

## **CLEAN-FRAC™**

 **Powered by OriginOil Technology™**

### **Process and Equipment Description**

#### **Function**

OriginOil's CLEAN-FRAC™ system is a continuous, chemical free, process to efficiently remove organics, such as crude oil, and suspended solids and bacteria from process water such as produced or 'frac flowback' water.

Testing has shown that OriginOil's CLEAN-FRAC system reduces organics, as measured by Chemical Oxygen Demand (COD), by as much as 98% and reduces Total Suspended Solids by as much as 99% in the matter of minutes.

OriginOil's CLEAN-FRAC system consists of three integrated modules:

- Single Step Extraction™ (SSE) tubular reactors designed to break the oil and water emulsion and to neutralize the charge on oil droplets and suspended solids, therefore coalescing the particles within the water phase.
- OriginOil's proprietary gas flotation concentrator specifically designed to lift the coalesced oil and solids to the surface of the water where a rake and dewatering belt will then separate the oil and solids from the water.
- Supervisory control and data acquisition (SCADA) system to measure input and output parameters and automatically control the process through proprietary algorithms.

#### **Deployment**

OriginOil's CLEAN-FRAC can be used as a standalone system for the separation and potential recovery of organics from produced or frac flowback water, enabling clients to reuse their process water for further fracturing or flooding operations. Reusing the water significantly reduces trucking and disposal costs, and may soon be increasingly required by regulators.

Coupled with equipment from OriginOil process partners, CLEAN-FRAC can be the first stage of a multi-stage system which can achieve Class B (ground water) grade water, or higher.

#### **Benefits**

By integrating the functional modules of the OriginOil CLEAN-FRAC system into a single piece of equipment, clients can simplify their operation, lower capital cost and reduce their operational labor cost and footprint.

- ✓ CLEAN-FRAC requires minimal energy and is chemical free, thereby lowering operational costs and simplifying downstream water recycling issues.
- ✓ CLEAN-FRAC is an inline system with continuous operation capability.
- ✓ CLEAN-FRAC operates without pre-filtering in most cases. CLEAN-FRAC has been shown to expedite the settling of heavy particulates in some instances.



## Process Description

OriginOil's CLEAN-FRAC makes use of the proven technology and performance of OriginOil Single Step Extraction systems for algae dewatering and cell rupture which have been in the field since 2010. Systems with aggregate capacity of 150 GPM have been built and in the proving stage at a demonstration-scale algae production and carbon capture recycling site in Australia.

### Step One: Extraction

The OriginOil SSE process at the core of CLEAN-FRAC utilizes electromagnetic pulses controlled by proprietary algorithms developed to optimize efficiency.

The electromagnetic pulses neutralize particles' repulsive charges, promote coagulation of suspended or dissolved organics and break emulsions in the water column.

### Step Two: Concentration

The gas flotation chamber generates a cloud of micro-bubbles to lift oil and solid materials to the surface of the water.

The mechanical design of the concentrator allows heavy material to fall to the bottom to be removed, while the oil and solids are raked from the surface with minimal water content. Potentially, the resulting hydrocarbon slurry could be recycled to the crude oil stream for recovery.

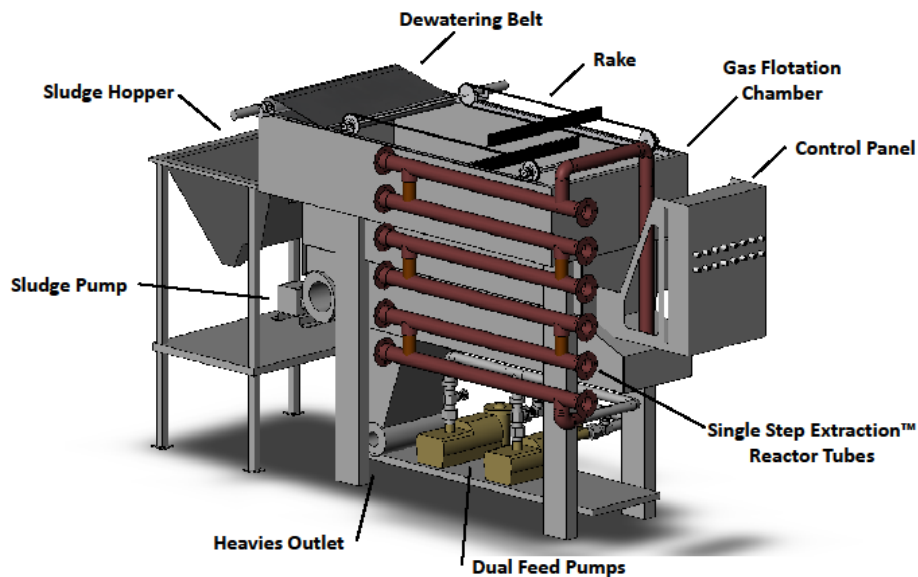


Figure 4: Artist's rendering of the CLEAN-FRAC™ Model 60K

## Process Control

The SSE Reactors and gas flotation concentrator are controlled by a SCADA<sup>1</sup> using algorithms developed for a specific configuration and the type of process water being treated.

The SCADA system can monitor specific water parameters and make real-time adjustments to control the electromagnetic pulse characteristics for maximum efficiency and minimum energy usage.

## Key Features

- ✓ As much as 98% reduction in organics as measured by COD
- ✓ Reduces TSS and color (PtCo CU) by as much as 99%
- ✓ Removal of heavy materials
- ✓ Breaks oil/water emulsion
- ✓ Designed for unattended operation
- ✓ Continuous inline treatment
- ✓ Proven scalable

## Configurations

All systems are fitted with connections for produced water input, effluent water, hydrocarbon product output, heavies output and external power connection. Unless the system is integrated into an OEM end to end treatment system, client must supply all external pumps, piping, fittings and power external to the system.

### Research Model

The CLEAN-FRAC Model 14K is a test or research system designed to process produced or frac flowback water at a continuous flow rate of 1 gallon per minute or 1,440 gallons/day in continuous operation. The Model 14K is completely self-contained.

### Production Models

The Model 60K (60,000 gals/day or 230,000 liters/day) is available for delivery within a twelve week timeframe.

Dimensions: Length 450 cm, width 137.5 cm, height 275 cm (will fit in one 20ft shipping container).

- Weight: ~1020 kg (2250 pounds).
- Electrical requirements: 120/208 volts, 3 phase, 50/60 hertz
- Power consumption: Approximately 0.2 kWh per barrel of water processed.

A Model 300K (300,000 gals/day or 1.15 ML/day) is in design stages.

Revised March 2013

---

<sup>1</sup> SCADA: Supervisory Control and Data Acquisition System