

MarinePaq EGC and EGR water treatment



INTRODUCTION

APATEQ's water treatment unit MarinePaq is the green and cost-efficient solution for the treatment of process water resulting from vessel's SOx reducing EGC (Exhaust Gas Cleaning) systems, such as scrubbers and NOx reducing EGR (Exhaust Gas Recirculation) systems. The MarinePaq is not limited in treating scrubber raw water that originates from technical / drinking water but also treats scrubber water originated from seawater. The performance of the plant is not influenced by this or the other type of water. This allows the end-user a maximum of flexibility with the source of the scrubber water.

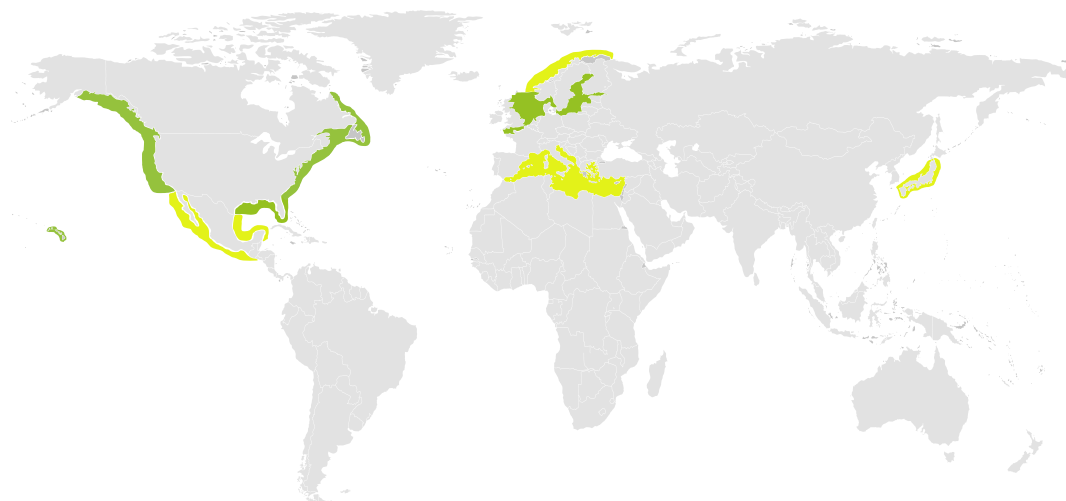
APATEQ combines field-proven membrane filtration technology with unique process technologies, setting new standards in terms of performance, quality, safety and economic value as well as ecological efficiency. The modular system produces an effluent that will always comply with the most stringent rules in place, be it in the open sea, coastal areas and in harbours, giving the operators peace of mind when operating the system.

IMO regulation

Complying with the global sulphur emission limit of 0,5%, respectively 0,1% in the ECA (Emission Control Areas) set by the IMO (International Maritime Organization) requires action taken by ship owners. They can switch to low sulphur fuel MGO (Marine Gas Oil), LNG (Liquefied Natural Gas) or install devices such as scrubber systems for the purification of exhaust gases from heavy bunker oil usage.

Process water from EGC

Installing EGC (Exhaust Gas Cleaning) systems such as scrubbers is mostly used in practice today, as low sulphur oil is more expensive than heavy bunker oil. Besides, back-fitting the engine of the vessel accordingly would mean substantial additional costs for ship owners. Thus, the implementation of scrubber systems for SOx reduction, in open, closed loop or hybrid design is mainly the widely spread practice today. Scrubber systems produce process water (scrubber water) in large (open loop) or smaller (closed loop) extent. Consequently, IMO has foreseen limiting values in terms of pH, PAH, nitrate and turbidity before discharging it to the sea (IMO MEPC.184 (59)). This makes a certain



Existing ECA

Possible future ECA

Emission Control Areas (ECA)
according to IMO

treatment necessary. For a discharge in coastal areas, including harbours, specific national regulations are put into place, preventing the relocation of the issue of emissions from the air to the sea.

Process water from EGR

Exhaust Gas Recirculation (EGR) is a method to reduce NOx emissions to meet Tier III requirements (valid for ships that have keels laid after 1 January 2016). In the EGR process, a proportion of the exhaust gas is recycled back to the engine by a scrubber system removing the contaminants. The process water resulting from the exhaust gas washing is continuously cleaned during EGR operation, making a dedicated device for treatment necessary.

MarinePaq for the combined treatment of process water from EGC and EGR

Existing regulations put into place by the IMO or local governments are subject of steady tightening. Limiting values for discharge into the sea will be decreased to minimum levels of overall pollution. As a consequence, EGC and EGR process water treatment systems that can fulfill existing regulations may not be sufficient in the future. Shipping companies should be aware of this before they take the decision for the investment on a water treatment system based on current legislation.

Clean-tech innovator APATEQ provides green and cost-efficient water treatment solutions for the maritime industry. The MarinePaq can be used to clean the water from both sources: closed loop SOx EGC and the NOx reducing EGR systems. The combined water treatment system lowers the initial investment and requires less space on board the vessel versus the independent systems for closed loop and EGR processes. Alternatively, the MarinePaq is available as onshore solution, providing an effluent suitable for direct discharge into the harbour. Thus, shipping companies can treat process water from EGC and EGR from their vessels by themselves on a centralized spot, saving expensive water disposal costs for hauling this water to the nearest industrial wastewater treatment facility and they are independent from the availability of external water disposal providers, simultaneously saving time and gaining flexibility on their fleet. The performance of APATEQ's MarinePaq is in full compliance with present legislation. Also, it can be easily adapted to meet

future, tighter legislation (e.g. stricter limiting values for heavy metals), as the modular design of the system allows not only capacity but also performance increases. Process water from EGC such as scrubber water is typically highly contaminated with heavy metals, hydrocarbons and soot resulting from the combustion of the heavy bunker oil. The same applies for EGR water when heavy bunker oil is used. APATEQ excels above other technologies available on the market by combining field proven membrane filtration technology with proprietary process technologies that the company masters, ensuring a reliable, failure-free operation at low operation expenses. By means of APATEQ's MarinePaq solution, even the smallest particles are reliably removed, providing an effluent that allows a direct discharge into the sea, coastal areas and harbour according to the most onerous international legislation. The membranes used for the treatment excel by a very long lifetime before they have to be thoroughly cleansed or exchanged. Optimized membrane performance combined with constant automatic backwash allows effortless maintenance procedures with long intervals. Sludge produced during the treatment is compacted by an integrated chamber filter press and safely disposed of onshore to appropriate facilities. Alternatively, the sludge can be stored on board and pumped ashore on the next port of call, if this solution is preferred by the end-customer. The MarinePaq is designed for a 24/7 operation with highest degree of automation.

MarinePaq benefits

- Treats both EGC and EGR process water in one unit
- Runs with both, technical / drinking water and with seawater alike
- Extraction of surplus oil from the scrubber water is possible
- Field-proven reliability ensuring a constant compliance with IMO discharge rules
- Low operation costs
- No expensive scrubber water hauling required
- No dependency on the availability of external water disposal providers
- Modular design easily allows performance and capacity increases
- Long lasting membranes
- Low maintenance efforts
- Reliable 24/7 operation

TECHNICAL SPECIFICATIONS

MarinePaq

The MarinePaq produces an effluent that complies with the IMO MARPOL Annex VI norms for open sea discharge in the ECA. The IMO MEPC.184(59) guidelines require three wash water parameters to be continuously monitored if discharged to sea:

Acidity: pH > 6,5

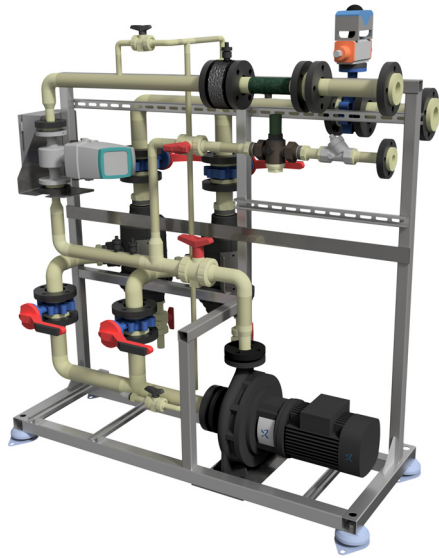
Turbidity < 25 FNU (Formazine Nephelometric Unit)

PAH (Polycyclic Aromatic Hydrocarbons) < 0,05 mg/l

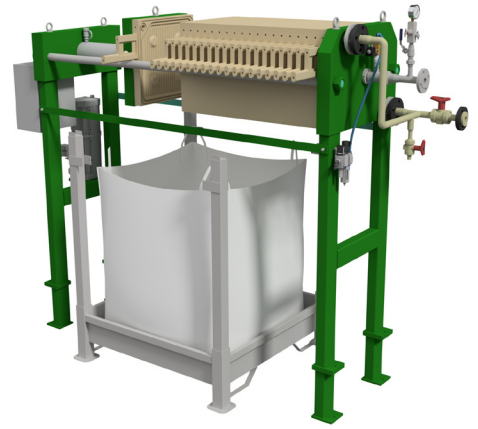
	MP 3	MP 6	MP 9	MP 12
Dimensions Module 1 (LxWxH), in mm	1.650x850x1.660	1.650x850x1.160	1.650x850x1.660	1.650x850x1.660
Dimensions Module 2 (LxWxH), in mm	2.400x2.000x2.300	3.000x2.000x2.300	3.400x2.090x2.350	3.400x2.090x2.350
Dimensions Module 3 (LxWxH), in mm	2.200x980x2.000	2.670x980x2.000	2.780x1.070x2.210	3.050x1.070x2.210
Weight (dry) Module 1, in kg	185	200	260	260
Weight (dry) Module 2, in kg	1.800	2.600	3.500	4.900
Weight (dry) Module 3, in kg	1.000	1.600	2.000	2.200
Weight (wet) Module 1, in kg	200	220	290	300
Weight (wet) Module 2, in kg	4.000	6.000	7.300	10.500
Weight (wet) Module 3, in kg	1.250	1.950	2.400	2.700
Installed power, in kW	24	26	28	28
Power consumption, in kWh	4,2	5,9	6,5	7,5
Maximum permeate flow, in m ³ /h	3	6	9	12
Raw water inlet, in DN	40	50	80	80
Treated water outlet, in DN	32	50	50	50

Electrical power supply / frequency for all MP versions: 440VAC (3ph) / 60Hz

All the dimensions and weights are only indicative and may vary slightly from project to project.



left: Feed module
right: Chamber filter press



Main module

PROCESS TECHNOLOGY

The MarinePaq is divided into three modules:

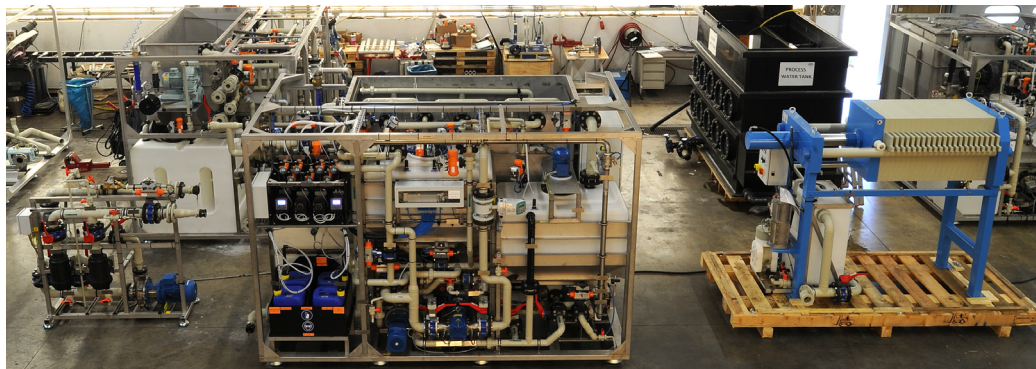
- Module 1: Feed pump or alternatively regulation valve with pre-filters, flow meter, junction box, static mixer, pH probe measurement and transmitter, automatic and manual valves (If the MarinePaq is located below the process water storage tank, the pump might be replaced by a suitable flow regulating valve.)
- Module 2: Ultrafiltration membrane tank, air service unit and valve cluster, CIP tank and heater, backwash / permeate tank, backwash / permeate and CIP pumps, sludge module, electrical cabinet with frequency converters, plastic chemical storage tanks and dosing pumps, sludge pump, pressure measurements, pH probe measurement and transmitter, automatic and manual valves
- Module 3: Semi-automatic chamber filter press with electrical cabinet, alternatively equipped with filtrate tank and filtrate pump

This modular design allows an easier placement of the plant in existing confined spaces as the modules can be set-up in different areas of a room and be connected by piping to form a unit. The pre-neutralized EGC and EGR water (pH

> 5,5 – 6,5) is pumped from the scrubber water bleed-off or process tank to the MarinePaq. The water passes through 0,5 mm mesh pre-filters (two redundant filters implemented for ease of serviceability) that serves as a “police filter” for the system by removing large ash particles, suspended solids and magnesium oxide particles, protecting the downstream equipment such as membranes and pumps.

Subsequently, a submerged ultrafiltration membrane filters out the suspended solids. The process is based on innovative flat sheet ceramic membranes with a cut-off of < 0,1µm. The ultrafiltration acts as a physical barrier removing suspended solids, most of the PAH’s (which are typically collected together with the soot particles), the free and emulsified oil and ash suspended solids from the EGC and EGR water. The ultrafiltration concentrate represents approximately 10% of the feed flow.

Therefore, a volume equal to approximately 10% of the influent raw water will be post-treated by a semi-automatic chamber filter press. Oil accumulating on top of membrane tank is extracted from time to time by opening an automatic valve. The oil is collected in the sludge tank and brought to the chamber filter press.



MarinePaq production

SPECIAL FEATURES

Modular Design

The MarinePaq is designed in a modular way to provide both flexibility and reliable operation. By means of the system's modular design, the MarinePaq can easily be adapted according to the customer needs. As standard MarinePaq modules are available off the shelf, construction changes of running systems (such as capacity increase of the system or changed effluent quality requirements) can be effected quickly.

Built Quality

MarinePaq is constructed for a long service life and continuous operation by meeting the most stringent standards in a highly corrosive environment. Corrosion-resistant, weight-saving piping is used for the entire installation to ensure a failure-free, long-lifetime operation of the MarinePaq system, performing under toughest conditions, i.e. salty seawater with a very high load of contaminants.

Autonomous Operation

As all of the APATEQ's water and wastewater treatment systems, the MarinePaq is fully automated and requires little operator attention. Designed with modern communication protocols, it can easily communicate with the scrubber and / or the ship control room. The system runs in full automatic mode and dedicated alarms will trigger the interventions of an operator, i.e. for refilling chemicals necessary for the water treatment process or for emptying of the chamber filter press once its batch dewatering process is complete. All in-process cleaning routines are automatically initiated, depending on the degree of pollutants in the water. A 3-stage alarm strategy allows the operator to address less critical alarms whenever it is most convenient, making the operation of the MarinePaq very user-friendly.



*left: Detailed view
MarinePaq module
right: Control cabinet
with touch-screen panel*



OPERATION, MAINTENANCE & TRAINING

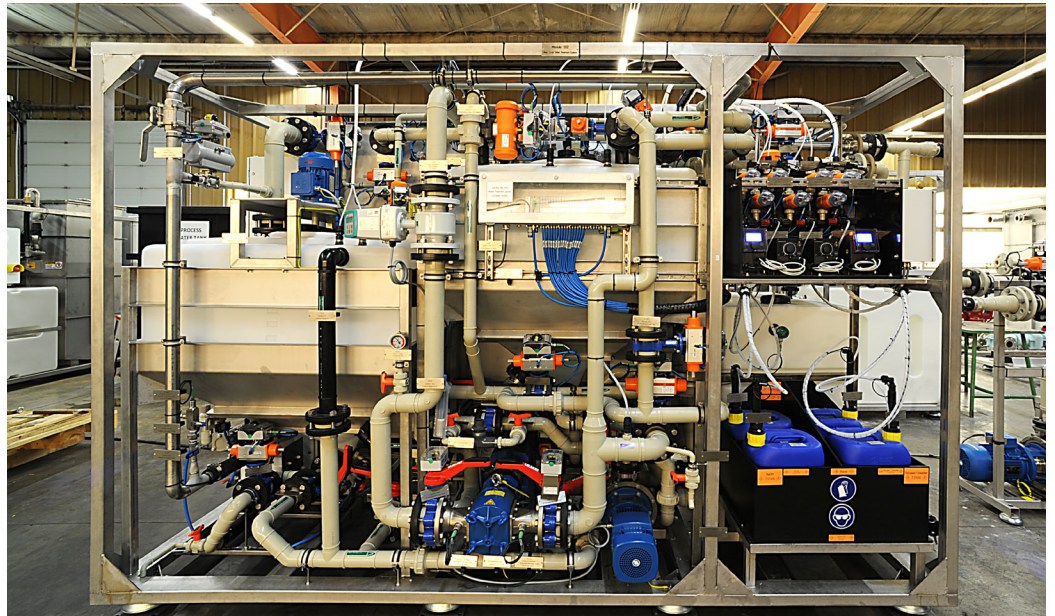
After having received comprehensive training in our facilities, during commissioning and during sea trial, the operators of the MarinePaq will be fully qualified to operate the equipment in the vessel. APATEQ will assist during the commissioning process and the sea trial and thereafter will be available for any customer's demands throughout the lifetime of the ship. With a detailed operation manual and maintenance manual, the crew will be able to run and maintain the equipment to its best performance.

Designed with submerged ultrafiltration membranes, the MarinePaq has a unique feature of being able to remove surplus oil that can accumulate in the bleed-off process tank and that can normally not be extracted easily with other membrane systems. Furthermore, with a very conservative process design, the capacity of our plants is always given in effluent volume, which takes the downtimes of the plant for cleaning procedures in consideration. Therefore, the customer will always be assured that the treatment volume is available at any time.

With a vast network of service engineers worldwide, APATEQ can offer fast and flexible interventions. Our fully trained representatives in the major shipping centres in the world offer services in local languages and with reliable APATEQ quality.



Top view of ultrafiltration membranes



Main module

ABOUT APATEQ

Clean-tech innovator **APATEQ** provides green and cost-efficient one-stop solutions for selected markets in the water and wastewater industry by means of unique, membrane-based systems with an extremely long lifetime of reliable operation.

In addition to systems for the treatment of vessels EGC and EGR water, APATEQ develops and manufactures turnkey, custom designed produced water treatment systems for oil and gas field operators, compact wastewater treatment plants for demanding applications and full solution systems for the treatment of industrial wastewater. Our plants meet the most stringent international legislation and are in compliance with even the most onerous environmental standards. The effluent from our systems is suitable for direct discharge, reuse or irrigation, saving our most precious resource: fresh water.

APATEQ supplies the world's largest container vessels with its technology. The World Economic Forum selected APATEQ as Technology Pioneer.



*The world's largest
container vessels are
equipped with the
MarinePaq*



MarinePaq (onshore version) at the harbour of Gedser (DK)

APATEQ - PWT S.A.

2, rue Kalchesbruck, L-1852 Luxembourg phone: (+352) 202116801 e-mail: info@apateq.com www.apateq.com

