

Treatment of Produced Water from Oil and Gas Production Operations

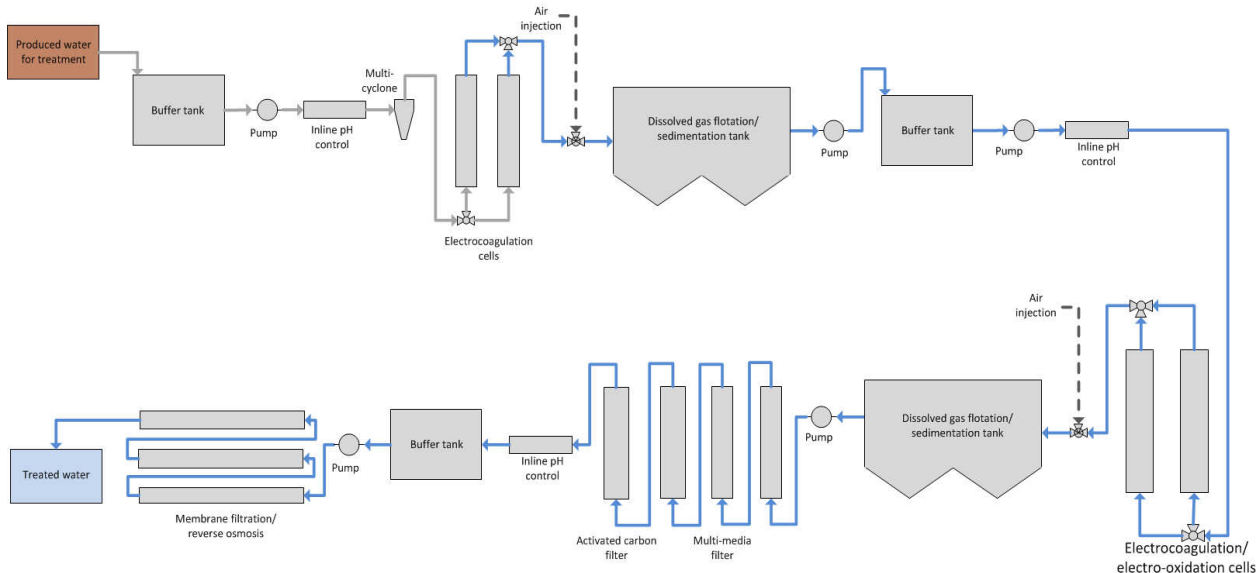
PROCESS OVERVIEW

Global Advantech's produced water and effluent treatment systems contain a number of innovative design features and benefits to ensure effective and continuous operation. The systems are supplied configured with two to four water treatment processes, depending upon the nature of the influent water and the local permitted discharge criteria:

1. Electrocoagulation to remove emulsified/dissolved hydrocarbons, suspended solids, and heavy and alkaline earth metals.
2. Advanced electrochemical oxidation cells (electro-Fenton) to mineralise many soluble

organic compounds to carbon dioxide water and simple salts, and oxidise sulphides and ammoniacal compounds

3. Multi-stage filtration, including cartridge, zeolite, membrane and activated carbon filters.
4. Ultra-filtration and nano-filtration/reverse osmosis to remove COD such as volatile fatty acids (e.g. acetic acid) and/or dissolved salts, where the level of salinity in the discharged water has to be reduced to meet local environmental criteria.



Typical system configuration for the treatment of produced and flowback water

REMOVAL OF CONTAMINANTS

Most of the contaminants in produced water may be removed using one or two stages of electrocoagulation (See *Technology Data*

Sheet "TDS801 *Electrocoagulation and Advanced Electrochemical Oxidation*"), followed by filtration.



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REMOVAL OF CONTAMINANTS Cont/...

Electrocoagulation cells remove emulsified/dissolved hydrocarbons, suspended solids, heavy and alkaline earth metals, as well as most dissolved organic, ammoniacal and sulphide compounds. The compounds give rise to the chemical oxygen demand (COD) levels in water.

	One pass	Two passes
Suspended solids	>95%	>99%
Emulsified/dissolved hydrocarbons	>95%	>99%
Bacteria/algae/larvae	>95%	>99%
Heavy metals	>95%	>99%
Calcium, magnesium	>90%	>95%
Arsenic	>70%	>90%
BOD	>90%	>95%
COD**	>90%	>95%

Some soluble organic and ammoniacal compounds, sulphides and mercaptans are not easily removed by electrocoagulation alone and may require additional treatment

with advanced electrochemical oxidation for their removal. However, certain organic compounds, such as volatile acids (VFAs): acetic/ethanoic acid to valeric/petanoic acid (i.e. C₂ to C₅ acids), are not removed by electrocoagulation or *in situ* advanced electrochemical oxidation and additional treatment is required (see below).

After treatment with electrocoagulation (and, advanced electrochemical oxidation), the water is filtered with several media, plus activated carbon to remove any remaining suspended solids and traces of hydrocarbons. The water is then either discharged or passed through a high pressure membrane filter (reverse osmosis plant).

Any volatile fatty acids are removed by converting them to sodium salts and passing the water through a high pressure membrane (reverse osmosis) system.

FEATURES AND BENEFITS

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

- Offshore/onsite treatment – removes the cost and environmental impact of transporting water onshore/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.
- Substantially lower power consumption than membrane filtration or thermal evaporation.
- Self-contained, compact footprint - built into a number of 20 feet ISO containers, each with integral bunds – only require power connection and hard standing.
- Fully automated and with telemetry available for remote monitoring.
- Available in configurations for safe area operation and for ATEX Zone 2 operation.