



Pacific Green

ENVI-Marine™



ENVI-Marine™ /

Future Proof Your Emission Control



Leading performance

The performance of the ENVI-Marine™ system comfortably meets the IMO 2020 sulphur emission regulations in either “open” or “closed” mode.

Small, flexible footprint

The ENVI-Marine™ System is small compared to most other systems. Our patented TurboHead™ technology allows for a footprint that is considerably smaller without compromising on efficiency.

Attractive CAPEX / OPEX

The advanced TurboHead™ technology, careful material selection and skilled engineering design ensure competitive initial pricing and cost effective operation and maintenance.

Unrivalled Capacity

To meet the challenge of fitting the world’s shipping fleet with Exhaust Gas Cleaning Systems (EGCS) Pacific Green Technologies has manufacturing agreements with 6 factories in China with a combined capacity of 1 scrubber every 48 hours.



Game changing scrubber technology.

World beating technology, one of the smallest and most flexible footprints on the market, high quality engineering and swift installation, these are just some of the reasons why Pacific Green’s ENVI-Marine™ device has been installed on more than 120 ships.

As leaders in the field, Pacific Green has proven experience, outstanding performance and the aftercare service essential to both fit and maintain your vessel’s EGCS ensuring the real benefits of reduced fuel costs and low emissions.

Our scrubbers all feature:

- All stainless steel from European or Japanese suppliers
- Grade 2 Titanium quench ducts
- Duplex 2205 stainless steel scrubbing vessel
- Grade 2 Titanium TurboHeads™
- Class approved Continuous Emission Monitoring System and Wash Water Monitoring Systems
- Highest quality manufacturing and quality assurance process

Shipping
Industries Best
OEM Supplier

2019 SHIPTEK International
Maritime Awards



The ENVI-Marine™ Exhaust Gas Scrubbing Device

The ENVI-Marine™ process is a simple concept. The flue gases are first quenched, then cleaned, by specialized frothing through pure seawater, using our patented TurboHead™ process before being discharged as harmless salts.

ENVI-Marine™ systems are fully flexible and can be supplied as open loop, open loop hybrid-ready, or hybrid systems capable of both open and closed mode operation.

For vessels running heavy fuel oil, this system offers industry-leading ROI and will clean the exhaust to international emission standards far into the future.

Ultra efficient patented TurboHead™ frothing design

Reassurance of global retro-fit and service network

Simple fitting process allows one device to deal with multiple inlets

Every project is customized, flexible and commercially driven

Compact, flexible shape creates smallest possible footprint

No moving parts or media to replace in the scrubber

Rapid payback period

Future-proof technology: Long-term compliance



ENVI-Marine™ N

ENVI-Marine(N) is an external installation adapted to fit adjacent to an existing exhaust stack.



ENVI-Marine™ E

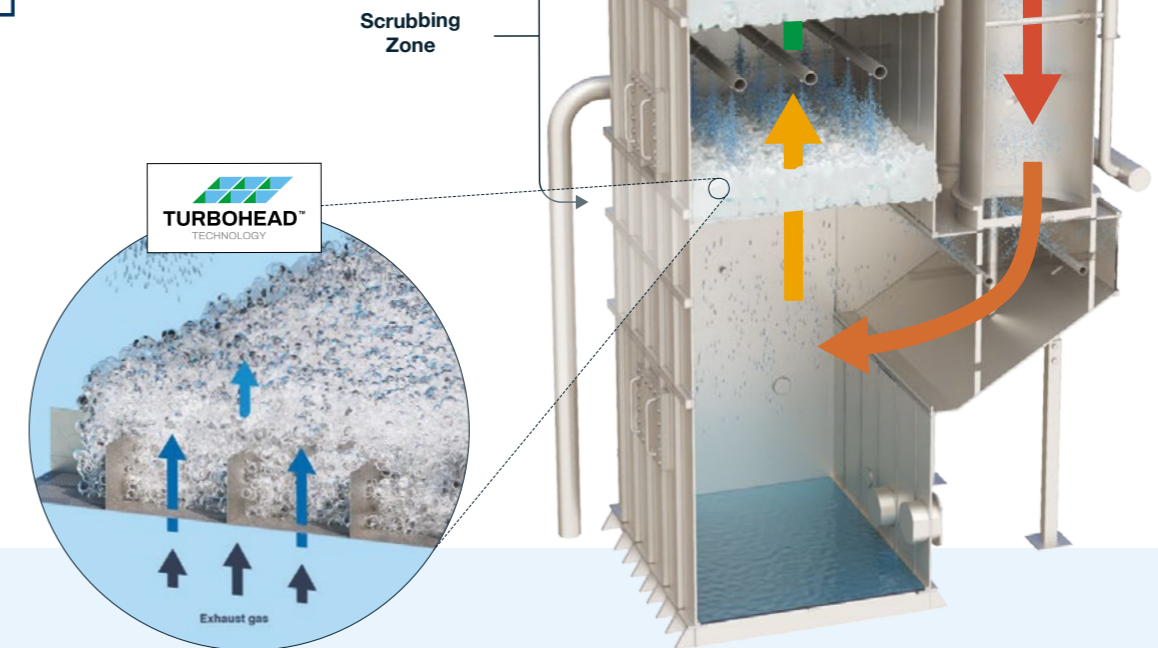
ENVI-Marine(E) is an enclosed installation adapted to fit as an extension of an existing funnel.

The ENVI-Marine™ system has three areas of interaction - the quench zone, and two TurboHeads™

Hot exhaust gases from the main and auxiliary engines are diverted into the ENVI-Marine™ system. Initially the gases are cooled to below 55°C by passing through a seawater quench zone, then they are cleaned in a turbulent seawater froth using two of our patented TurboHeads™.



Watch - How ENVI-Marine™ Works



Functions by:

- Using seawater to absorb SO2 emissions produced by marine engines and seawater's natural alkalinity to neutralize the resulting sulphur based emissions
- Post treatment discharge of neutralized sulphur into sea
- Uses caustic soda or magnesium hydroxide as a supplemental reagent when in operating in closed loop

Flexible layout due to:

- Patented horizontal head
- Potential for component separation
- Able to configure rectangular or cylindrical footprint
- Compact footprint due to efficiency

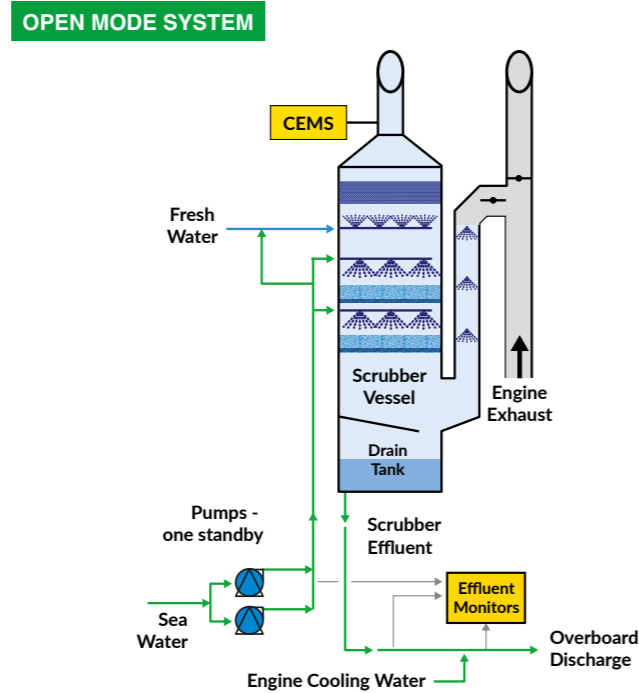
Open or Closed Loop?

Depending on the operating area of a ship, it may be preferable to have an open or a closed loop system.

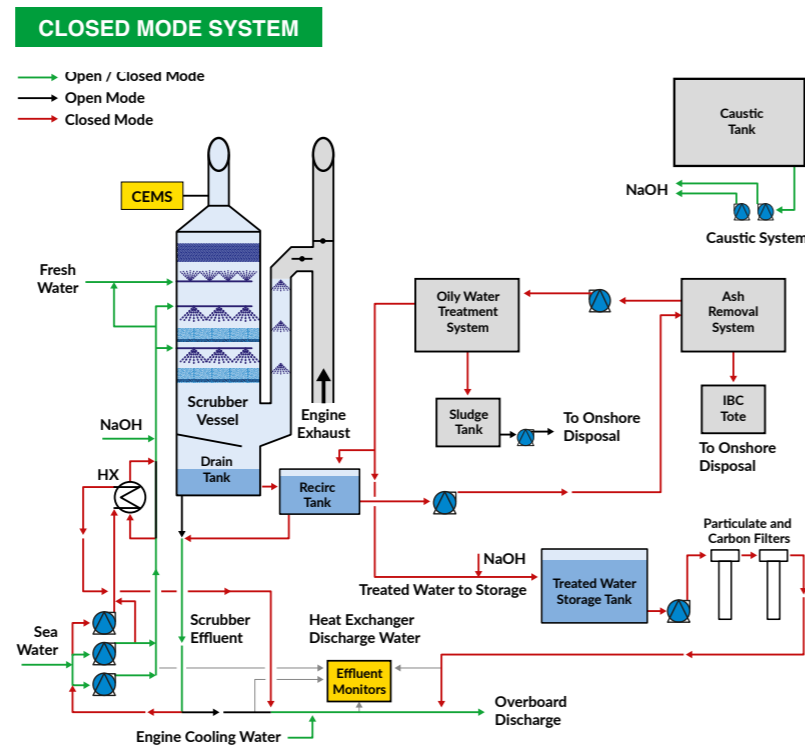
While the vast majority of ships will opt for open loop, some ships operating in discharge restricted areas - which includes selected ports and the coast of California - will opt for a closed loop system.



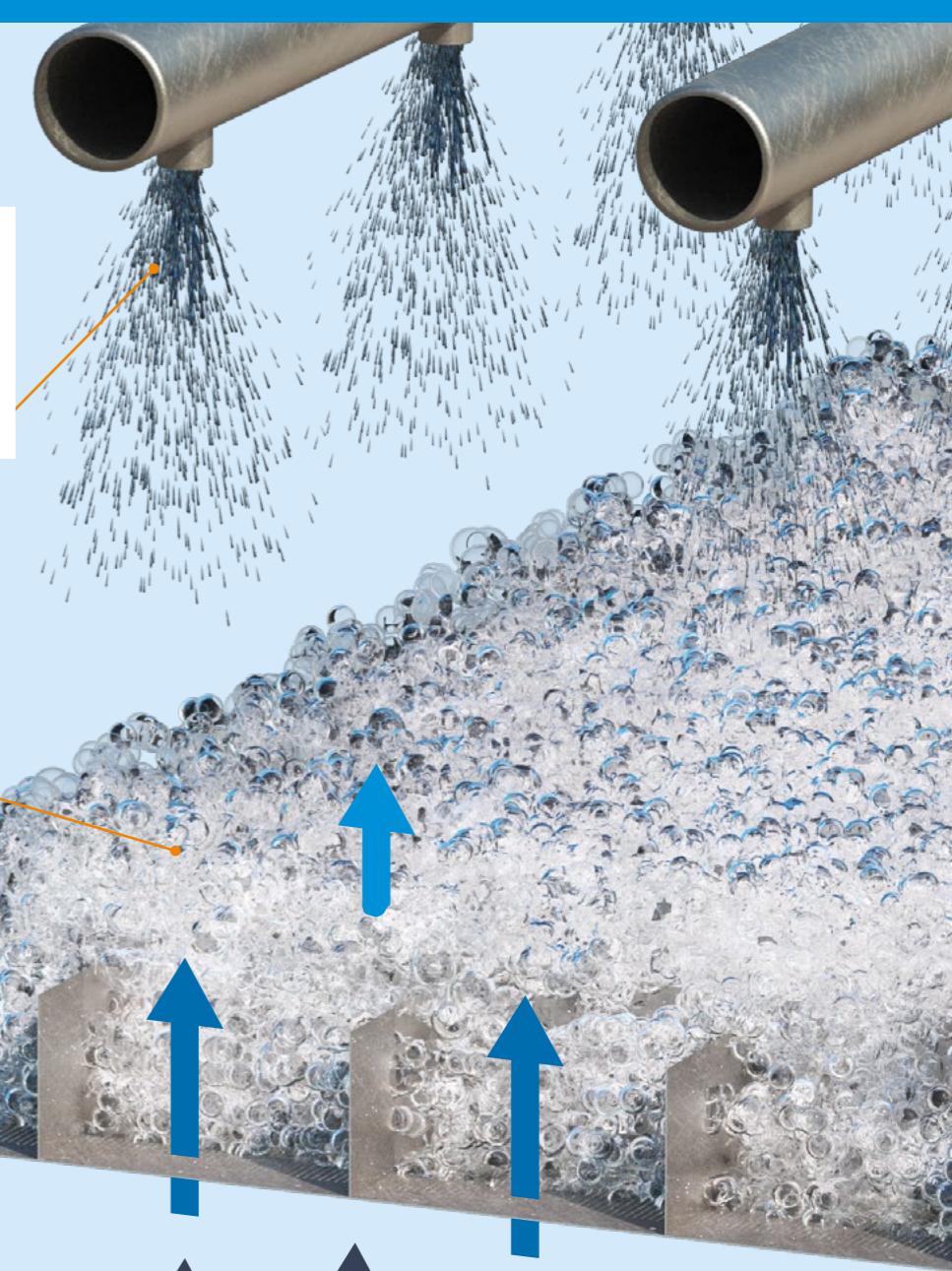
The ENVI-Marine™ system is designed to operate in either open or closed modes, depending on the emission discharge regulations for the waters in which the ship is located.



Single pass raw seawater, scrubber effluent returned to the sea.



No overboard discharge permitted. Wash water is recirculated with caustic soda or magnesium hydroxide added to neutralize sulphur. Solution is processed and contaminants are stored for disposal ashore.



Nozzles, with carefully calculated water volume

'Froth' Layer, generated by interaction of gas and water

Baffles, designed to maximize interaction

Patented TurboHead™ is designed to create turbulent interaction between the seawater and exhaust gas.

Exhaust gas

How does it work?

Seawater is continuously sprayed down onto the TurboHead™ structure where it meets gas flowing upwards. The unique patented design of the TurboHead™ causes the gas and water to mix and create a turbulent 'froth', sometimes referred to as 'foam'. It is the maximum surface area of the froth where the reaction takes place to clean the exhaust gas.

A cleaner future faster

Pacific Green Marine Technologies is an innovator in ground breaking scrubbing technology that not only saves shipowners money now but will also enable them to meet ever-stricter compliance demands far into the future.

How do we future-proof your emission control?

We have more than a decade of experience in designing, manufacturing, overseeing and implementing flue-gas emission control systems throughout the world, backed up with support systems that are second to none. Our patented design is effective, compact, simple to install and cost-beneficial both for new build and retrofit installations.

Pacific Green also has an unparalleled joint venture with the Chinese manufacturing giant, PowerChina. This partnership combines the design skills, innovation and sales network of Pacific Green Technologies, with the huge global reach and massive engineering capacity of PowerChina SPEM.

Through design and engineering excellence, Pacific Green has developed an innovative approach to turbulent wet scrubbing that, compared to other technologies, is more efficient and more cost-effective to build, operate and maintain. For vessels running heavy fuel oil this system offers industry-leading ROI and will clean the exhaust not only to IMO2020 international emission standards but also in the long term.



Not all scrubbers are the same.

With a system that is arguably the world's most compact for its performance, Pacific Green is able to take on and beat the competition with class winning efficiency and lower running costs. As a consequence, ship owners are increasingly turning to Pacific Green to meet the environmental challenges faced by exhaust gas emission controls worldwide.

Every member of our experienced team knows the marine industry inside out and recognises the challenge faced by ship operators in today's world of ever more strict emissions regulations.

Our expert team is on hand to take you through three steps to a full solution customised to your needs

1. Discussion / Proposal / Contract

Our expert team of Pacific Green Marine engineers will discuss your fleet requirements and work closely with you to create a fully costed proposal, with special care and planning for deployment with minimal impact.

2. Survey / Plan / Build

Once the proposed approach is agreed our design & engineering team will survey your fleet, formulate a plan and then meet your vessels in a port of mutual convenience where an expert team will install your ENVI-Marine device from a combination of prebuilt and custom built components.

3. Implement / Test / Commission

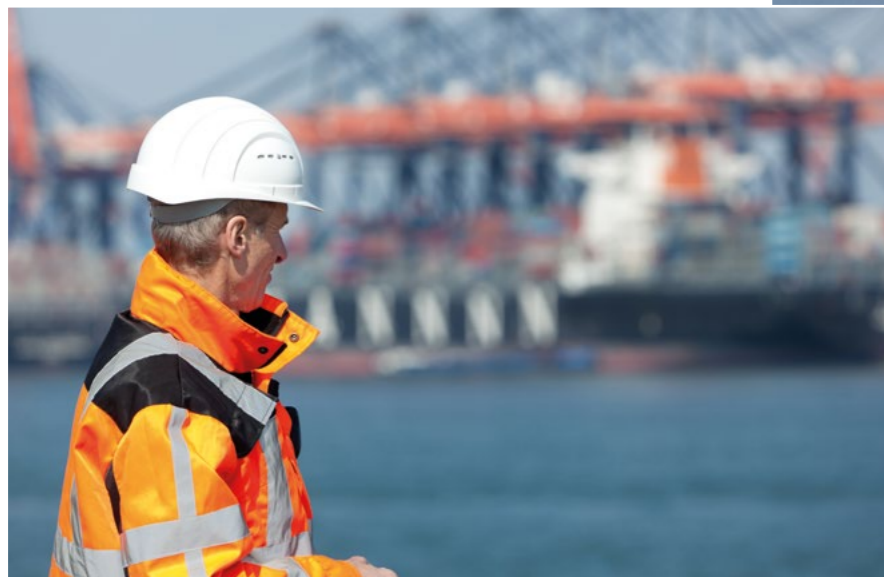
Once fleet vessels are launched back to sea with fully tested ENVI-Marine technology in place, we work with you to plan out a service schedule. Also operate with the peace of mind that our Global Service Team are on hand to respond to any support you need while at sea.

Global Service Network

With numerous global manufacturing bases, the Pacific Green Technologies Global Service Network offers total reassurance of support wherever and whenever it is required and keeps costs down, maximising your return on your gas scrubber investment.

With the knowledge, skills and support of the Pacific Green Global Service Network, you can rely on your equipment for as long as you own it. Our committed team will ensure high performance that will keep you competitive throughout your equipment's life cycle.

Our licensed installation and service centres are trained to both fit, and maintain Pacific Green equipment. Our factory-trained personnel are on hand throughout the process to provide support and security for you and your vessel.



We know downtime is very expensive in any industry, especially shipping, so we manufacture, procure and deliver to site all parts within an agreed timetable.

Pacific Green is pleased to offer an annual service agreement plan for its ENVI-Marine™ Exhaust Gas Cleaning System.

We recommend the following plan to maintain the ENVI-Marine™ Exhaust gas scrubbers within your fleet. This service agreement can be undertaken over a span of 3 years. The onboard inspections would take place with an initial inspection after exiting the guarantee period and a second visit 2 years later.

Part A – Onboard Inspection / Total of 2 Inspections

- EGCS body, CEMS, WWMS, PLC

Part B – Sensor Exchange Pool / Total of 3 Exchanges

- Sensor Exchange for the WWMS

Part C – Bi-Annual Remote Inspection / Total of 6 Reports

- Bi-annual remote reports on the systems performance
- Remote assistance for trouble shooting

Part D – Recommended Spares

- Bulk delivery of annual spares to decrease costs associated to delivery



You could make an estimated saving of up to \$37,700.00 per vessel over 3 years, with a more streamlined approach to maintenance.



A mighty powerhouse of technical engineering & infrastructure delivery

PowerChina's business scope covers electric power projects, development of oil, non-ferrous metal and mineral resources, real estate development, environmental conservation, investment in utilities and infrastructure, engineering and technical consulting services, import and export trading, and overseas contracting.

Currently, PowerChina has 30 subsidiaries, three joint-stock companies and representative offices in 13 countries and regions worldwide.

\$49b

annual revenue

30,000

technical elite staff

800

projects in 80 countries

150+

offices worldwide

A world-class partnership



The PowerChina SPEM and Pacific Green Technologies joint venture is uniquely positioned by being able to combine the design, innovation and sales network of Pacific Green Technologies, with the huge global reach and massive engineering capacity of PowerChina.

Pacific Green Technologies and PowerChina SPEM are a powerful partnership, and one of the few entities able to scale operations at a worldwide level to meet growing demand.



Scott Poulter
Chairman & CEO

“Our joint venture with PowerChina SPEM enables Pacific Green Marine to offer unrivalled production capacity coupled with vast design and engineering resources. We believe this continues to place Pacific Green Marine as an industry leader in the exhaust gas cleaning market. There is no doubt this joint venture puts us at the cutting edge for Chinese scrubber installations and gives us unrivalled international coverage.”

ENVI-Marine™ EGCS - The Best Solution to Meet IMO 2020 Sulphur Emission Regulations

ENVI-Marine™ EGC systems are the most cost-effective way to meet the IMO's global emission limit of 0.5% sulphur and the sulphur limit of 0.1% in Emission Control Areas (ECA).

The case for installing exhaust scrubbers as soon as possible is compelling: Capital outlay can be earned back rapidly depending on the vessel's size and the prevailing fuel price differential. And only companies such as Pacific Green, which have partnerships with huge engineering companies such as PowerChina SPEM, have the global capacity to act quickly and efficiently.

With the favorable price differential between HSFO and LSFO, shipowners continue to look at scrubbers as an economic solution to complying with IMO 2020

Why Gas Scrubbers Continue To Be The Future of Marine Emissions Control

It is very likely that scrubbers will continue to play a major role in the marine fuel mix over the near to medium term, even as continued efforts are made to clean up existing fuels and push for clean alternatives.

The COVID-19 pandemic has been a global tragedy, which alongside the war in Ukraine has smashed the economies of many nations and laid waste to whole sectors of industry. Now oil prices have recovered, during Q4 2022 (October- December) fuel spreads have widened between LSFO (low sulfur fuel oil) and HSFO (high sulfur fuel oil) This has benefitted scrubber vessels with improved voyage economics in excess of \$6000 a day

Dated Brent, the benchmark used to price more than two-thirds of the world's oil continues to trend upwards in price. This is good news for those shipowners who have installed marine gas scrubbers, as a rise in oil prices will likely be reflected in the spread between high sulphur fuel oil and low sulphur fuel oil, a spread which has been, at its height, over \$300.

As the spread widens, scrubbers become more attractive.

Most shipowners believe that the spread will continue to increase, after all, LSFO requires blending of distillates, which, in comparison to HSFO, are expensive and will become more so as the oil price rises. And, as the spread widens, scrubbers become more attractive, not just as a way to meet the new sulphur emission standards established by the International Maritime Organization (IMO) in January 2020, but as a way to save substantial amounts of money.

Some industry sources have criticised scrubbers for their inadequate role in tackling decarbonisation. However, Pacific Green is developing technology to help upgrade scrubbers to capture carbon at source in a vessel, ensuring they will continue to play a vital role as the world moves toward a cleaner future.

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