TECHNOLOGY DATA SHEET TDS812

# Treatment of Flowback Water from Hydraulic Fracturing Operations

## FLOWBACK WATER TREATMENT OVERVIEW

Global Advantech has developed systems, which will efficiently treat flowback water arising from hydraulic fracturing (fracking) operations and for pre-treatment to remove undesirable components from water used to make up fracturing injection solutions. The systems utilise a number of process steps and incorporate innovative design features and benefits to ensure effective and continuous operation.

Global Advantech's systems are able to remove the majority of sulphates, carbonates, selenates and other cations (divalent and higher), which may be dissolved in water, depending upon its source. The systems also remove dissolved heavy metals (including iron), alkaline earth metals (calcium, strontium, barium and radium), suspended solids and biological materials (bacteria, algae, larvae, etc.) These cations both contribute to acidity and solubilise heavy metals into solution, making these discharges hazardous to the environment.

Global Advantech's treatment systems utilise:

- Combined chemical conditioning and electrocoagulation treatment to remove sulphate and carbonate cations, heavy metals, radio nuclides, hydrocarbons, most organic chemicals and suspended solids, whilst minimising the production of waste by-products.
- High pressure reverse osmosis to remove dissolved salts.

## ADVANTAGES OF GLOBAL ADVANTECH'S FLOWBACK WATER TREATMENT SYSTEMS

Global Advantech's flowback water treatment systems have a number of innovative advantages:

- Onsite treatment – removes the cost and environmental impact of transporting water offsite for treatment and reduces cost of importing water for use.
- Simultaneous removal of sulphates, selenium, heavy metals, arsenic, radionuclides, dissolved hydrocarbons, and suspended solids.
- Modular may be configured to treat and reduce a wide range of contaminant levels water to meet local permitted discharge criteria.
- Continuous flow operation.
- Minimisation of waste by-products - less hydrated flocs than conventional chemical treatment alone, therefore lower floc volumes.
- Ambient temperature operation, with substantially lower power consumption than thermal evaporators.
- Self-contained - built into a number of 20 feet ISO containers, each with integral bunds – only require power connection and site preparation of level hard standing.
- Fully automated and with telemetry available for remote monitoring.
- Available in configurations for safe area operation and for ATEX Zone 2 operation.

## FLOWBACK WATER TREATMENT PROCESS

Please refer to the schematic diagram after this section.

1. Flowback water for treatment is pumped into the multi-cyclone to remove particulates greater than 63 microns, which are periodically discharged to the filter press.
2. Water overflows the multi-cyclone into the first buffer tank, where its pH is adjusted to work efficiently with the selected chemical.

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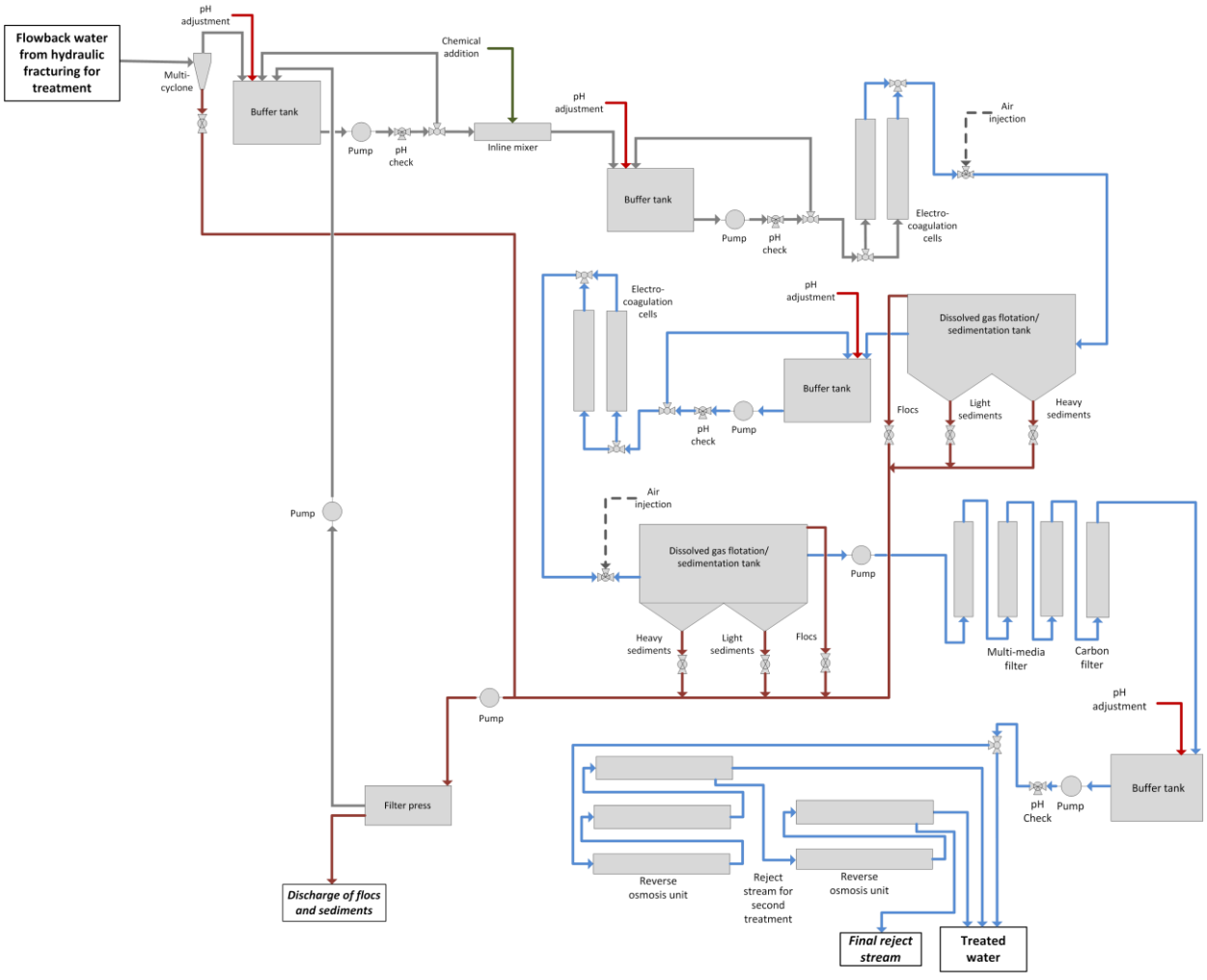
## PROCESS

3. Next the water is pumped through the inline mixer, where it is mixed with the selected chemicals and through into the second buffer tank.
4. The water is then treated using two stages of electrocoagulation, each with different cell chemistry, to remove accumulating suspensions of ultrafine particulates, clays, most organic compounds and any emulsified hydrocarbons. Each electrocoagulation stage includes flocculation/sedimentation tanks after the cells to remove all the flocculated and precipitated ultrafine particulates, clays, heavy metals, organic compounds and hydrocarbons.
5. Optionally, one of the electrocoagulation stages may be configured to act as an electro-Fenton system to oxidise and breakdown some organic compounds.
6. After the electrocoagulation/electro-oxidation stages, the water is filtered using multi-media and activated carbon filters.
7. Finally, high pressure reverse osmosis membrane filtration is used to remove to remove dissolved salts (typically chlorides), when required for discharge to the environment or re-use.
8. Sludges, flocs and sediments from the flocculation/ sedimentation tanks and secondary separator are pumped to a filter press for dewatering prior to discharge.



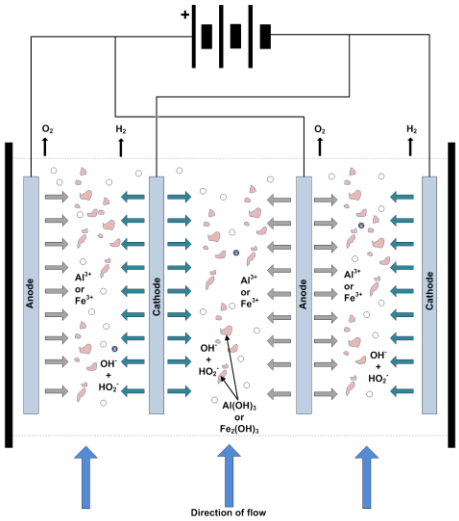

**Typical configuration for Global Advantech's system for flowback water treatment**

# Treatment of Flowback Water from Hydraulic Fracturing Operations

## ELECTROCOAGULATION PROCESS

Electrocoagulation is a proven and cost effective electrochemical process to remove most contaminants/pollutants from water: suspended solids, emulsified hydrocarbons and many dissolved organic compounds, heavy metals, arsenic, bacteria, algae, larvae, etc., from water for re-use/discharge. The electrocoagulation process is continuous flow and is low in energy consumption.

Electrocoagulation cells consist of pairs of parallel metal plate electrodes separated by a few millimetres with a low voltage applied at high current densities. The current flowing between the electrodes destabilises electrical charges, which maintain suspensions of particulates, e.g. clays, and emulsions/micro-emulsions of hydrocarbons and insoluble organic compounds. The particulates coagulate together into flocs. The hydrocarbons and insoluble organic compounds coalesce into larger droplets and rise in the flotation/ sedimentation tanks. Some anodic oxidation of organic compounds also takes place within the




cells – this process may be enhanced by re-configuration and the addition of chemical agents.

For more information, please refer to Technology Data Sheet: *TDS801 Electrocoagulation and Advanced Electrochemical Oxidation.*

## GLOBAL ADVANTECH'S ELECTROCOAGULATION SYSTEMS

Global Advantech's systems contain a number of innovative design features and benefits to ensure effective and continuous operation:

- Cells use optimised electrochemistry, with a large number of parallel plate electrodes for efficient operation.
- Hydrodynamic design of cells ensures water flow is through the whole cell volume and electrodes are evenly consumed.
- Upward flow cells with air injection prior to flotation/sedimentation tanks to dilute hydrogen gas below explosion and flammability limits.
- Cells may be reconfigured to operate in advanced electro-oxidation (electro-Fenton) mode.
- All systems are PLC controlled, programmed to prevent metal plate passivation (development of oxide layers of the surfaces of electrodes, which acts as insulation preventing cells from continuing to operate efficiently).
- The cell electrodes are mounted in carrier cartridges to facilitate rapid replacement.
- Multi-cell configurations enable a single cell to be taken off-line for maintenance.
- Instrumentation options include plate consumption monitoring, remote telemetry.
- Compact single and full-size multi-cell systems, capable of handling from 1m$^3$ per hour to more than 1,000m$^3$ per hour water flow available.
- Electrocoagulation systems are available configured for safe area operation and for operation in ATEX Zone 2.