PureteQ

THE SCRUBBER MAKER

PureteQ designs, delivers and commissions state of art, reliable and patented Exhaust Gas Cleaning Systems to the shipping industry across the globe. This includes superior quality and extensive safety measures, which go on and beyond normal industry standards. Our Water Treatment System is easy to install and operate, and the open tower in-line scrubber system has no moving parts nor any obstructions such as a packaging layer. The simple construction requires less maintenance and it is very simple to operate for the crew. It features the lowest OPEX in the business.

Scrubbers: performance, economics and prospects for their use

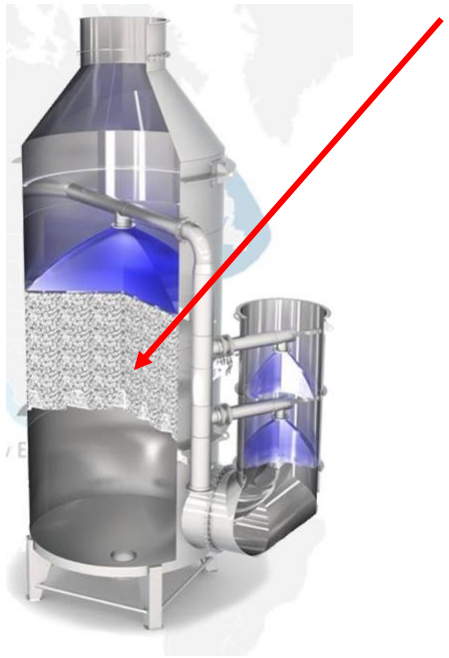
2021 Exhaust Gas Cleaning System

- PureteQ was established in 2010 to invent and patent technologies that could transform Environmental issues into sustainable solution.
- Owned by a Danish Billionaire Erik Skjaerbaek and some of the employees.
- HQ situated in Svendborg, Denmark. Branches in:
  - PureteQ Japan KK, Tokyo
  - PureteQ GmbH, Hamburg
  - PureteQ China
- Since 2014 development of patented SOx scrubbers for maritime application.
- 1st Hybrid Scrubber system installed and commissioned in spring of 2015. Since then, more than 100 operational and approved scrubber
- Now also involved in numerous International CO2 Capture Projects and Power to X.

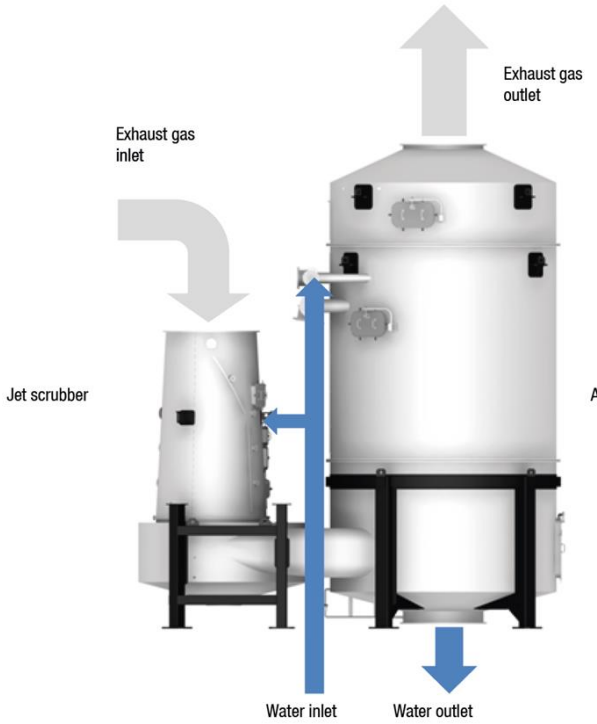
Expertise – what we do

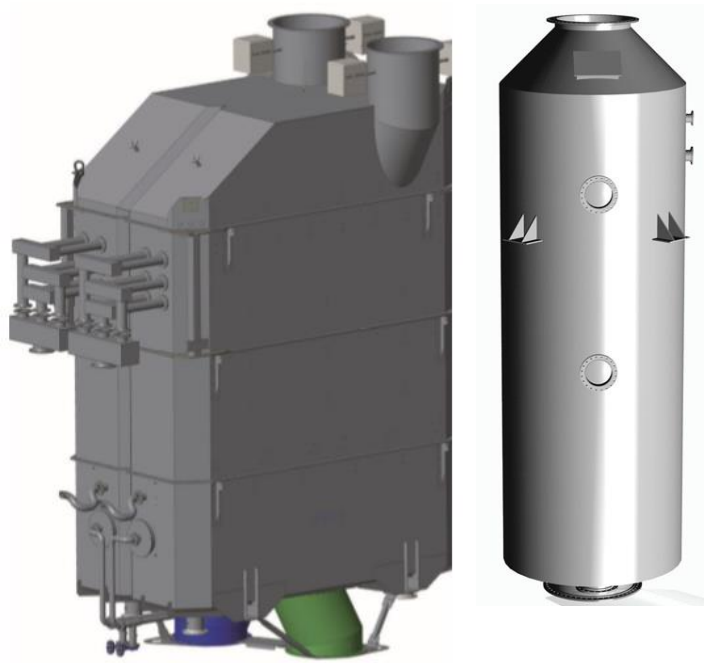
https://youtu.be/ILPvUjKHtG4

Types of wet scrubbers



By-pass or U-type scrubbers



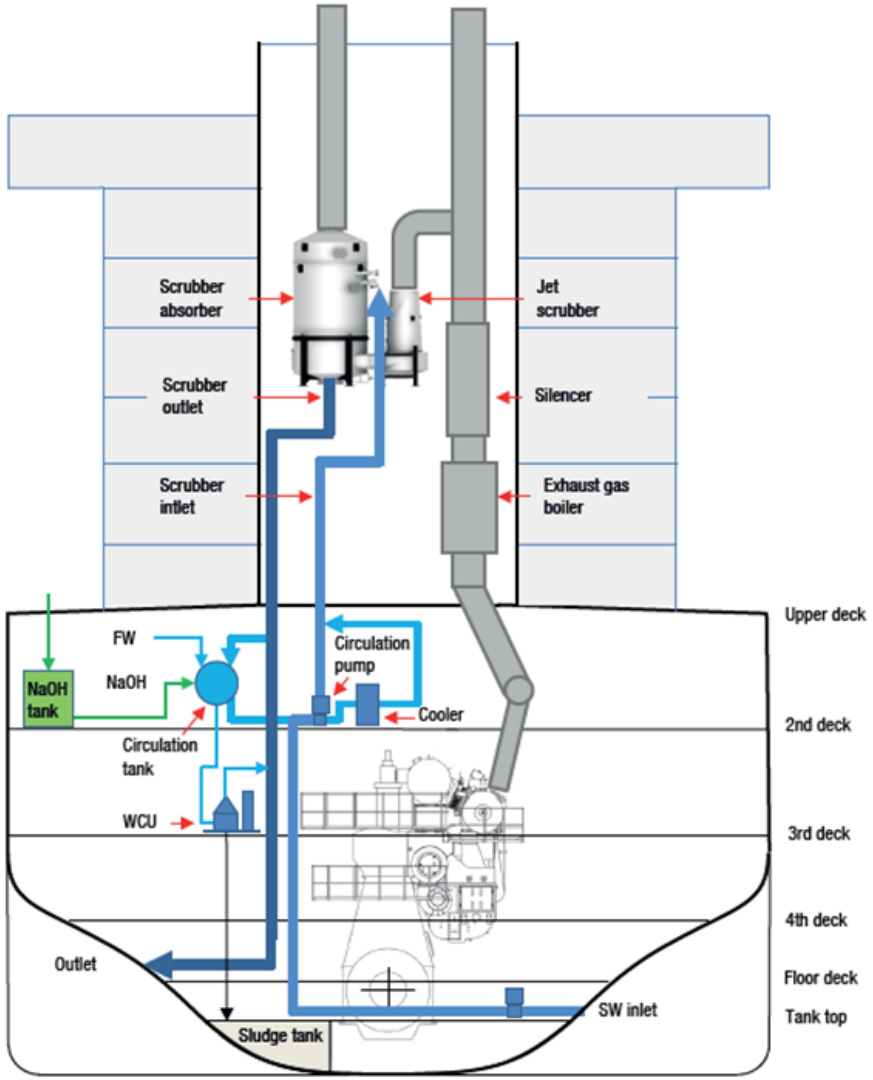


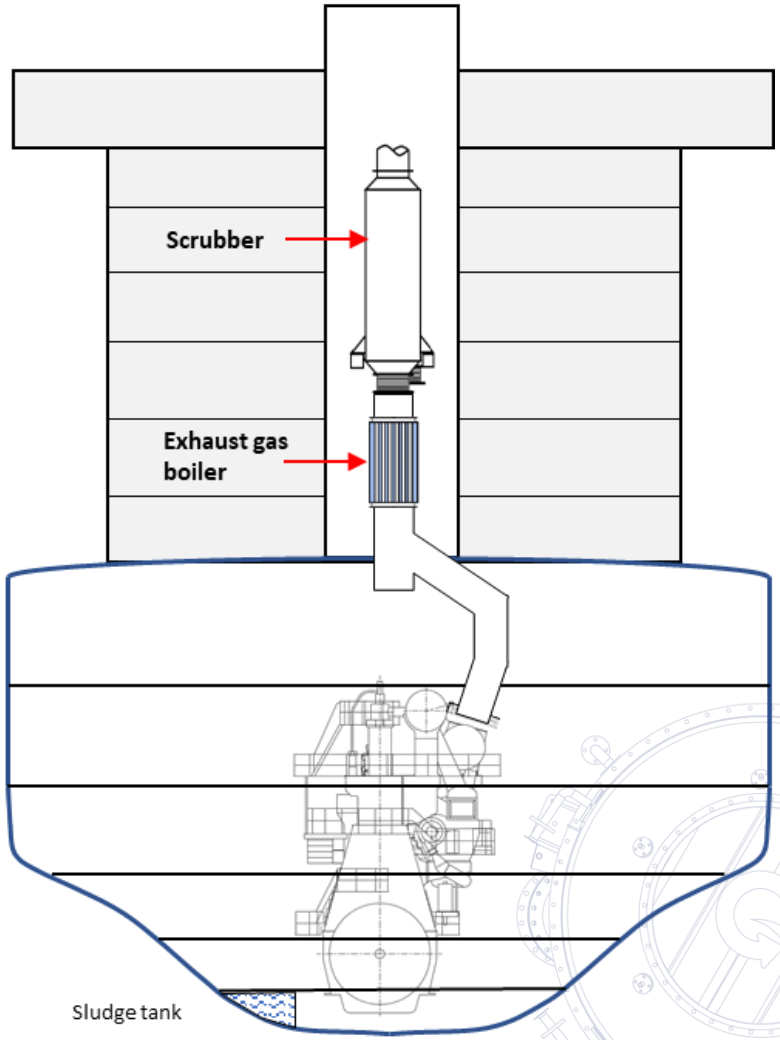
In-line scrubbers

There are many types of scrubbers, and they will all clean the gas, but different ways and thus cost associated therewith Furthermore, each system has pros and cons.

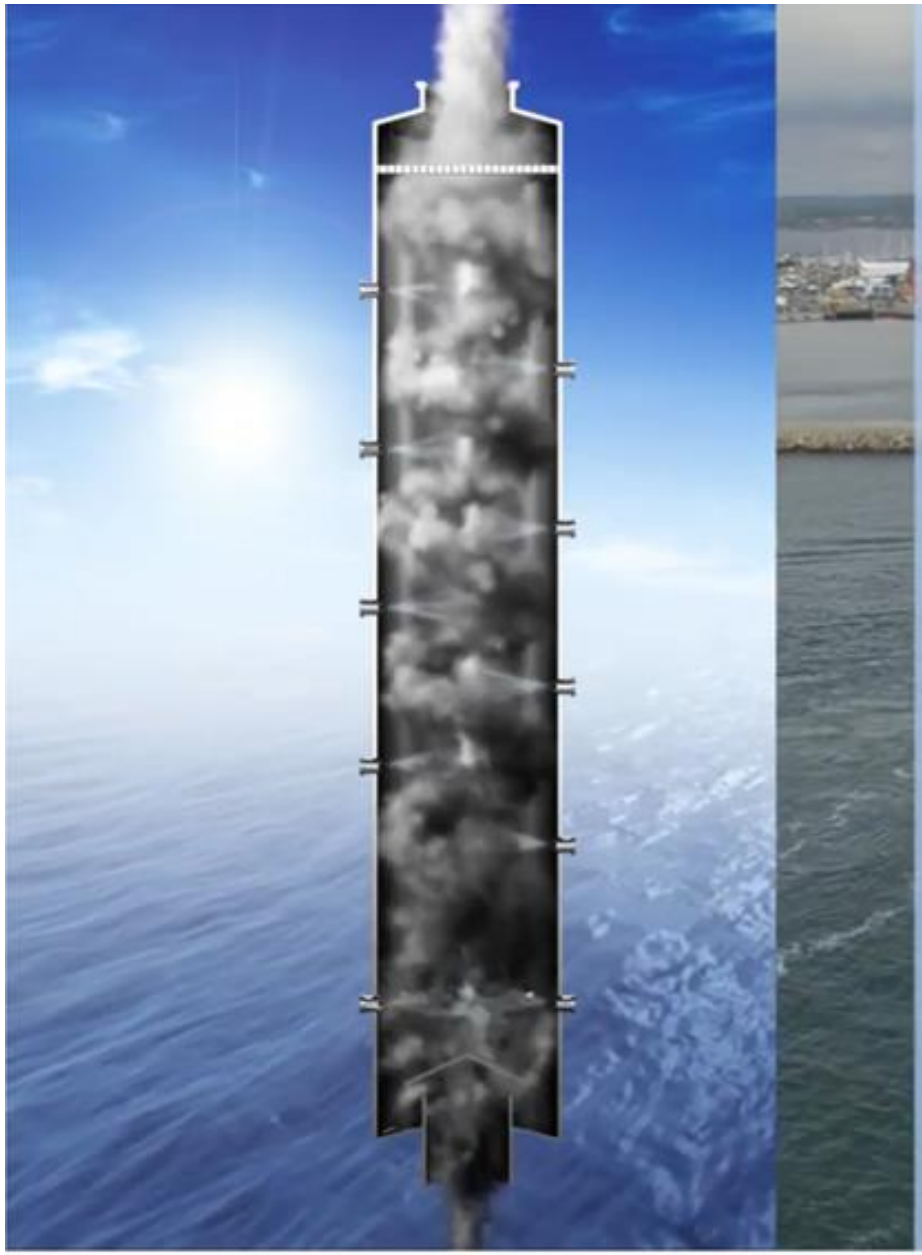
Integration of Scrubbers

- Different types of scrubbers fits different ships.
- There is no universal solution and systems must be matched to individual ship and trade patterns
- Software must be matched to individual needs and education of crew
- Different cost associated with installation and operation of different types of scrubbers





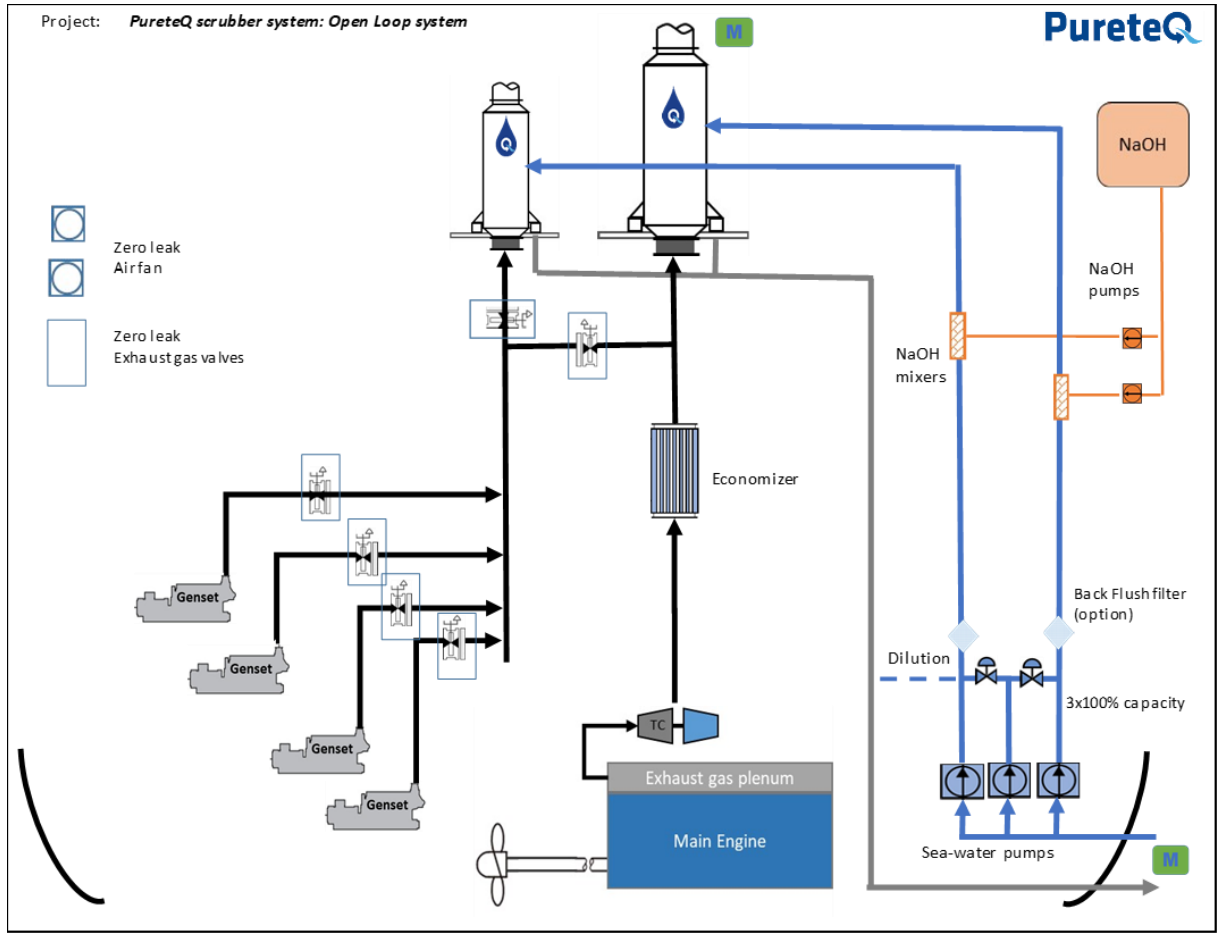
In-Line Open Tower Exhaust Gas Cleaning System



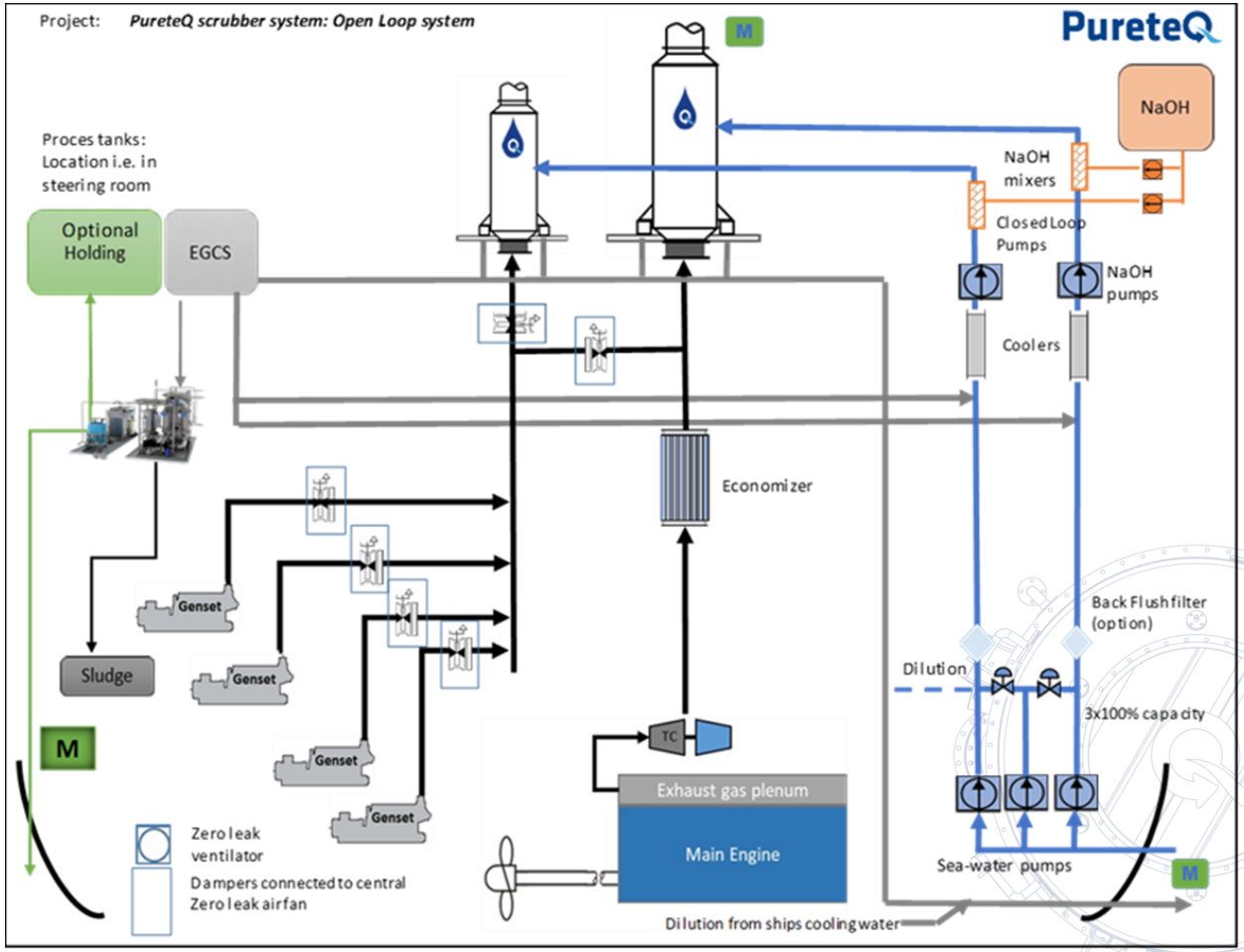
- Open Tower – no packed bed – low back pressure
- High alloy for long life
- Hydrodynamic fluid distribution
- Best energy performance in the market
- Superior Control System with remote access
- Now available as Generation II for reduction of total cost of installation.

Outperforms traditional **scrubber** systems

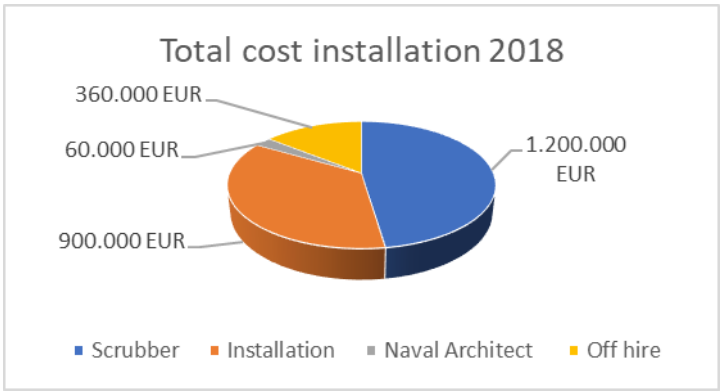
Open or Hybrid Scrubber System

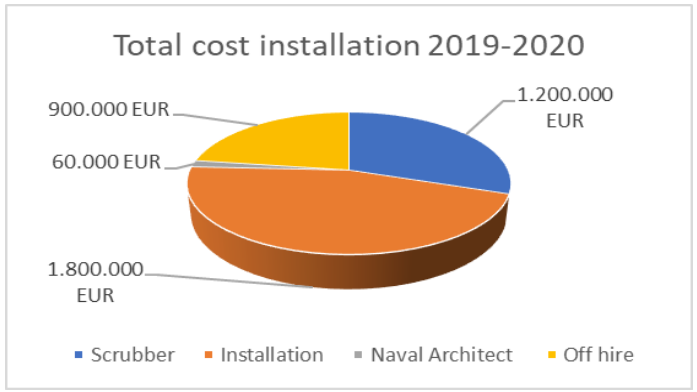


No mater what configuration, PureteQ guides the shipowner throughout the process from initial design to installation and final approval of the system and by the Flag State.



Installation experience





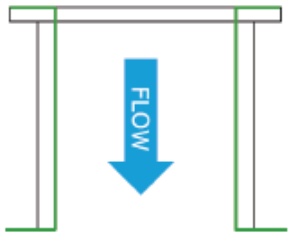
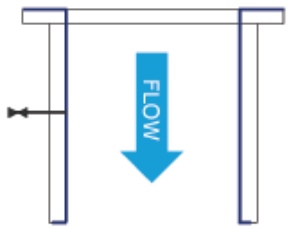
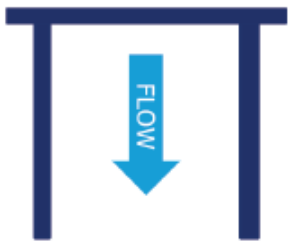
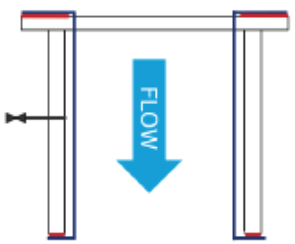
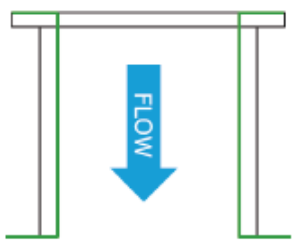
- Capacity
  - 14-16 days for simple Hybrid Ready installation
  - Avoid "French Parking" = additional off-hire and cost
- Quality
  - Learnings on importance of installation quality
- **Teachers Pet Scenario**
  - Be prepared
  - Follow-up - daily yard meetings
  - Team up with your supplier
  - Right competencies on own staff
  - Be proactive
  - Attention to Detail
  - Push (the squeaky wheel gets the grease)
  - Beware of:
    - No or few people
    - Unusual questions
    - Playing the timecard (delay or extra cost)
  - Preparation, rethink the job to minimize work on the ship
  - Sufficient manning from supplier at yard during installation
  - Know the shortcomings! Naval architect, yards, other stakeholders…
  - Mitigate short-coming's from the installation
  - Ships crew must arrive in time for OJT
- Document/record

Installation experience

What are the learnings so far ?

- Quality of installation
  - Wrong alloys
  - Electrical noice
- Overboard pipe designs
  - Inadequate design
  - Inadequate coating
  - Guides are now available

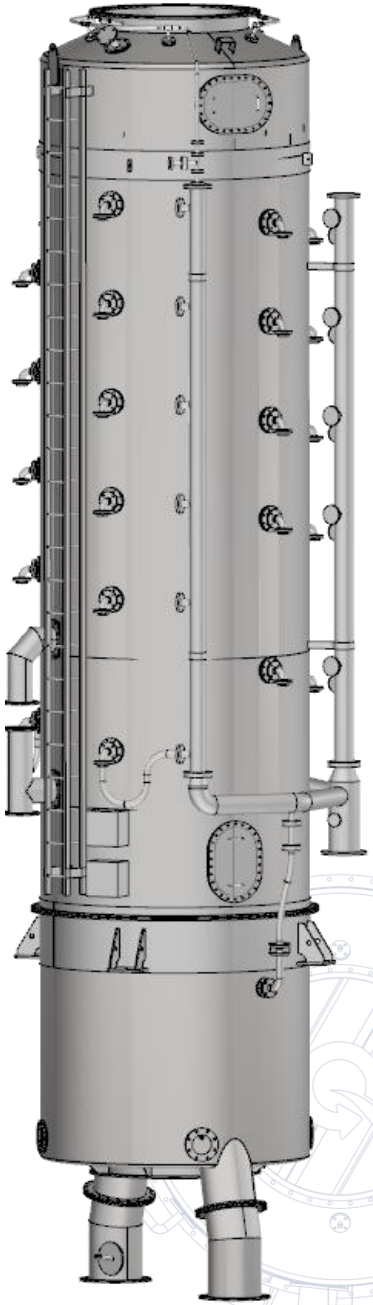
- CEM Systems
  - cooling will have to be applied when operating in warm location
  - Instrument air must be supplied, or air preparation units installed
  - Huge difference in lifecycle cost
- Water Monitoring Systems
  - Sensor failure/reliability
  - Installation quality

	*Coated C-Mn Steel* *(Acid- and abrasive resistant epoxy coating)* + Widely used solution with most experience - Vulnerable to mechanical damage at flange face - Vulnerable to improper coating application at the valve flange and at diffusor brackets - Hides any corrosion damage under the coating - Requires UTM or diving inspection at class annual survey
	*Welded sleeve of stainless steel* *(Suitable for non-stagnant seawater per class guidance)* + High corrosion and abrasion resistance + May simplify correct installation of diffusor - Vulnerable to stagnant seawater (pitting) - Hides corrosion damage under the sleeve - High potential for galvanic corrosion issues + Due to the test cock, UTM or diving at the class annual survey is not required
	*Stainless substantial thickness (t≥15mm) overboard pipe* *(Suitable for non-stagnant seawater per class guidance)* + High corrosion and abrasion resistance + Easier to achieve correct installation of diffusor - Vulnerable to stagnant seawater (pitting) - High price - High potential for galvanic corrosion issues - Requires UTM or diving inspection at class annual survey
	*Bolted or otherwise non-welded stainless sleeve* *(Suitable for non-stagnant seawater per class guidance)* + High corrosion and abrasion resistance - Vulnerable to stagnant seawater (pitting) - Requires high manufacture and installation accuracy - Potential for leaking gasket at shell end + Due to the test cock, UTM or diving at the class annual survey is not required
	*PE lining* + Immune to corrosion and abrasion resistant - Hides any corrosion damage under lining - Vulnerable to improper lining application at the overboard pipe's outer end - Will, if approved, require UTM or diving inspection at class annual survey - Case-by-case approval

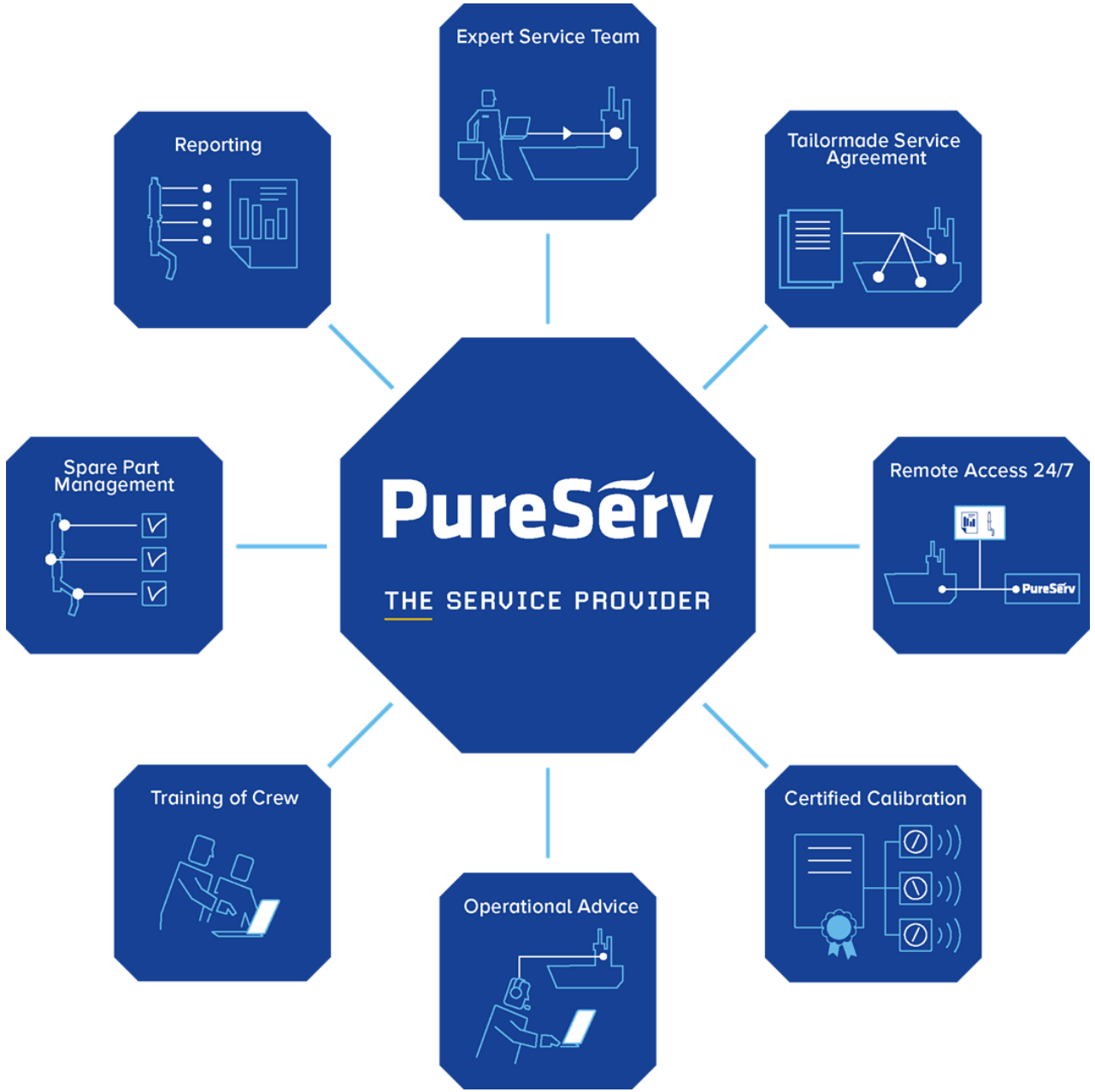
Generation II Scrubber

PureteQ has now developed a “Generation II Scrubber” that significantly reduces the total cost of installation including shipyard cost and Off-hire

- Same PureteQ scrubber tower but with improved design and functionality
- Higher level of integration of tower-related components by PureteQ
- Pre-assembly of tower related components by PureteQ
- Single connection point of tower equipment to shipyard cabling
- Single or multiple connection point of wash-water into the scrubber tower
- Same favorable cost but larger scope for PureteQ
- Faster installation
- Quality assurance by PureteQ for critical equipment installation
  - Correct handling – installation – testing of critical equipment
  - Correct locations and execution of critical connecting points, such as sample water flanges
  - Less rework at shipyard
  - Less claims from ship operator by removing majority of alarms and excessive spares consumption
  - No adjustment in number of nozzles
  - Reduced pressure losses = less electrical consumption



After Sales Service

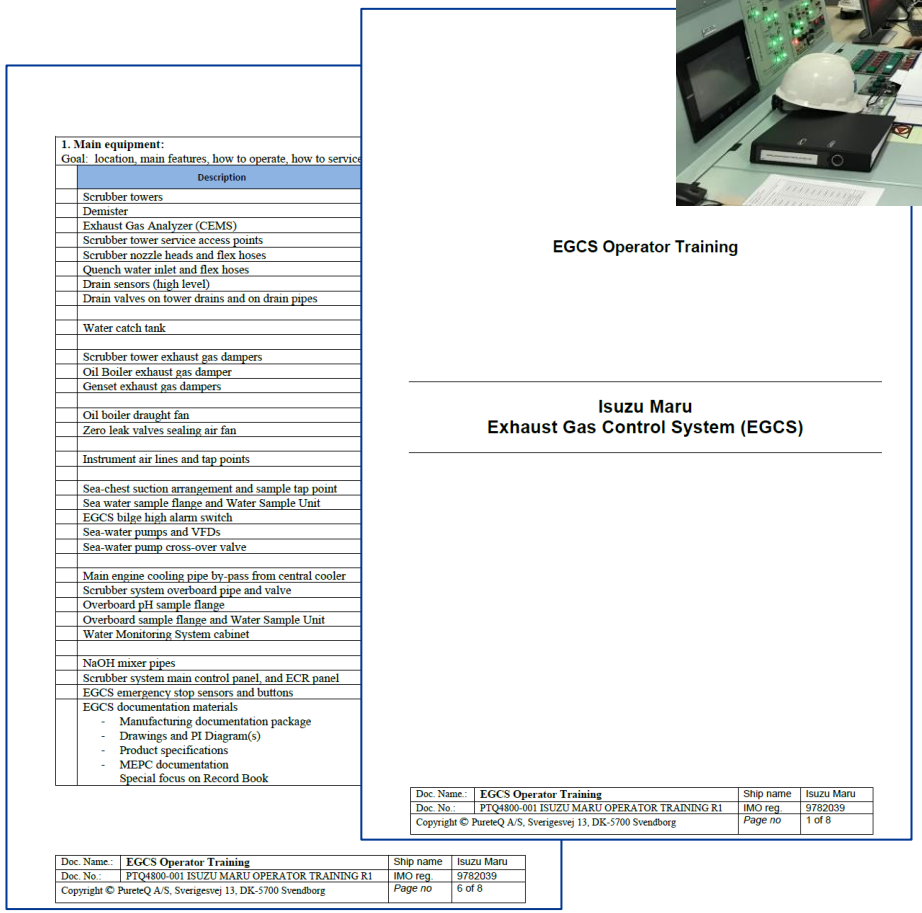


Service Agreement:

- Pay only for what you get
- Discounts on materials and hours
- Priority
- One or more visits to the ship by PureteQ Service Engineer. PureteQ Service Engineer will assist the crew or shop in maintenance activities, calibration and validation of sensors
- Certified service of Gas Analyzer and Water Monitoring System
- **Modular Training Program**
- **24h hotline service**
- **Remote Service**
  - Online operational guidance for the crew
  - Online guidance for the replacement of spare parts
  - Online monitoring of scrubber-system to safeguard MARPOL performance
- Supply of spare parts for the scrubber system worldwide at a fair price;
- Access to our safety stock –critical spares will be shipped within 24 hours;
- Manuals and videos to ease maintenance and operation activities for the crew;
- Access to discounted rate for software update
- Service letters to ensure knowledge sharing across ships and systems

Modular Training Programs

TeamViewer Pilot



1. Main equipment:
Goal: location, main features, how to operate, how to service

	Description
	Scrubber towers
	Demister
	Exhaust Gas Analyzer (CEMS)
	Scrubber tower service access points
	Scrubber nozzle heads and flex hoses
	Quench water inlet and flex hoses
	Drain sensors (high level)
	Drain valves on tower drains and on drain pipes
	Water catch tank
	Scrubber tower exhaust gas dampers
	Oil Boiler exhaust gas damper
	Genset exhaust gas dampers
	Oil boiler draught fan
	Zero leak valves sealing air fan
	Instrument air lines and tap points
	Sea-chest suction arrangement and sample tap point
	Sea water sample flange and Water Sample Unit
	EGCS bilge high alarm switch
	Sea-water pumps and VFDs
	Sea-water pump cross-over valve
	Main engine cooling pipe by-pass from central cooler
	Scrubber system overboard pipe and valve
	Overboard pH sample flange
	Overboard sample flange and Water Sample Unit
	Water Monitoring System cabinet
	NaOH mixer pipes
	Scrubber system main control panel, and ECR panel
	EGCS emergency stop sensors and buttons
	EGCS documentation materials - Manufacturing documentation package - Drawings and PI Diagram(s) - Product specifications - MEPC documentation Special focus on Record Book

Doc. Name.:	EGCS Operator Training	Ship name	Isuzu Maru
Doc. No.:	PTQ4800-001 ISUZU MARU OPERATOR TRAINING R1	IMO reg.	9782039
Copyright © PureteQ A/S, Sverigesvej 13, DK-5700 Svendborg		*Page no*	6 of 8

EGCS Operator Training

Isuzu Maru
Exhaust Gas Control System (EGCS)

Doc. Name.:	EGCS Operator Training	Ship name	Isuzu Maru
Doc. No.:	PTQ4800-001 ISUZU MARU OPERATOR TRAINING R1	IMO reg.	9782039
Copyright © PureteQ A/S, Sverigesvej 13, DK-5700 Svendborg		*Page no*	1 of 8

PureteQ Academy

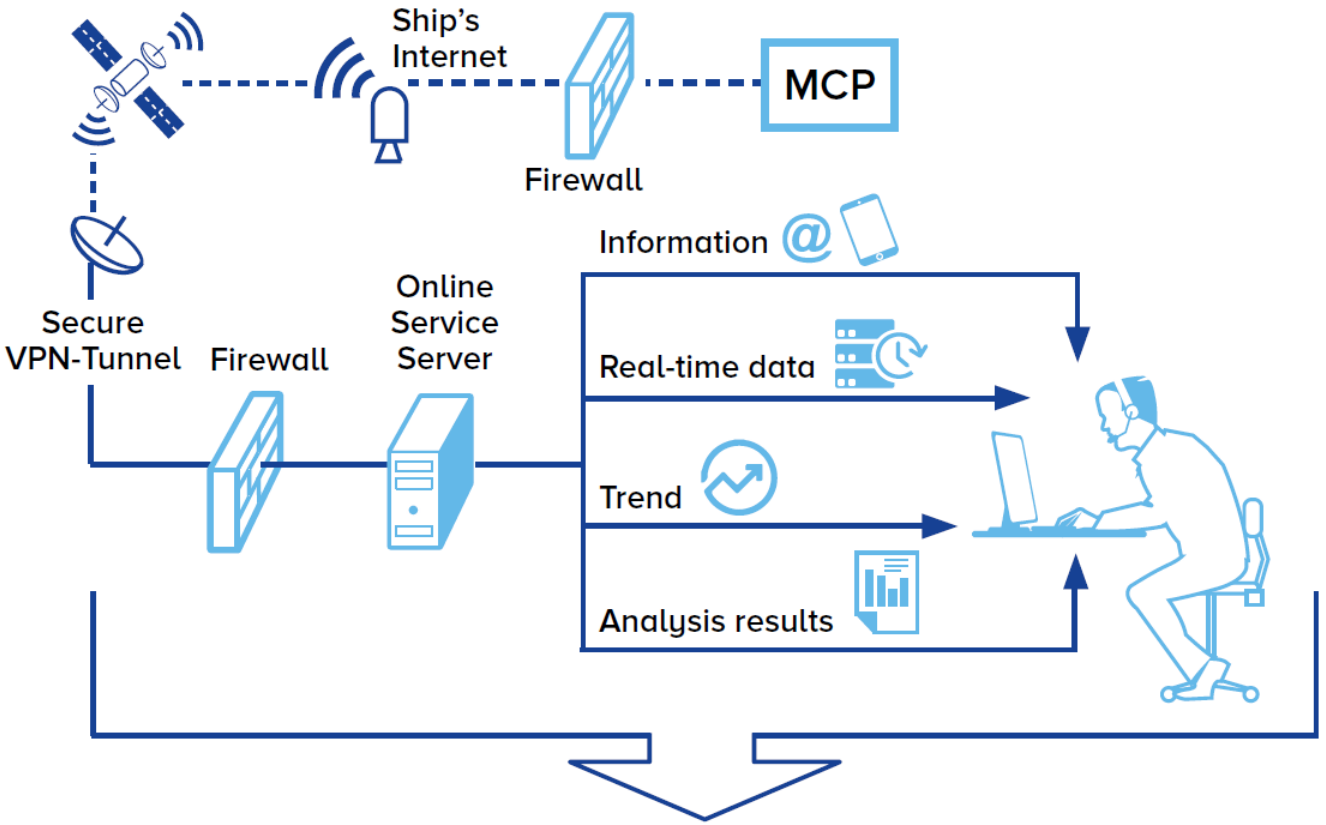
Training enables involved personnel to solve operational issues. Experience have shown that proper training creates ownership and prevents unnecessary downtime.

PureteQ offers a modular training package for Engineers, Deck Officers, Crew and Shore Personnel in;

- Navigating control system to include on-screen analysis of operation and alarms
- Governing Documentation (as build)
- Design and functionality of EGCS
- Operation & Maintenance to include replacement of parts
- Troubleshooting
- Optimization of energy consumption, including setting of parameters
- Basic regulatory knowledge of MEPC 259(68) and MEPC.1/Circ.883 IMO circular
- Real Time Remote Access functionality

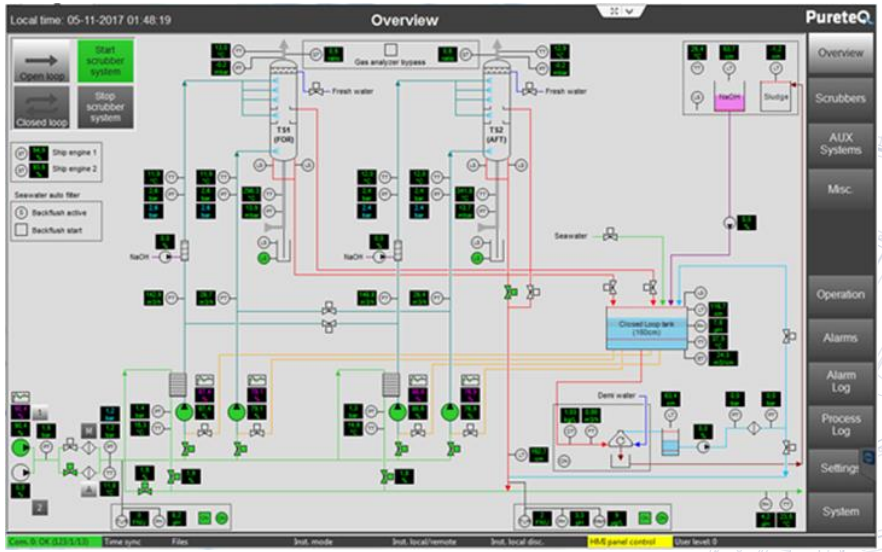
All training modules are offered on site or in a virtual environment.

24/7 Remote Service and Support



PureteQ believes in the value of making good use of digitalization for our clients who require safe, reliable and fast support at a fair price. After all, remote support of the ship crew is less expensive and faster than waiting for on-site service from a Service Engineer.

- On-line Monitoring
- System optimization
- Reporting
- Operational advice
- Sparepart management
- Software updates

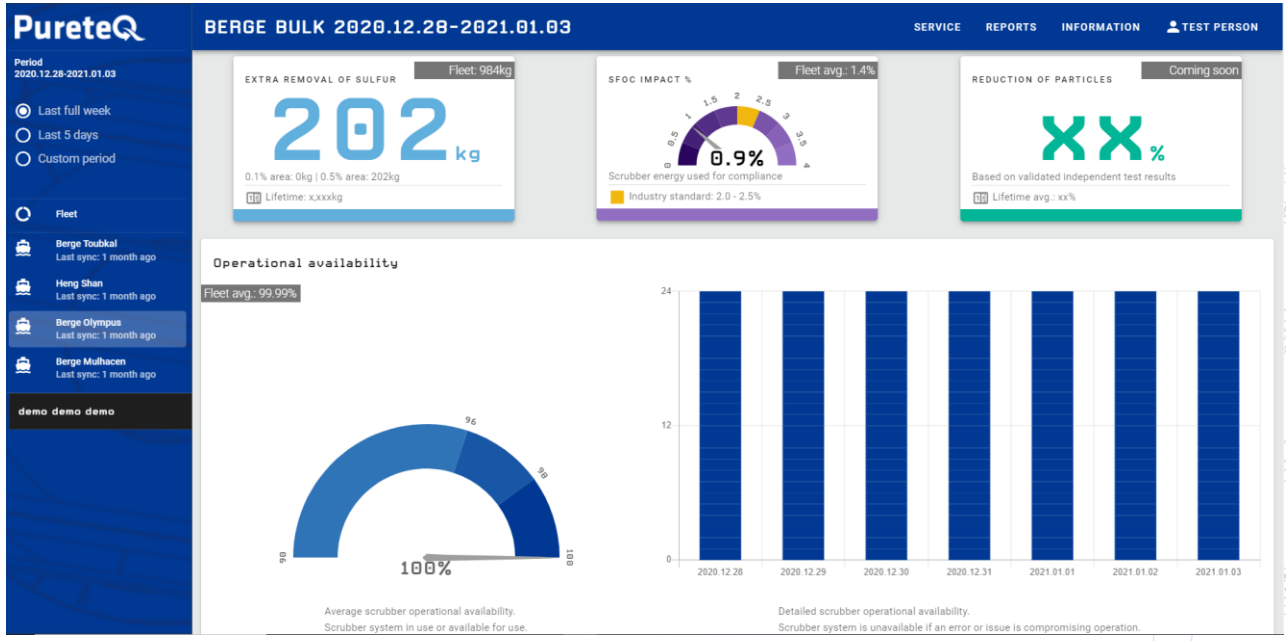


Fleet Scrubber Optimization - Environmental & Performance Reporting

Many shipowners now have different scrubber systems installed.

PureteQ have developed a new cloud-based software for performance optimization of scrubber systems across the fleet and scrubber makes

- Limited data consumption
- Feature for Environmental Performance Reporting
  - CO2 savings
  - Particle reduction
  - Sulfur reduction
- Savings are based on comparison between HFO with scrubber and compliant fuel
- Taken the lesser positive report from SINTEF into account as well as actual test performed by 3rd party on sailing installations
- Perfect match to new IMO regulation on Carbon indexing of existing ships –EED(X)I, CCI and SEEMP
- Software is being tested now on various scrubber makes



Carbon Capture Storage (CCS) Technologies

PureteQ is currently involved in three CCS projects:

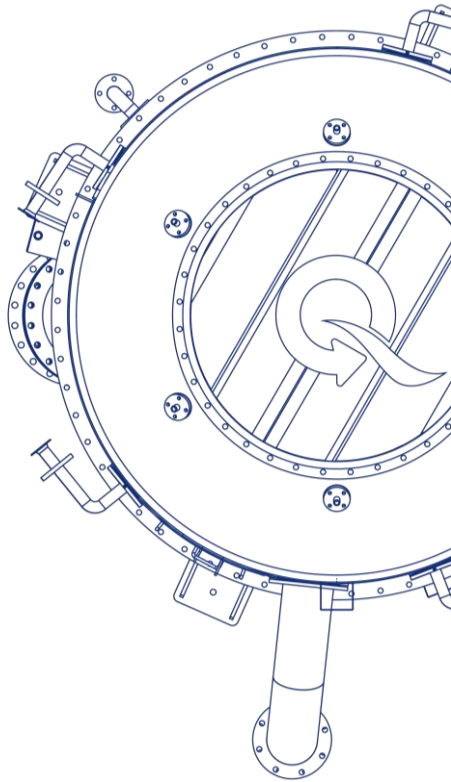
1. CCCH2 is a Combined Carbon Capture and Power to X (H2) project based on EStech patent application.
2. CC&R is a Carbon Capture & Repurpose project based on an American patent application on Chemical Sequestering.
3. ACT3 Project based on something called ElectroCO2, which is a process more effective than current amine-based technologies for CO2 Capture.

Scrubbers are a pre-process to CCS technologies as well as a vital part

What will be the best option for ships ?

Perhaps the CC&R as energy requirements are lower, pending by-product solutions.

- Will there be an infrastructure to receive and store the carbon captured ?
- “Green” or “Clean” energy availability ?
- Infrastructure availability ?



CCCH2 - COMBINED CARBON CAPTURE AND ENERGY STORAGE

PureteQ

CCCH2 - COMBINED CARBON CAPTURE AND ENERGY STORAGE

PureteQ

CCCH2 - COMBINED CARBON CAPTURE AND ENERGY STORAGE

PureteQ

PureteQ/Estech CO2 capture test on site power plant (bio-gas generators)

2 x bio-gas generator2 (2x 844 kW)

The exhaust from gensets passes an "exhaust" room where the scrubber system is installed

Chimneys of the 2 x gensets

The CO2 scrubber system is installed in separate room

The scrubber system extracts exhaust of the generators exhaust pipes into the CO2 scrubber for washing.
Present results are a 73% reduction in a single stage cleaning (commercial plant will be 2 stage scrubbing)
The exhaust is measured for CO2 content before and after the scrubber tower.

CCCH2 - COMBINED CARBON CAPTURE AND ENERGY STORAGE

PureteQ