

Exhaust Gas Cleaning

Desulphurization scrubber for marine and power plant applications
Introduction

Krystallon has developed the most efficient SO₂ scrubber available in the market for marine and power plant applications. P&O's ferry Pride of Kent installed such a unit in 2005 and has operated multiple thousands hours of uninterrupted operation, without a single incident.

The guaranteed emissions reduction performance is well below that required by European marine SO_x emissions legislation (2005/33/EC).

Emissions in the stack have been noted as follows:

The measurement of SO₂ emissions in the exhaust stack indicates >95% removal for operation that involves removing the steam plume from the stack exhaust, and closer to 100% for no deplume requirement.

NO_x – 5% removal.

PM – the current units achieve a reduction over 50% of the Particulate Matter (both primary and secondary). This removal efficiency will be affected by fuel chemistry.

System already has passed a detailed Environmental Impact Assessment.

The proposal is targeted at a single pilot unit. Krystallon installed this unit at its own cost and risk as a pilot PPC system , to prove:

Significant benefits of using our sea water scrubbing technology to remove harmful pollutants from the air and water discharge

Emit near zero SO_x pollutants yet keep the engines operating on 3.5% high sulphur fuel oil

Krystallon unit fitted to one of the 2.2MW engine exhausts at the PPC facility in Limnos. This was undertaken at Krystallon's risk and cost aiming to demonstrate the outstanding environmental performance of the system.

Scrubber Benefits

By scrubbing one engine, PPC will be able to understand how effective the Krystallon scrubber can treat the exhaust from an engine, and project it to the overall power plant. This would be at no risk or cost to the power plant.

Additional to the reduction of SO_x emissions, the scrubber makes a significant contribution to eliminating particulate emission – which is very likely to be the subject of the next round of legislation.

The scrubber will also act as an effective silencer, as it will be fitted in place of the existing silencer that is frequently corroded and in need of regular overhaul.

Fitting scrubbers therefore, effectively "future proofs" the power plant from up–coming legislation on further reducing sulphur content and other legislation on PM. It also, more importantly, enables the power plant to purchase high sulphur fuel oil 3.5% S, which apparently has a dramatic positive effect on the operating and overall fuel costs.

Krystallon OEMing this technology believes that this way forward is both the best for the current power plant operation, as well as protecting itself from future more strict legislation. Also, the manufacturer stands 100% behind this technology and guarantees its performance, while has a stated policy of no harm to the environment in all its worldwide operations. This technology is backed by very extensive environmental impact assessment work undertaken over a 2 year time frame and that proves that the technology is an excellent alternative to the use of low sulphur fuel oils.

Pilot Unit

This unit is designed to treat the engine exhaust from a 2.2MW engine. The corroded silencer removed and replaced with the scrubber vessel, which acts as a very efficient silencer.

The system operates by collecting sea water from the engine cooling water system and pumping it into the scrubber system. The water would be collected from the cooling water return line, and would therefore have no effect on the operation of the engine.

The wash water would remove the SO₂ plus particulates and oils from the engine exhaust and exit the bottom of the scrubber. From there it would be pumped through the Water Treatment Plant, where are removed all the particulates, oils and the miscellaneous residues obtained during scrubber chemical reactions. The cleaned wash water stream is then mixed with more water from the engine cooling system where the alkalinity increases the pH to over 6.5

Equipment Specification (Pilot Unit)Side view of a Krystallon installation similar to Limnos, 2 X 5MW, 3 X 2.2MW

The specifications for the various components in the system are as follows:

Engine Scrubbers (2.2MW)

Number of units –1
Space Requirement –2m x 3m
Pressure drop –10" w.c. (25mbar)

Scrubber Supply Pumps ‐P100

Number of units ‐1
Design capacity of each ‐110m³/hr
Discharge Pressure ‐3.0bar.g

Water Treatment Pumps ‐P500

Number of units ‐1
Design capacity of each ‐110m³/hr
Discharge Pressure ‐2.0bar.g

Pumping Power Requirements

Estimated at 25kW maximum

Water Treatment Plant ‐WT500

Number of units ‐1 off MC‐10
Throughput ‐110m³/hr
Pressure drop ‐1.5bar.g

Caustic Injection System

Storage tank 1m³ capacity
Positive displacement pump
Amount controlled by pH indicator controller

Sludge Collection Tank

Capacity of 1m³
Material of Construction polypropylene
Positive displacement transfer pump

Exhaust Gas Monitoring

Uses high quality in‐situ CEM system

Water Discharge Monitoring

Fluorometer monitoring PAH concentration

Performance Targets

The operating targets for the subject unit, in PPC at Limnos Power Plant, are listed below. The performance is based on the engine running on 3.5% sulphur fuel and with a maximum power load of 2.2MW:

Performance Targets for installed Unit in PPC at Limnos Power Plant

SOx Removal Efficiency – With Deplume >95%
SOx Removal Efficiency – Without Deplume >98%
Discharge Water Quality <1ppm hydrocarbons, <30ppb PAH

Process Design Parameters

The system is designed to operate on a single 2.2MW diesel engine using the available water supply for scrubber supply water and dilution of the scrubber discharge. The scrubber is designed for efficient performance with an engine operating at full load on 3.5% Sulphur fuel.

Scrubber supply pump is included which add sufficient wash water to the scrubber to ensure adsorption of the SO₂ in the engine exhaust gas. After scrubbing the exhaust gas, the wash water is treated in Krystallon's water treatment package. The scrubber supply pumps also act as a source of reaction water, which is added to the wash water. This generates clean water which will be discharged to the sea.

The Water Treatment Plant is designed to remove the suspended particles and entrained oils contained in the water wash stream, using small cyclone separators, or multiclones. The particulates that have been scrubbed out from the engine exhaust are collected in the base of the vessels and are periodically blown down to a Sludge Collection Tank. Caustic is added to maintain the pH in the tank at 7. The particulates settle out in the base of the tank, and the excess clean water is pumped out to sea. The contents in the tank will require removing once the tank starts to fill.

An important piece of the overall package is the monitoring equipment supplied for both the water outlet (to measure the cleanliness of the discharge water) and the gas emission to the atmosphere. This equipment uses the very latest in Continuous Emissions Monitoring (CEM) technology with very accurate measurements recorder in a supervisory computer system.

Monitored parameters on exhaust and water discharge

Exhaust discharge: SO₂, SO₃

Exhaust CEM: CO₂, NO, NO₂ and Temperature

Water Discharge: pH

Water discharge uses Fluorometer technology: Temperature and Hydrocarbons (using PAH as surrogate)