

Water Solutions for Upstream Oil & Gas



Produced water project, Bahrain



OPUS® technology, Chevron, San Ardo, California, USA

Dedicated to Creating Water Solutions for the Oil & Gas Industry

Oil & Gas exploration and production processes are highly complex and capital-intensive. Production companies face several challenges including safety, climate, technical issues, environmental constraints, and geographical issues. Continued innovation has increased the attractiveness and profitability of some exploration areas which pose geographical challenges.

Water is a Major Component in all Phases of Oil & Gas Production

Veolia Water Technologies provides sustainable management solutions for handling and treating produced water, and for production of water injection. With innovative technologies and a long history of serving the industry, Veolia provides solutions for:

- Enhanced oil recovery
- Treatment of injection water
- Treatment for beneficial reuse of produced water
- Treatment of produced water for surface discharge
- Sulfate removal
- Salinity reduction

Proven Solutions for Clean Production

Injection and Enhanced Oil Recovery



Prior to injection, produced water is often treated to remove contaminants that could otherwise plug the reservoir and/or damage injection equipment.

Veolia provides a comprehensive solution incorporating a variety of options to treat produced water and remove undesired elements.

Solutions are designed to meet the high performance demands of the Oil & Gas industry:

- Efficient treatment for increased productivity
- Robust and reliable installations and processes
- Operational safety in all environments
- Strict adherence to environmental compliance

A wide array of technologies and process expertise is available from Veolia to provide solutions for pretreatment, primary, secondary and tertiary treatment applications.

Our treatment solutions are suitable for applications across the entire upstream market, including both conventional and unconventional plays. Technologies support water treatment challenges in: water flood, chemical enhanced oil recovery, steam assisted gravity drainage (SAGD), and coal bed methane.



Beneficial Reuse of Produced Water

Produced Water Reuse Applications

Treating produced water for recycle and reuse benefits producers by protecting the environment, minimizing the need for fresh water, and enabling compliance to increasingly strict requirements. Successful uses of reclaimed water include:

- Process water for production operations
- Injection water
- Distillate for use in steam generation (SAGD)
- Agricultural irrigation

Treating produced water so that it can be safely reused requires technologies that can handle oil and grease, sparingly soluble inorganic salts, volatile organic compounds, and hazardous trace contaminants. These constituents pose challenges to traditional water treatment processes. Veolia has pre and post treatment systems that allow water treatment technologies to meet performance expectations.



Treatment for Surface Discharge

Produced water management is a developing capability, and production companies need a partner to assist with treatment for surface discharge. Producers are faced with evolving restrictions on the handling and discharge of water from:

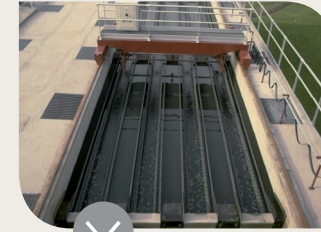
- Conventional and unconventional Oil & Gas fields
- Secondary and tertiary recovery from aging oil fields
- Tailings water
- Coal bed methane

These streams are subject to quality limitations, especially concerning total dissolved solids, suspended solids, metals, scale-formers, NORM, oil and grease, organics, and sodium absorption ratio. Veolia offers a wide range of solutions to the industry, tailored to meet your specific treatment and reuse objectives.

Proven Technologies for Upstream Oil & Gas



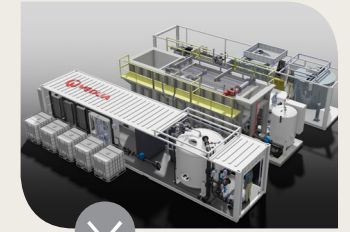
OPUS® II technology is the next generation OPUS process that utilizes Ceramic Ultra-Filter membranes as pretreatment prior to ion exchange and reverse osmosis operated at an elevated pH. The effluent is high quality water suitable for industrial reuse or surface discharge.



The **MULTIFLO™** process can be used in clarification or water softening applications. The proprietary Turbomix reactor promotes formation of heavier solids. The system combines coagulation, flocculation, and lamella settling in a single unit.



HPD® evaporation and crystallization systems are effective in concentrating wastewater streams to produce high-quality distillate for reuse and volume reduction. Unique processes developed for SAGD and shale gas applications are effective for produced water containing high levels of TDS.



SHALEFLOW™ is a transportable, modular solution that utilizes well proven technologies to treat up to 10,000 barrels per day (300 gpm) of produced water with a simple “drop and go” approach.



CoStrip™ Degasifier offers an efficient alternative to vacuum degasification by using enhanced flotation technology with natural gas or nitrogen to strip dissolved gasses such as volatile organic compounds (VOCs) from produced water.



POWER CLEAN™ nutshell filters are effective for the removal and treatment of hydrocarbons and suspended solids from produced water applications.



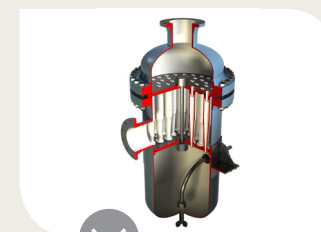
The **SULPHATE REMOVAL PLANT (SRP)** is used to extract sulphates from seawater prior to injection. The SRP uses nano-filtration membranes to remove sulphates while leaving the other salts unaffected, thus maintaining the stability and permeability of the formation clays.



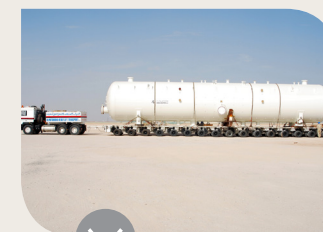
The **ROSS™** System is a simplified, yet robust solution for the treatment of oilfield produced water. Using Ceramic Ultra-Filter membrane technology, this system provides removal of oil and silica as well as softening of the water simultaneously in a fully modular system.



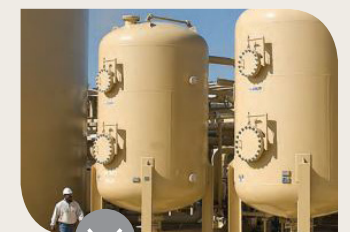
AUTOFLOT™ is a Mechanical Induced Gas Flotation (IGF) separator. Induced Gas Flotation separates oil from produced water or other oily water streams with a low retention time. An hydraulic version of our IGF is also available depending on the application.



HYDROCYCLONES de-sanding technologies efficiently removes troublesome solids such as sand, to protect against loss of production and eliminate associated costs. The system improves oil removal efficiency and reduces maintenance.



The **TIPPS™** Corrugated Plate Interceptor (CPI) is a gravity separation system for the removal of oil and solids from oily water. The pressurized CPI is used for multi-phase separation of solids, organics, and water.



ID ION EXCHANGE SOFTENING High specification Strong Acid Cation (SAC), Weak Acid Cation (WAC) or a combination of both in series, or a multi-step process of softening with other water treatment technologies for produced water treatment.

Oil & Gas Services and Solutions

Oil & Gas exploration and production processes can be highly complex and capital-intensive. By integrating chemistry and equipment technologies with local, field production services, Veolia offers solutions to drive down operating expenses.

Protection for your Equipment Assets and Production Processes

Veolia's line of HYDREX™ performance chemicals provides effective protection against your stimulation, completion, deep well injection, midstream and pipeline challenges. HYDREX™ delivers the results you need to remain profitable at the well site.

- Maximize your production efficiency
- Protect your asset integrity
- Maximize life cycle costs
- Minimize lease operating expenses

Veolia doesn't just provide treatment chemistry, equipment, and service. We provide comprehensive solutions that deliver results. By managing the technologies, delivery capabilities, on-site services, and control & reporting components, we free your time so that you can focus on production.

What to Expect from Veolia

Our HYDREX™ field teams work closely with each customer to develop tailored solutions. We target both flow rate and product quality to improve bottomline:

- On-site surveys at each well/field, along with laboratory modeling of your operational conditions
- Predictive tools to clearly define any operational limits which influence treatment
- Simulated pilot studies that validate the chemical approach being designed



Smarter Water Solutions with AQUAVISTA™

This digital services platform for water treatment systems provides personnel with a tool to efficiently manage your water treatment operations. Real-time data is customized, aggregated and always available through a suite of intelligent water process applications and algorithms.

- Improved asset performance, higher efficiency
- Lower operational and capital costs, reduced maintenance and chemical use
- Secure and reliable in a cloud-based system
- Dashboard adapts to your specifications, existing systems, and can be monitored anytime, anywhere

AQUAVISTA™ Operates on Four Levels:

AQUAVISTA™ Portal is a monitoring and reporting tool that provides a dashboard customized to meet the needs of any type of water treatment operation. It has alarm management, document management, order management tools, and a maintenance module. The Portal enables remote monitoring in real-time on any device.

AQUAVISTA™ Insight is a performance tool that applies algorithms and benchmarking metrics to the water treatment process. Predictive maintenance can minimize downtime of water treatment systems as well as production processes. This tool notifies operators with opportunities to take proactive improvement steps.

AQUAVISTA™ Plant offers online smart automation, with a full auto-pilot function. This suite of intelligent software and holistic solutions offers online control, monitoring and forecasting to meet operational and safety targets. Aquavista Plant uses a combination of hydraulic, process, and economic models and is based on machine learning and Artificial Intelligence concepts.

AQUAVISTA™ Assist provides access to a network of Veolia's experienced water experts to offer process support. Features include troubleshooting, emergency support, feedback, and training courses. Augmented reality technology enables off-site experts to see what the operator is seeing remotely.

Resourcing the world

Veolia Water Technologies

Tel +1-800-337-0777

water.info@veolia.com

www.veoliawatertech.com