum of chemicals, and very low energy. It ensures membranes and filters last much longer. In short, OriginClear technology can make high-speed and economical water treatment and reuse possible.

### ***The Technology***

Electro Water Separation™ with Advanced Oxidation (EWS:AOx™) is a flow-through process consisting of “lossless” electro-oxidation, which breaks down organic chains and oils and oxidizes miscible organics and bacteria, followed by electro-coagulation which causes organic particles to clump up for easy removal.

This water, now generally free of organic contaminants, can be further purified through a downstream sequence of filtration in order to clean it for beneficial applications, such as oil well re-use and agricultural irrigation.



Figure 3: OriginClear's co-founder, Nicholas Eckelberry, explains the ECT/EWS system

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EWS effectively removes, with a minimum of chemicals and in a single pass, organic contaminants and bacteria in water, as witnessed in COD (Chemical Oxygen Demand) and BOD (Biochemical Oxygen Demand) readings; conventionally, a difficult and costly step.

## Test Results

### Key Counts

Analyte	INLET	AFTER EWS
Heterotrophic Plate Count – CFU/ml	1.85 x 10 <sup>4</sup>	35
TRPH (Free Oil recovery) – mg/l	590	1.3
TSS (Total Suspended Solids) – mg/l	15	5.9

Heterotrophic plate count (HPC): bacterial reduction is reduced by three orders of magnitude to nearly nil.

TRPH (Total Recoverable Petroleum Hydrocarbons). EWS recovers petroleum as a wet oil. As seen above, the recovery is nearly complete.

Total Suspended Solids (TSS): EWS captures these to prevent downstream fouling.

### VOC Testing

VOCs (Volatile Organic Compounds) were oxidized to Non-Detect.

The one exception, tert-butyl alcohol, should neutralize with longer residence time.

Analyte (µg/l)	INLET	AFTER EWS
Tert-Butyl alcohol (TBA)	36	35
Benzene	30	ND
Toluene	3.2	ND
Ethylbenzene	ND	ND
m,p-Xylene	2.3	ND
o-Xylene	2.2	ND
Xylenes	4.6	ND
Naphtalene	1.3	ND

### Boron

Boron was outside the scope of the pilot program, and the client waived the requirement to test for it.

Conventional solutions already exist for this contaminant.



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## Energy Costs

The energy consumption of ECT's complete system was about 20kWh for a treated water output of 23 bbl/hour. This translated to about 1 kWh per barrel, or 15 cents per bbl, assuming 15 cents per kWh energy cost.

ECT with EWS is highly energy-efficient.



Figure 4: Water samples from the Kern County ECT/EWS pilot program.

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## Conclusions

- ❖ EWS:AOx reduces or removes organics from polluted water without excessive chemicals.
- ❖ EWS:AOx components can be used ahead of Black Walnut or WEMCO, allowing for an increased flow rate at low operational costs.
- ❖ EWS:AOx optimizes the flow for final stage polishing, with fouling nearly eliminated.
- ❖ EWS:AOx utilizes low energy and long life components. It replaces or optimizes current methods of pre-treating water for filtration.

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OriginClear, Inc.

*The essential contribution of ECT Services and Technologies, Inc. is gratefully acknowledged.*

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