



HYDRUS TECHNOLOGY  
FRACTURE STIMULATION FLOWBACK  
WASTEWATER TREATMENT

## 1.0 Introduction & Background

Hydraulic fracturing, known as fracking, is commonly applied to wells for shale gas, tight gas, tight oil, and coal seam gas (CSG) to greatly increase the flow rate in an otherwise low permeability reservoir. Fracturing is a well-stimulation technique in which large volumes of water are mixed with additives and subsequently injected into rock formations such as shale. The rock is fractured by hydraulically pressurized fracking fluid that contains chemical additives to reduce friction, bacteria, and provide pathways for the hydrocarbons to flow. Upon completion of the frac, a portion of this fluid returns out of the well and is known as flowback fluid. This flowback contains a large component of fracking fluid mixed with brine formation water from the rock and requires treatment or disposal.

Large scale hydraulic fracturing is now creating new demands, challenges and constraints for the use, supply, treatment and disposal of flowback water that returns from the well during fracking. The treatment of this water for either re-use or release to the environment has lagged because of the technical complexity and cost. As a result, the implementation of mobile treatment technology that cleans complex fracturing fluid flowback is required for beneficial re-use or environmental discharge.

## 2.0 Key Challenges

Concern for the environmental impact of hydraulic fracturing is widespread with many in the community concerned about contamination of groundwater, the depletion of scarce fresh water resources, degradation of air quality arising from methane leakage to the atmosphere, the triggering of earthquakes, noise pollution, surface pollution, and the consequential risks to health and the environment.

Increases in seismic activity following hydraulic fracturing have been attributed to the deep-injection disposal of flowback and brine, which is produced from hydraulically fractured wells. For these reasons, hydraulic fracturing is under international scrutiny, restricted in some countries, and banned altogether in others. Some of those countries, notably the U.K., have repealed bans on hydraulic fracturing in favor of regulation. The European Union is drafting regulations that would permit controlled application of hydraulic fracturing. In Australia, legislation varies across state boundaries and there has been a reluctance of governments to act.

## 3.0 Technical Solution

The core technologies for frac stimulation water treatment include electrochemistry (EC), chemi-adsorption, chemical oxidation (such as chlorine dioxide, ozone, etc.), Ion Exchange, and membrane filtration (such as Nano-filtration, Reverse Osmosis, etc.). A key ingredient of frac fluid is guar-based gum. When borax or zirconium chemicals are added, they cross link among guar-based gum to provide a high viscosity support for the proppants such as sand and alumina used in fracking operations.

When fracing is complete, it is customary to reverse the crosslinking and recover the frac fluid from the hole for re-use. Hydrus Technology has developed a multi-stage approach to enable the water for frac fluid to be either re-used for further fracing, or to be released safely to the environment.

These steps include:

1. Hydrus ('HTX') first stage treatment is an emulsion-breaking step designed to separate the oil from the water that often arises from drilling and fracing operations. The first stage enables dissolved or emulsified oils to be returned as product.
2. The second stage HTX treatment combines catalytically enhanced oxidation with an excess of ferrous ( $\text{Fe}^{2+}$ ) ions to enable complete oxidation
3. A clarifier step (stage 3) then settles the water to enable it to be sent to either the final polishing step.
4. Liquid sludge at around 2% solids by weight is pumped to a dewatering section where sludge is first densified by further flocculation, followed by dewatering in an inclined screw press.

The system is configurable to provide secure communication with Hydrus Technology cloud servers for authentication, remote operation, diagnostics, and changed parameters for changed influent waters. The control system ensures maximum safe operating uptime in the field, providing certainty for clients.

## 4.0 Benefits

Benefits arising from the Hydrus Technology approach to frac water treatment include:

1. Emulsion breaking as a first step enables recovery of emulsified light and heavy oil components from the fracking liquid, for return to the client.
2. Use of catalyzed oxidation processes avoids the need for transport, storage and use of powerful oxidizing agents as used by our competitors, with attendant operational risks of explosion while in transit, spillage causing ground or surface water contamination and/or Health Safety and Environment (HSE) issues
3. Use of nano-filtration enables recovery of acetic acid, widely used in fracing and cleanup operations as a biodegradable pH adjuster and iron controlling agent
4. The high quality of the treated water provides the opportunity for either re-use or safe return to the environment in compliance with typical EPA Guidelines

## 5.0 Conclusion

Hydrus Technology has a clear solution to the rapidly emerging crisis that surrounds the environmental impact of hydraulic fracture stimulation fluids. The solution incorporates the production of biodegradable components and return of these to operators for further well and formation development. Sludge disposal off site is limited to a relatively small component of 20% solids cake, which meets all relevant criteria for disposal in a landfill.

The technology represents a state-of-the-art mobile water treatment system and it is imperative that such technologies come to the attention of both the public and the various regulators for the emerging industry of unconventional oil and gas.