



# Content

- 3 About APATEQ
- 4 Frac Flowback and Produced Water Treatment
- 8 Industrial Wastewater Treatment
- 10 Compact Wastewater Treatment
- 14 Leachate Treatment
- 16 Scrub Water Treatment
- 18 Membranes
- 19 Primary Treatment
- 20 Sludge Dewatering
- 21 Air Injection
- 22 Our Mission





## About **APATEQ**

**APATEQ** engineers and manufactures turnkey, custom designed systems for the treatment of frac flowback and produced water from oil and gas production, compact wastewater treatment plants for demanding applications and full-solution systems for industrial wastewater. We have a top tier technical team, each member having gained decades of experience in water and wastewater treatment or global product industrial manufacturing and commercialization.

# Products - OilPaq

## Frac Flowback and Produced Water Treatment



## OilPaq

“OilPaq” is a unique solution for treating frac flowback and produced water generated from oil and gas production. The treatment is conducted by turnkey plants directly on-site at on- or offshore oil fields, thus saving scarce and expensive fresh water and reducing produced water storage and transportation costs. Offered either containerized or in rack-mounted modules, OilPaq systems combine APATEQ’s proprietary primary treatment process, achieving an oil and total suspended solids removal rate of up to 90%, with a subsequent proprietary treatment process encompassing specially conditioned organic or ceramic membranes to generate high-quality water suitable for e.g. reuse in frac operations or for reinjection to achieve enhanced oil and gas recovery. With an additional post-treatment module, it could either be used for irrigation or as process water or discharged directly.

APATEQ uses a proprietary process that ensures that the used membranes do not clog fast, have a long running time and last many years before they need to be replaced. Even with varying composition of produced water, the results of the APATEQ treatment technology are typically less than 2 ppm of both free hydrocarbons and suspended solids. It requires no or very small amounts of chemicals in comparison to existing processes and 100% of the oil that is separated from the raw water can be directly processed in refineries instead of having to be burned, buried or otherwise disposed of. Fully automated, OilPaq can easily be controlled and monitored remotely by PC, tablet or smartphone with an app showing the graphic user interface of the plant.

### Key Features

- On-site treatment at oil fields on- and offshore
- Same solution for frac flowback and produced water
- No or small amounts of chemicals required
- Effective removal of scale formers (hardness, silica, iron, barium, strontium)
- Effective removal of particulates (oil, solids, bacteria, clay) with an effluent showing typically less than 2 ppm of hydrocarbons and less than 1 ppm of TSS (Total Suspended Solids)
- Low operation costs with far less clogging of membranes, long intervals between CIPs (Clean-In-Place) and low chemical demand
- High system recovery rates, minimizing generated liquid waste and additional income from recovered oil sold to refineries
- Excellent thermal insulation of the plant
- Compact treatment system requiring less space than conventional solutions
- Packaged, modular, shop-fabricated, pre-piped, pre-wired treatment system
- Full automation does not require fulltime on-site assistance



# Products - OilPaq

## Frac Flowback and Produced Water Treatment

### Reuse of effluent in frac operations

OilPaq technology is ideal for treatment of flowback and produced water for reuse in frac operations. In the process, the feed water is first treated in APATEQ's primary treatment device "PrePaq" for removal of up to 90% of total suspended solids. This process utilizes a proprietary technology, to assist in the separation of solids with zero chemicals used. These dense solids are then removed in a settling zone at the bottom of the device. Excess solids are intermittently purged from the PrePaq for dewatering and subsequent disposal. The effluent from the PrePaq is then processed through APATEQ's proprietary membrane ultrafiltration technology. Operated in cross-flow mode, the membranes remove free oil, the remaining suspended solids and bacteria to very low concentrations in one single step. The solids removed by the ultrafiltration membranes are collected in the ultrafiltration concentrate, which is brought back into the feed tank of the OilPaq. Here the solids will be removed from the system by settling on the bottom of the tank. The treated water from the ultrafiltration process can be reused for new frac operations, provided the salinity is within acceptable limits. If the salinity is too high, fresh water is added to bring the salinity levels down. This, however, allows great savings in fresh water.

#### Benefits

- Enables reuse of produced water and frac water
- Reduces fresh water demand
- Lessens dependency on natural fresh water resources
- Minimizes truck traffic for water transportation
- Reduces produced water disposal costs

### Reinjection for EOR or disposal

Another possible reuse of the treated water is to reinject it into the formation for enhanced oil recovery (EOR) or for disposal. As the OilPaq produces an effluent with the following characteristics:

- oxygen free,
- bacteria free,
- suspended solids < 1  $\mu\text{m}$  (depends on the formation),
- free and emulsified oil < 2 ppm,

the reinjection of the water back into the formation is possible without the danger of clogging or fouling the well.

#### Benefits

- Increases reservoir injection rates
- Enhances recovery of oil from formation
- Reduces plugging of formation pores with particulates and scale deposits
- Minimizes injector piping corrosion
- Reduces injection chemical demand

### Pilot plant

APATEQ offers on-site performance demonstration of the OilPaq technology using mobile pilot systems. These pilot units are capable of treating 50 to 200 barrels/day of water.

Through piloting, each unique application can be thoroughly tested prior to design and installation of the full-scale system. This ensures that the installed system will achieve the designed performance and operating cost parameters.



From left to right: produced water, water after primary treatment, clean water after ultrafiltration



## Safety and Environment

The OilPaq is designed to operate safely in potentially hazardous areas such as potentially explosive environments and thus meets the highest international standards including IECEx. The system features include, for example, that water surfaces in the OilPaq tanks are blanketed with nitrogen. Sensors for light and heavy gases as well as oxygen are installed in the OilPaq, continuously monitoring environmental gases. In case of any gas detected inside the plant, it immediately shuts down automatically. Alarms inform the operator, even remotely, if other equipment reaches levels out of range. In these unlikely events, the OilPaq's software is programmed to take immediate corrective action, such as switching from a defective aggregate to its standby redundant counter part. All process critical modules are designed with redundancy in mind to enable continuous and unabated operation of the plant.

The OilPaq is developed to meet future legislation. The plant's effluent is in compliance with the most stringent environmental standards. As the OilPaq does not require additional chemicals for the oil-water separation process, recovered oil from the produced water can be fully used in refineries and the effluent water can be reused at 100% as it is not polluted by any residues.



# Products - RecyPaq Industrial Wastewater Treatment





# RecyPaq

Industrial companies that require large quantities of high quality water for their processes, such as for cooling or cleaning purposes, face enormous and steadily rising fresh water and disposal costs. The APATEQ treatment system for industrial wastewater has proven its efficiency and value in a diversity of industrial sectors including dairy, pulp & paper, vegetable and fruit processing. APATEQ provides full-solution systems for the treatment of industrial wastewater from various sources, producing an effluent according to the clients need such as reuse, irrigation or direct discharge, thus saving fresh water costs and wastewater disposal fees. For plant operation, no or small amounts of chemicals are required, which additionally leads to lower operational costs. Eligible applications are e.g.

- reduction of chemical oxygen demand (COD) / biological oxygen demand (BOD),
- suspended solids removal,
- desalination,
- pesticides / plant protection removal.

Depending on the raw water characteristics and demanded effluent quality, the “RecyPaq” combines different modules of APATEQ’s technology portfolio for primary, secondary and tertiary treatment as well as subsequent polishing and sludge treatment. The APATEQ products and systems for industrial wastewater treatment include

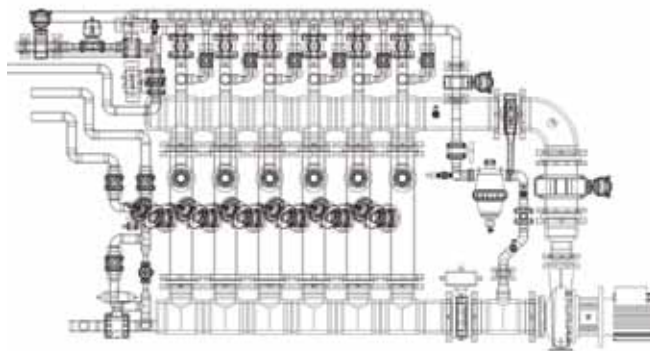
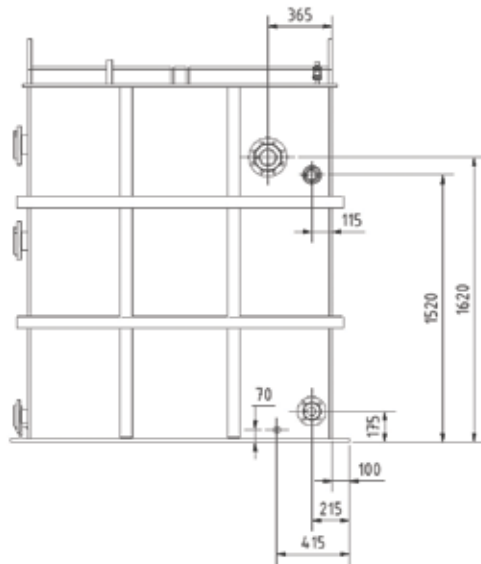
- high quality, stainless steel pumps and mixers to transport industrial wastewater including abrasive and corrosive liquids,
- various primary treatment devices such as screens, gravel filters and APATEQ’s proprietary “PrePaq” for solid-liquid separation,
- ultrafiltration and microfiltration membrane systems, as well

as reverse osmosis and nanofiltration to purify processed wastewater, whereas the ultrafiltration is provided by APATEQ’s proprietary process technology that runs conventional membranes at a high efficiency level (down to 0.01  $\mu\text{m}$  level),

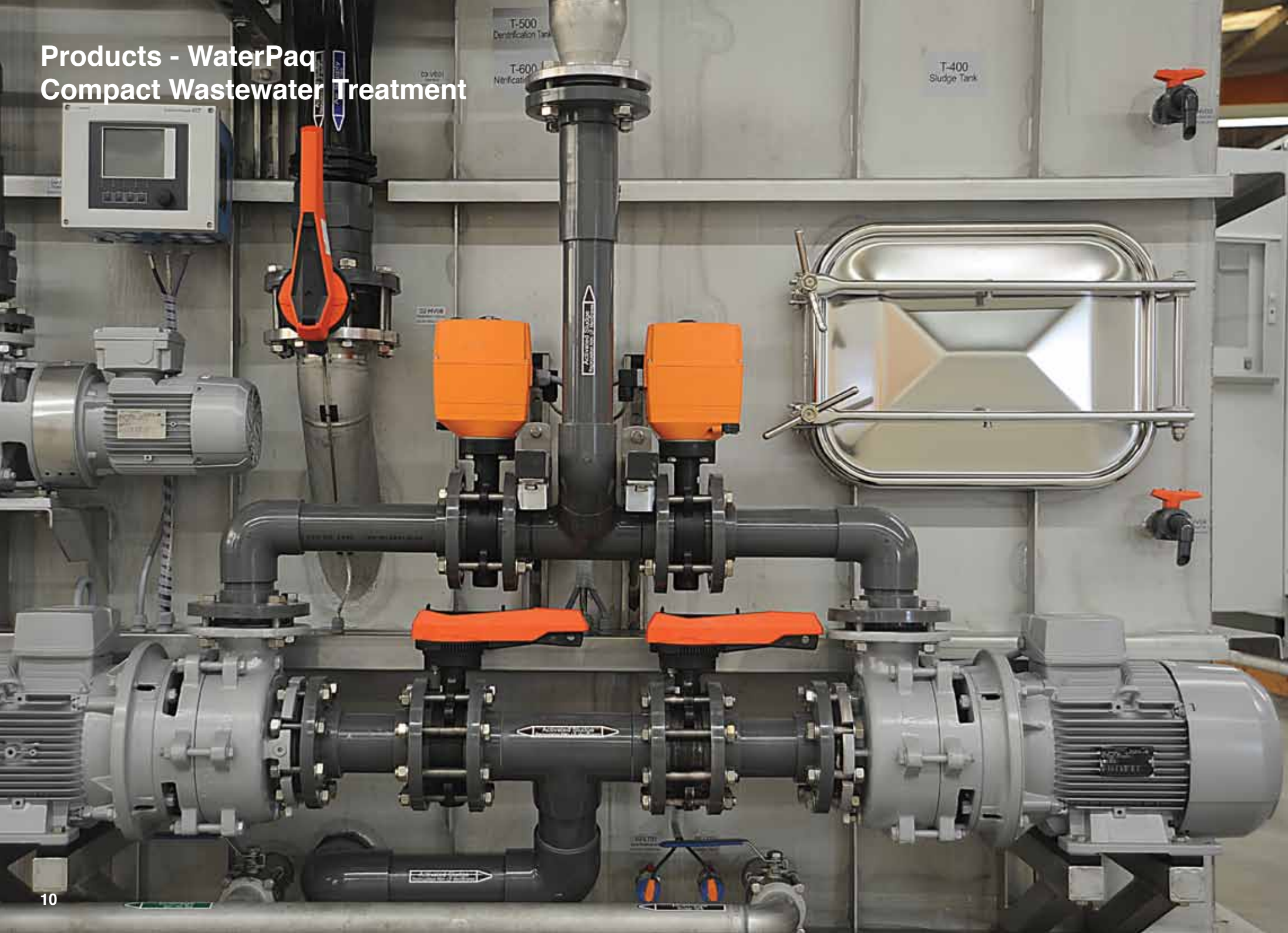
- media filtration systems to polish the effluent to meet restricted discharge limits for reuse,
- sludge collector systems,
- ultraviolet (UV) and ozone systems for post-treatment / disinfection and
- monitoring and control systems.

APATEQ’s proprietary primary treatment module PrePaq, for example, eliminates up to 90% of TSS (Total Suspended Solids) from wastewater, so that subsequent treatments such as membrane filtration are relieved and thus work with lower energy consumption and reduced chemical additive input should chemicals be required in a specific application, extending the lifetime of the membranes. PrePaq performance is based on gravity and fluid dynamics and requires no or less chemicals.

By means of a proprietary process, APATEQ applies conventional membranes that remove particulates larger than 0.01  $\mu\text{m}$  at high efficiency level and low operational costs, as the process does not require high chemical consumption and allows long intervals in between their effortless cleaning procedures. If needed, a subsequent treatment by e.g. a 1- or 2-stage reverse osmosis can be added. Possible concluding purification could comprise disinfection techniques such as ozone, chlorination and hydrogen peroxide. Similarly to the rest of the APATEQ product portfolio, the RecyPaq is fully automated and can be monitored and controlled remotely, no full time on-site operator is needed, resulting in additional cost savings.



# Products - WaterPac Compact Wastewater Treatment



# WaterPaq

Our compact wastewater treatment system “WaterPaq” combines high performance and low operational expenses at a significantly reduced footprint. Containerized APATEQ wastewater treatment plants can handle from 10 m<sup>3</sup>/day to 120 m<sup>3</sup>/day. Depending on the plant capacity, the process technology is housed into one or two ISO containers.

Effluent from the APATEQ WaterPaq complies with the toughest international regulations for direct discharge. Alternatively, the container can be customized in order to produce water for reuse purposes, such as washing, cooling or irrigation.

The WaterPaq is ideally suited for operating at remote locations, even in environmentally sensitive landscapes such as environmental protection zones in Canada. Due to its specific insulation, the system is suitable for harsh climate environments at temperatures between -40°F to +125°F (-40°C and +50°C). It is flexible with regard to fluctuations in inlet volume, as well as total suspended and dissolved solids. Wastewater treatment with the WaterPaq allows remote operation, surveillance and troubleshooting.

The plant is delivered as a plug-and-play unit including piping and cabling and thus can be installed and commissioned within days. Only limited civil works are necessary for the WaterPaq; for the container format version, only a container foundation is required.



## Key Features

- Savings of discharge fees / fresh water expenses
- Low operation costs and effortless maintenance
- Ideally suited for high total suspended solids (TSS)
- Operation is flexible with regard to fluctuations in inlet volume, load and TSS
- Easily scalable technology
- Skid mounted and / or containerized solution for mobile use (CSC certified shippable containers)
- Suitable for remote locations, even environmental protection zones
- Eliminates bacteria and most of the viruses
- Membranes are positioned outside of the bioreactor for ease of handling and serviceability
- Small footprint
- Suitable for harsh climate environments
- Remote operation, surveillance and troubleshooting
- Short lead time
- Quick commissioning and fast start-up time
- Only limited civil works required
- Sludge treatment within the unit
- Buffer tank included in the plant to hold 8 hours worth of raw water



# Products - WaterPaq

## Compact Wastewater Treatment

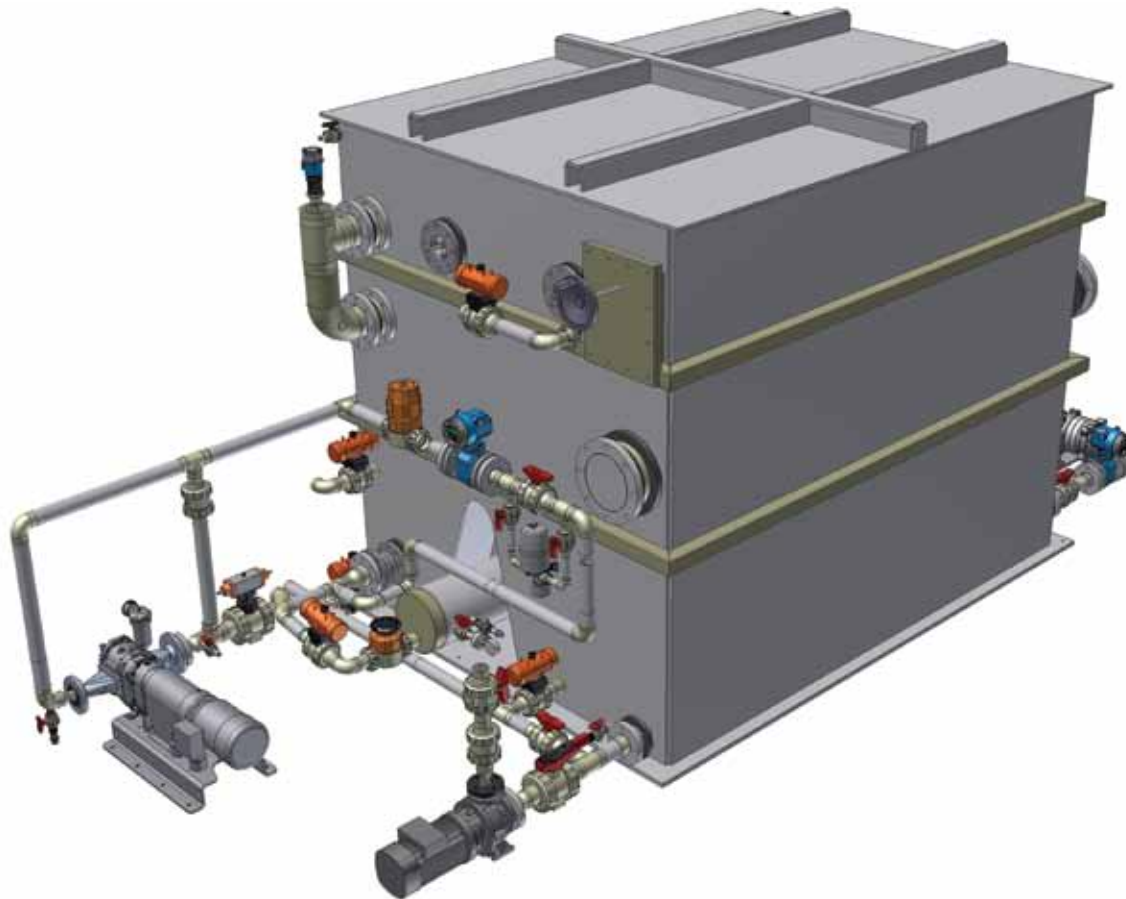
### Modular Design and Full Automation

WaterPaq has a modular design that can easily be adapted according to customer needs. As standard WaterPaq modules are available off-the-shelf, construction changes of running systems (such as a capacity increase of the system or changed effluent quality requirements) can be effected quickly. Naturally, the APATEQ engineering team conducts the commissioning and takes care of a smooth and rapid transition of the plant including its control system.

WaterPaq is either delivered in a turnkey, containerized format or alternatively, compactly mounted on stainless steel racks for integration into an existing plant or housing. Containerized plants can be transported easily and are very mobile, thus they are very useful for rig sites or man camps. Rack-mounted solutions are ideally suited for oil field service providers who run other equipment in containers already. Here, WaterPaq modules easily fit in as they are designed to occupy only a very small footprint.

Either containerized or rack-mounted, the WaterPaq is fully automated and doesn't require a fulltime on-site operator. With an app displaying the plant's graphic user interface, it saves additional manpower costs by controlling and monitoring the plant remotely from desktop computer, tablet or smartphone.





## Turnkey systems for decentralized and mobile use

With our team of dedicated, highly experienced project engineers, designers, coordinators, field engineers, offshore technicians and workshop staff, APATEQ takes care of complete turnkey projects from order intake to commissioning and operation.

All turnkey projects include:

- As-build drawings / 3-D drawings
- Electrical drawings
- Technical handbook
- Installation supervision
- Commissioning
- Training
- Plant supervision
- Maintenance contract (optional)

Delivered as a plug-and-play unit, the WaterPaq can be commissioned and shut down quickly, thus rendering it ideally suited for mobile applications such as working camps, construction sites or offshore rigs. At the same time, the WaterPaq offers a compact decentralized solution for small, remote communities without access to the municipal sewer system. In the absence of infrastructure with canals to the nearest municipal wastewater treatment plant and associated pumping stations, an on-site wastewater treatment by APATEQ's WaterPaq is a sensible and economically attractive proposition.

Products - LeachPac  
Leachate Treatment



# LeachPaq

Landfill leachate consists of liquids arising from organic and inorganic waste, as well as rainwater seeping into the landfill. Leachate is typically heavily loaded with COD, BOD, nitrogen, pesticides and sometimes heavy metals. To protect surrounding soil, ground water and surface water, safe disposal of the leachate is undeniably an environmental necessity.

Producing an effluent suitable for direct environmental discharge, industrial reuse or irrigation, APATEQ's "LeachPaq" is the complete, on-site leachate treatment solution. Since no two leachates are the same and the leachate landfill load can vary over the course of time, APATEQ applies either membrane bioreactor or ultrafiltration / reverse osmosis technologies. To create customer savings and ensure short lead times, APATEQ utilizes a modular-system-approach to standardize each LeachPaq. For a turnkey operation, the fully automated LeachPaq is delivered rack-mounted or containerized.

Since the leachate is processed on-site, the very expensive leachate transportation and disposal costs are reduced markedly. The LeachPaq control system is designed for total automatic and

remote operation; therefore, LeachPaq can be operated without permanent on-site supervision.

## Key Features

- On-site treatment of heavy loaded leachate
- Effluent is suitable for direct discharge
- Low operation costs by using APATEQ's proprietary technology
- Modular system adaptable to changing conditions of inlet
- Automatic plant operation and remote monitoring
- Available rack-mounted or as mobile, containerized solution
- Turnkey delivery
- Quick commissioning

Members of the APATEQ team possess more than 20 years of experience in design, construction and operation of leachate treatment systems and have built more than 50 plants in Europe and Asia.



# Products - MarinePaq Scrub Water Treatment





## MarinePaq

APATEQ provides compact systems for installation in harbors and on-board large vessels to treat contaminated water from exhaust gas cleaning with scrubber techniques of closed loop or open loop. In an open loop system, outgoing exhaust gases are washed with seawater in the scrubber. The seawater is discharged directly into the sea after an appropriate treatment. In a closed loop system, outgoing exhaust gases are washed with process water in the scrubber. The process water is recirculated continuously. A closed loop can operate anywhere, but has higher operation costs.

“MarinePaq” meets all international environmental standards on water purification. Whereas the very compact on-board solutions handle lower capacities and are designed for the specifications of offshore discharge, the harbor installations handle large capacities of up to 500 m<sup>3</sup> and are designed for very tough specifications. The system, regardless if harbor or on-board installation, efficiently removes contaminants from the scrub water to meet the respective regulations for direct discharge. For on-board installations specifically, all requirements of IMO (International Maritime Organization), such as PAH, pH and turbidity are by far exceeded.

The harbor based MarinePaq relies on chemical pre-treatment, ultrafiltration, sludge treatment and active carbon filtration followed by selective ion-exchangers. It excels by extremely low operation costs, because the system has a very low specific energy consumption and the membranes last several years, they can be replaced inexpensively and allow long intervals between CIPs (Clean-In-Place).

MarinePaq is constructed for a long life span and continuous operation by meeting the most stringent standards in a highly corrosive environment. To increase reliability and continuous unabated operation, all vital components such as pumps, automatic valves etc. are provided with redundancy in mind (backup units are incorporated).

Similarly to the vast majority of APATEQ’s other water and wastewater treatment systems, MarinePaq is fully automated and can be monitored and controlled remotely, thus reducing the operation costs as no permanent supervision on-site is required.



## Membranes

APATEQ utilizes organic or inorganic membranes in its proprietary processes to build wastewater plants and oil-water separation systems. Consequently they offer several advantages:

- minimized membrane surface fouling
- increased process efficiency
- significant cost reduction
- low energy consumption
- effortless cleaning procedure with long intervals in between cleanings
- substantial extended membrane lifetime

Depending of the used membrane, the ultrafiltration removes particulates and free or emulsified oil components larger than  $0.01 \mu\text{m}$ . Ensuring a constant operation at high performance levels between the CIPs (Clean-In-Place) and to lower the surface load, low fouling membranes with high hydrophilic membrane surface are integrated into the system.

Typical diameter of human hair:  
50 microns

Typical diameter of membrane pores:  
0.01 to 0.04 micron



# Technology

## Primary Treatment

Depending on the specific wastewater characteristics, APATEQ applies different wastewater treatment methods that are either proprietary developments or components procured from quality suppliers.

“PrePaq” operates by means of gravity and fluid dynamics. Using no energy, no chemicals and with an efficiency of up to 99.9%, APATEQ’s proprietary pre-treatment module separates organic and inorganic matter sizes down to 15  $\mu\text{m}$ . Resulting in smaller plant dimensions at lower investment and operational costs, primary treatment with PrePaq reduces the pollutant load for subsequent treatment steps materially.

When conditioned with our proprietary alternating coatings, the PrePaq can also be used in the oil field to separate hydrocarbons from produced and flowback wastewater. PrePaq relieves the subsequent membrane filtration process and eliminates the majority of the suspended solids.

## Sludge Dewatering

Acting as a gravity thickener within the APATEQ systems, a sludge storage tank removes solids in the primary treatment and sludge particles are separated by the membranes.

The sludge from the biological stage is pumped into the sludge storage tank via a motor valve. A pressure probe measures the sludge level in the sludge tank and controls the motor valve. Next, without adding flocculants or precipitation chemicals and with long lifetime and smooth operation, a bespoke compact sludge dewatering device thickens the sludge to a level of 17% DS (Dry Solids) or greater. The dry sludge is stored in a closed compartment within the plant. Disposal of the sludge can be scheduled in intervals as long as a month.

When used in containerized wastewater treatment plants to avoid any gas release inside of the container, an integrated air management system is installed. Using sample ports installed on the tank's outside wall, the operator can evaluate the current level of the sludge blanket in the tank. Depending on the volume of the sludge, different sized compact chamber-filter presses will be used.



# Technology

## Air Injection

Depending upon the plant capacity, venturi elements or air blowers are used to aerate the biology. Taking advantage of the existing recirculation flow to save associated air blowers or compressors, smaller systems will incorporate venturi pipes and save additional operational energy.

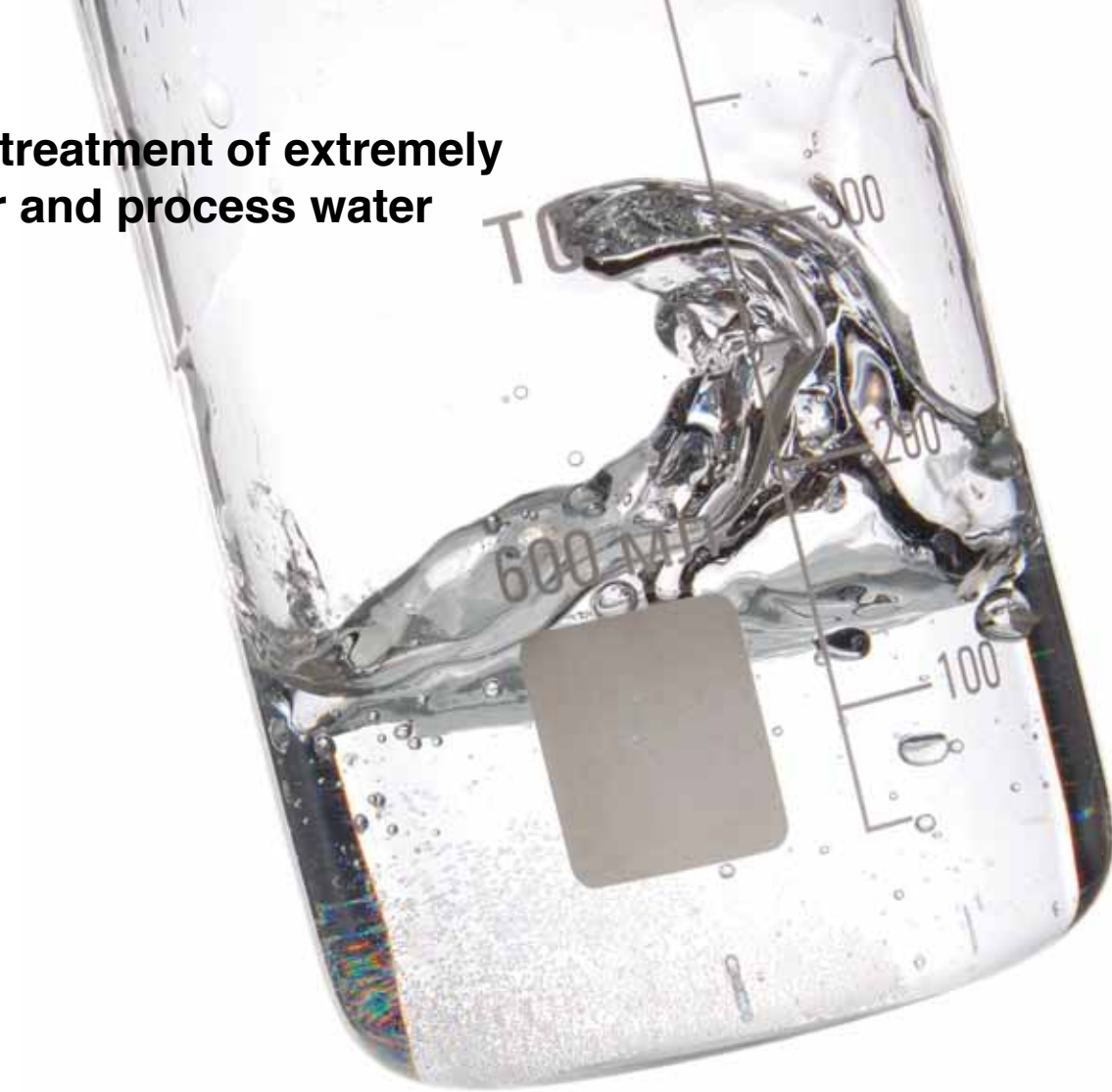
By passing fluid through a constricted section of a pipe, low pressure is created around this constriction zone sucking air into the pipe. The air is moved by the stream and blown into the biology tank where bacteria colonies are grown. The bacteria colonies eliminate organics from the treated liquid.

For air injection, APATEQ plants larger than 25 m<sup>3</sup>/day use state-of-the-art injection blowers. When possible, venturi elements will be installed. To prevent mechanical downtimes, the critical systems of the plant are designed with redundant air blowers and pumps. Therefore, if one component fails, the backup device will provide continuous operation. To ensure consistent component wear, the redundant equipment alternates operation between the devices.



## **Our Mission**

**Innovative, chemicals-free treatment of extremely difficult to treat wastewater and process water**



## What we stand for

APATEQ provides reliable water and wastewater solutions by means of innovative and proprietary technologies at the highest level in terms of performance, quality, safety and economic value as well as ecological efficiency. These technologies are designed to, depending on raw water characteristics and effluent water requirement, reduce or at best eliminate the usage of chemical additives for water and wastewater treatment thus reducing operation costs and sustaining the environment. Our plants are designed for 24/7 operation. All critical components are equipped redundantly, preventing plant downtimes. As most of the APATEQ systems are fully automated and can be monitored and controlled remotely, no permanent on-site operator is necessary.

Our primary goals are client satisfaction, environmental protection and water conservation. We deliver our products in due time including an extensive after sales service and warranty periods above legal requirements. Our plants are developed to meet current and future legislation and are in compliance with even the most stringent environmental standards. The effluent from our systems is suitable for direct discharge, reuse or irrigation, saving our most precious resource: fresh water.

APATEQ has been honored by several awards for its proprietary technologies and products internationally.



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