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TUNA MARINE

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Exhaust gas cleaning system for maritime industry

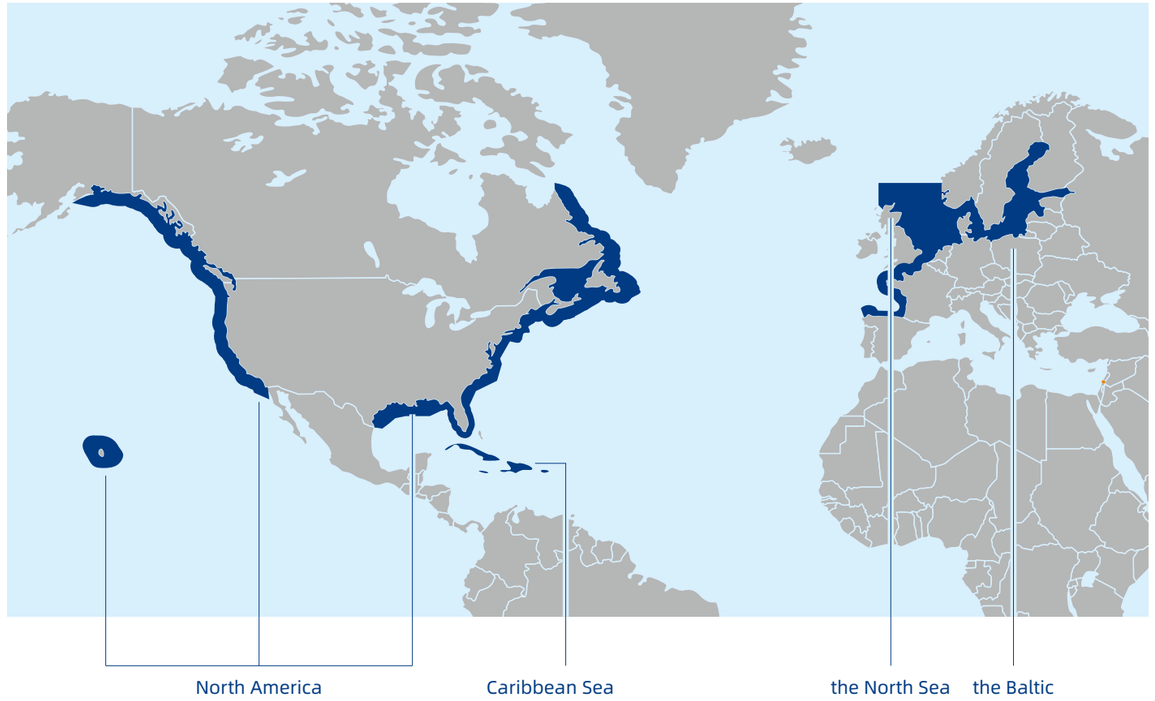
TMOU-SOx | TMOI-SOx

SHANGHAI TUNA MARINE
ENVIRONMENT TECHNOLOGY CO., LTD.

REGULATORY FRAMEWORK

Sulphur Oxides (SOx) in marine engines exhaust gas is concern to human health and the environment. Adverse effects are experienced at local, regional and global level.

In response to these impacts, the international Maritime Organization (IMO) introduces regulations for the prevention of air pollution under Annex VI of the MARPOL Convention. MARPOL Annex VI imposes a framework of mandatory limits on emissions of SOx both globally and Emission Control Areas (ECAs).



2015 ECA
0.1% S

2020
0.5% S

REGULATORY FRAMEWORK

In parallel with MARPOL Annex VI, a number of regional, national and local regulators have introduced their own controls, leading to a patchwork of regulatory requirements.

0.5%
all ECAs, wider extension

0.1%
within inland water control areas

0.1%
Territorial coastal waters of Hainan island

EXHAUST GAS CLEANING SYSTEM (EGCS)

Product Overview

This product is applicable to the SOx emission reduction for marine fuel combustion device. The SOx concentration can be reduced through the installed marine desulfurization scrubber to make the SOx emission value less than the emission value when using fuel containing 0.1% sulfur (m/m).(MARPOL Annex VI 14.4.3)

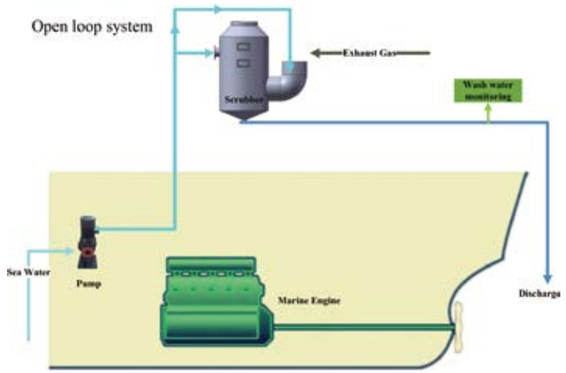
Application Background

With the development of international ocean shipping industries, the exhaust gas from ships has become the main pollution source in coastal areas, especially in ports areas. The air pollution caused by SOx in the exhaust gas from ships has attracted extensive attention of the international community. At present, there are four main technologies for desulfurization of exhaust gas from ocean ships, which are low sulfur fuel technology, LNG fuel technology, dry flue gas desulfurization technology and wet flue gas desulfurization(FGD) technology. Presently, wet FGD is adopted the mainstream technology.

Process Selection

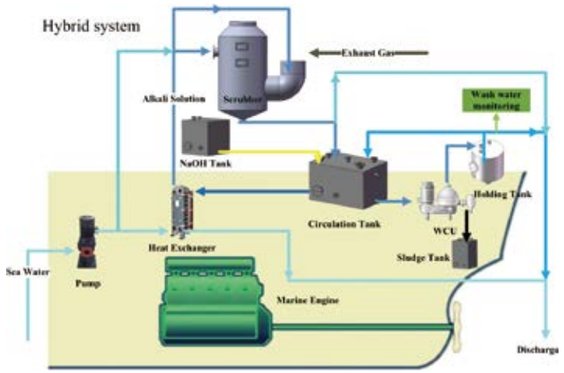
■Open Loop System

In open loop system, ship flue gas passes through the scrubber tower and is directly washed by seawater for desulfurization. After desulfurization, the clean flue gas is discharged through the chimney, and the washed water is discharged after simple treatment in accordance with standard.



■Hybrid System

The hybrid system integrates both open and close loop system and has the flexibility to operate seamlessly in either in low alkaline waters as well as the open ocean. Without the loss of efficiency and well within the IMO regulations for emission Air and Sea.



TM-SOx SYSTEM

■Scrubber System

TUNA's scrubber is u-shaped tower and the flue gas enters from the auxiliary tower. Compared with the i-shaped tower, it has the advantages of higher security and lower height.

Our design relies on the packed tower using sodium alkali desulfurization.

The packing material is placed in the tower, and slurry moistens the packing surface to increase the contact area between gaseous phase and liquid phase. The porosity of packing layer not only achieves air-distribution uniformity but also promotes the turbulence of gaseous phase.

U-shaped Tower

Scrubber type of TMOU-SOx	Unit	TMOU-SOx -4	TMOU-SOx -6	TMOU-SOx -8	TMOU-SOx -9	TMOU-SOx -10	TMOU-SOx -11	TMOU-SOx -13	TMOU-SOx -15	TMOU-SOx -17
Power SMCR	MW	4	6	8	9	10	11	13	15	17
Exhaust gas flow (@SMCR)	KG/h	31200	46800	62400	70200	78000	85800	101400	117000	132600
Nominal diameter	MM	1900	2400	2700	2900	3000	3200	3400	3700	4000
Total height	MM	6600	7200	7700	7800	8300	8250	8700	8900	9400
Net weight	KG	5800	8100	9500	10500	11200	12100	12700	13300	15100
Power consumption in OL	KW	56	79	100	110	129	141	164	186	209

Scrubber type of TMOU-SOx	Unit	TMOU-SOx -22	TMOU-SOx -28	TMOU-SOx -34	TMOU-SOx -40	TMOU-SOx -47	TMOU-SOx -55	TMOU-SOx -63	TMOU-SOx -71	TMOU-SOx -80
Power SMCR	MW	22	28	34	40	47	55	63	71	80
Exhaust gas flow (@SMCR)	KG/h	171600	218400	265200	312000	366600	429000	491400	553800	624000
Nominal diameter	MM	4500	5000	5500	6000	6500	7000	7500	8000	8500
Total height	MM	10150	10950	11750	12300	13000	13700	14450	15050	15750
Net weight	KG	19100	23600	27700	30500	33770	36100	40800	48700	58300
Power consumption in OL	KW	285	384	462	541	633	739	843	947	1066

I-shaped Tower

Scrubber type of TMOI-SOx	Unit	TMOI-SOx -4	TMOI-SOx -6	TMOI-SOx -8	TMOI-SOx -9	TMOI-SOx -10	TMOI-SOx -11	TMOI-SOx-13	TMOI-SOx -15	TMOI-SOx -17
Power SMCR	MW	4	6	8	9	10	11	13	15	17
Exhaust gas flow (@SMCR)	KG/h	31200	46800	62400	70200	78000	85800	101400	117000	132600
Nominal diameter	MM	1700	2000	2300	2500	2600	2700	2900	3200	3400
Total height	MM	9600	9900	9900	10000	10200	10200	10900	11100	11300
Net weight	KG	3500	4300	4900	5400	5700	5900	6800	7600	8300
Power consumption in OL	KW	72	99	127	139	154	169	196	223	250

Scrubber type of TMOI-SOx	Unit	TMOI-SOx -22	TMOI-SOx -28	TMOI-SOx -34	TMOI-SOx -40	TMOI-SOx -47	TMOI-SOx -55	TMOI-SOx -63	TMOI-SOx -71	TMOI-SOx -80
Power SMCR	MW	22	28	34	40	47	55	63	71	80
Exhaust gas flow (@SMCR)	KG/h	171600	218400	265200	312000	366600	429000	491400	553800	624000
Nominal diameter	MM	3800	4300	4700	5100	5600	6000	6400	6800	7200
Total height	MM	11500	11700	11900	12100	12400	13300	13500	13800	13900
Net weight	KG	11300	12900	14400	15900	17900	20500	22200	24100	25700
Power consumption in OL	KW	320	401	483	565	662	773	882	993	1115

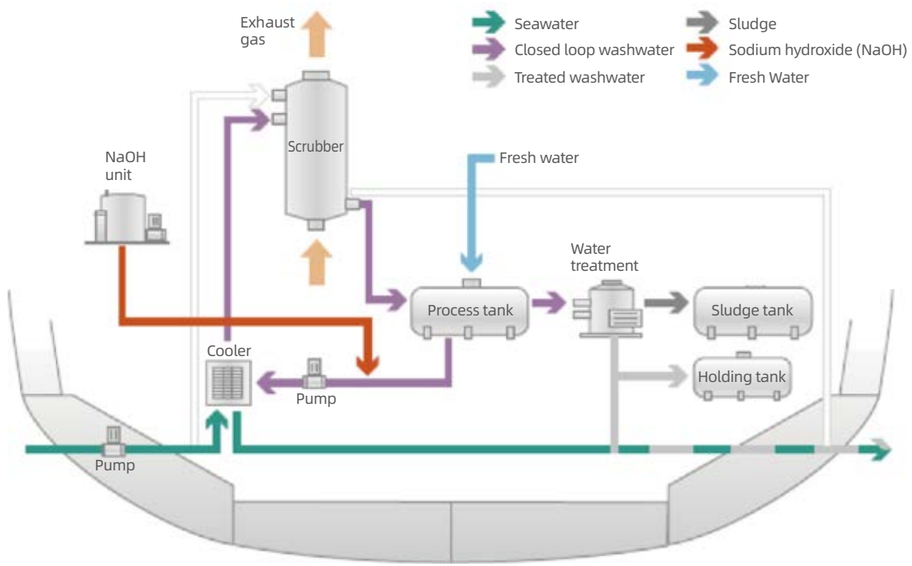
EXHAUST GAS CLEANING SYSTEM (EGCS)

Lye Circulating System

SO2 will be absorbed by the lye at the spray layer of the scrubber and the residue will flow to the bottom of the scrubber. Which is send into the lye circulation tank. A lye circulating pump will recycle the lye back into the spray layer. provided with lye circulating pump to resend the lye into the spray layer.

pneumatic stirring device of the circulating tank

Vertical circulating pump



Seawater Cooling System

The seawater heat exchange systems adopts a plate heat exchanger to reduce the temperature of circulating lye into scrubber. This will reduce the temperature of the exhaust flue gas.

Plate type heat exchanger

seawater self-priming pump

Alkali Supplement System

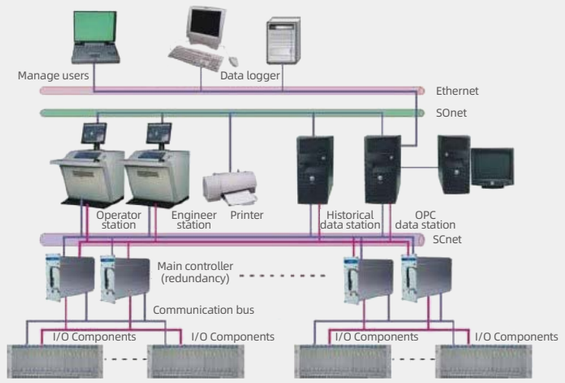
The alkali supplement system consist of one lye tank and two alkali supplement pumps (one main and another for standby). In order to neutralize the acidity of the exhaust gas, NaOH (Caustic Soda) is added into inlet of circulation pump by alkali supplement pump.

The flow rate of fresh lye is calculated according to the correlation between SQ2 and flue gas flow rate, and adjusted by feedback form pH meter and densitometer.

Vertical alkali supplement pumps

Subsystem and Auxiliary Equipment

Subsystem and Auxiliary Equipment: The ECGS control system is divided into three functional block: washing, heat exchange and waste treatment block. Ship crews can monitor and control the whole system by using an advance touch screen interface unit. The control system comes with a communication port which allowed exchange of data, operation parameters can be either uploaded, stored or printed. Shipowners can set up monitoring station in the ship control room according to their owe needs. The structure diagram of the EGCS control system is shown in Figure 4.6-1 and the outer dimension drawing of the control cabinet is shown in Figure 4.6-2.



control flow chart

Waste Water Treatment System

Waste Water Treatment System: The waste water treatment System is installed in the system to prevent the impurity accumulation in scrubbing water and to maintain required process chemistry. The waste water treatment System can be started or stopped or selected to remote control using the local control panel in the unit. The residue sludge is automatically pumped from WWTU to the external sludge tank. The clear water passes a series of baffles and a parallel flock trap to separate the smaller particles before it is overflowed to the discharge holding tank.

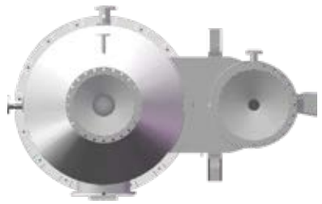
Waste water treatment unit

Electrical System

He pumps or fans of EGCS are power by the main switch board (AC440V 60Hz) of the ship with Power distribution cabinets dedicated independent. The main control cabinet is power by the main switch board (AC230V 60Hz) of the ship. The instrument and Electric valves are power by the main control cabinet.

Outer dimension drawing of the power distribution cabinet

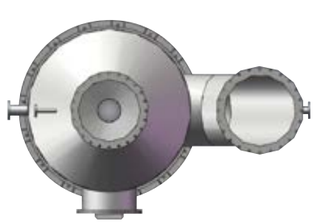
Project Case Bulk Carrier Scrubber Scheme



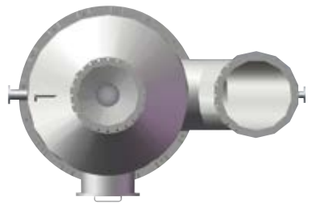
Vessel specifications	
Type	BULK CARRIER
Owner	SUMEC
Class	NK
Flag	Liberia
Engine information	
Main engine	
Main engine type	MAN B&W 6S60ME-C8.5 T- Ⅱ
Quantity	1 set
Engine MCR	9.663 MW
Fuel type	HFO
Fuel sulphur content	3.5%
Aux. engine	
Aux. engine type	6EY18ALW
Quantity	3 sets
Engine MCR	0.8 MW
Fuel type	HFO
Fuel sulphur content	3.5%
Scrubber information	
Scrubber type	Open loop
Treated exh.has flow	76140kg/h
Diameter	3.1m
Height	8m
Dry weight	
Material	UNS S32205+UNS S31254

Project Case Chemical Tanker Scrubber Scheme

Vessel specifications	
Type	Chemical Tanker
Owner	GOLDWIN
Class	
Flag	
Engine information	
Main engine	
Main engine type	MAN B&W 6S70ME
Quantity	1 set
Engine MCR	18.66 MW
Fuel type	HFO
Fuel sulphur content	3.5%
Aux. engine	
Aux. engine type	MAN 7L23/30
Quantity	3 sets
Engine MCR	0.909 MW
Fuel type	HFO
Fuel sulphur content	3.5%
Scrubber information	
Scrubber type	Open loop
Treated exh.has flow	169416kg/h
Diameter	4.5m
Height	10.1m
Dry weight	
Material	UNS S32205+UNS S31254



Project Case Container Vessel Scrubber Scheme



Vessel specifications	
Type	CONTAINER VESSEL
Owner	X-PRESS
Class	DNV-GL
Flag	Singapore
Engine information	
Main engine	
Main engine type	MAN B&W 6G60ME-G9.5-TII
Quantity	1 set
Engine MCR	12.5 MW
Fuel type	HFO
Fuel sulphur content	3.5%
Aux. engine	
Aux. engine type	MAN 9L21/31
Quantity	4 sets
Engine MCR	1.98 MW
Fuel type	HFO
Fuel sulphur content	3.5%
Scrubber information	
Scrubber information	
Scrubber type	Hybrid
Treated exh.has flow	117474kg/h
Diameter	3.9m
Height	6.6m
Dry weight	
Material	UNS S32205+UNS S31254

Project Case Multipurpose Cargo Ship Scrubber Scheme

Vessel specifications	
Type	multipurpose cargo ship
Owner	
Class	LR
Flag	Netherlands
Engine information	
Main engine	
Main engine type	WARTSILA 9L32
Quantity	1 set
Engine MCR	5.22 MW
Fuel type	HFO
Fuel sulphur content	3.0%
Aux. engine	
Aux. engine type	WARTSILA 9L20
Quantity	4 sets
Engine MCR	1.98 MW
Fuel type	HFO
Fuel sulphur content	3.0%
Scrubber information	
Scrubber type	Open loop
Treated exh.has flow	52100kg/h
Diameter	2.9m
Height	8.2m
Dry weight	
Material	SMO 254