Engine and SO_x scrubber technologies to meet IMO fuel quality requirements on sulphur and SO_x

Klaus M. Heim
Vice President, Global Research & Development
WÄRTSILÄ CORPORATION

CIMAC Circle SMM 2008
September 25th, 2008
Hamburg

WÄRTSILÄ

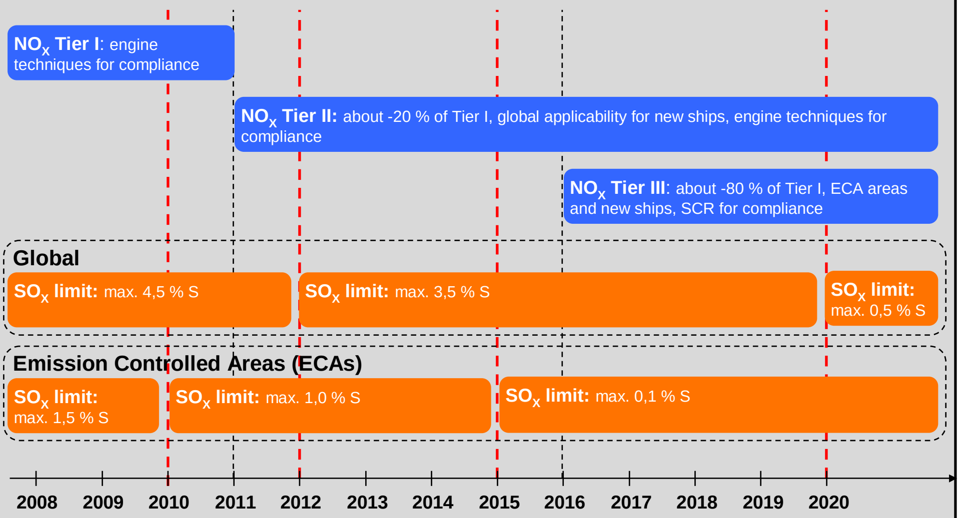
CIMAC Circle SMM 2008

Engine and SOx scrubber technologies to meet IMO fuel quality requirements on sulphur and SOx

- Implications of the upcoming IMO regulation on fuel sulphur content
- Options for the shipowner
- Exhaust gas scrubber technology

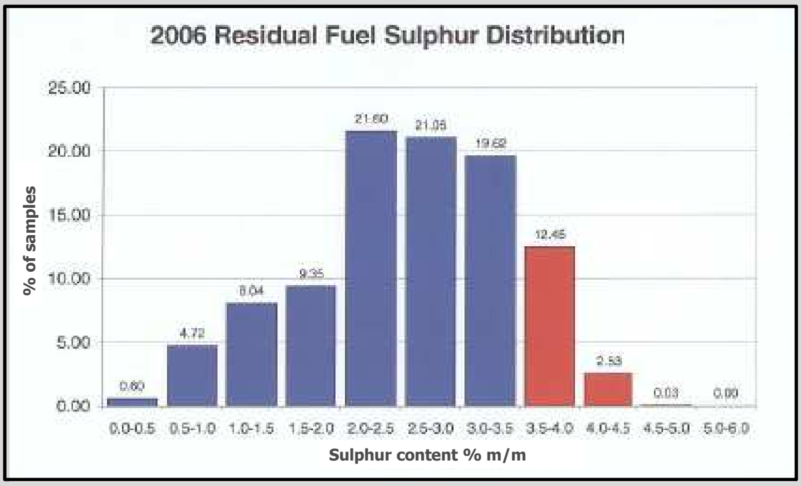
WÄRTSILÄ

IMO Tier II / Tier III requirements for ocean going vessels



WÄRTSILÄ

Today's sulphur content in Heavy Fuel Oil

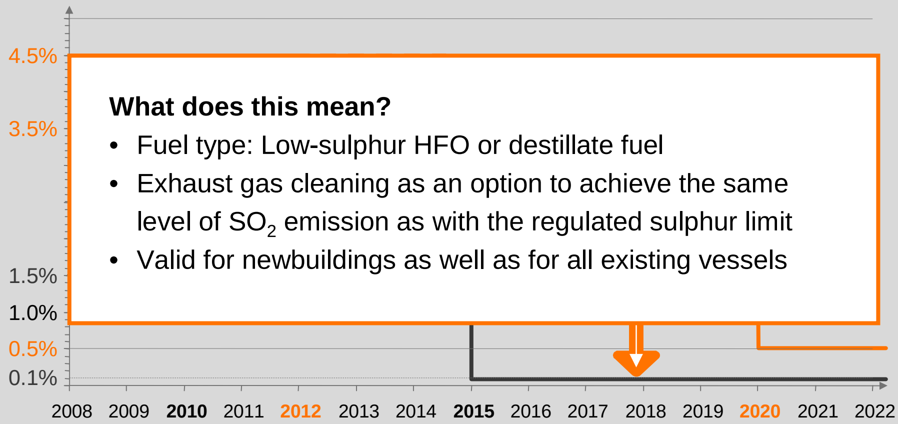


Source: Exxon Mobil

WÄRTSILÄ

Fuel sulphur content: IMO roadmap

Stepwise reduction of the sulphur content in Heavy Fuel Oil



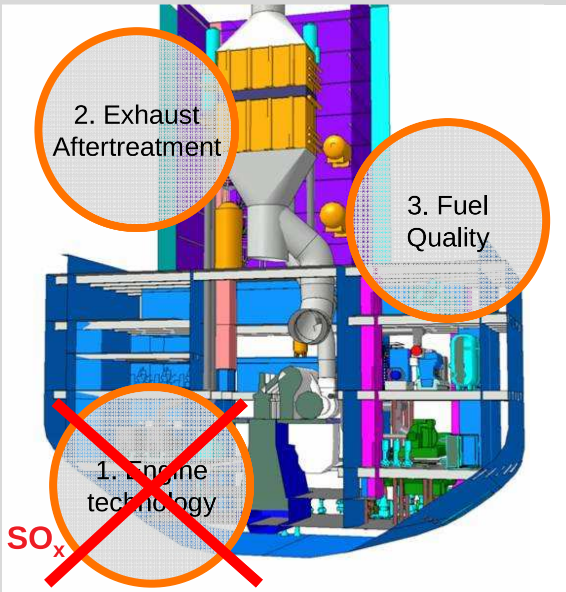
What does this mean?

- Fuel type: Low-sulphur HFO or destillate fuel
- Exhaust gas cleaning as an option to achieve the same level of SO_2 emission as with the regulated sulphur limit
- Valid for newbuildings as well as for all existing vessels

* SECAs (Baltic and North Sea, English Channel+ additional new areas)

WÄRTSILÄ

Options to reduce engine emissions

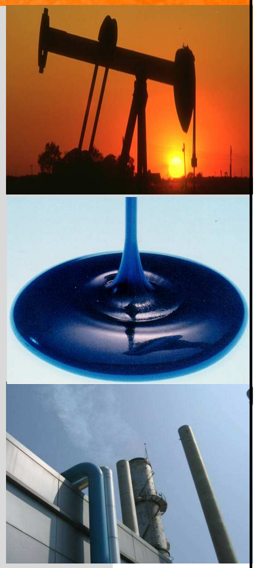


WÄRTSILÄ

Options for the ship operator

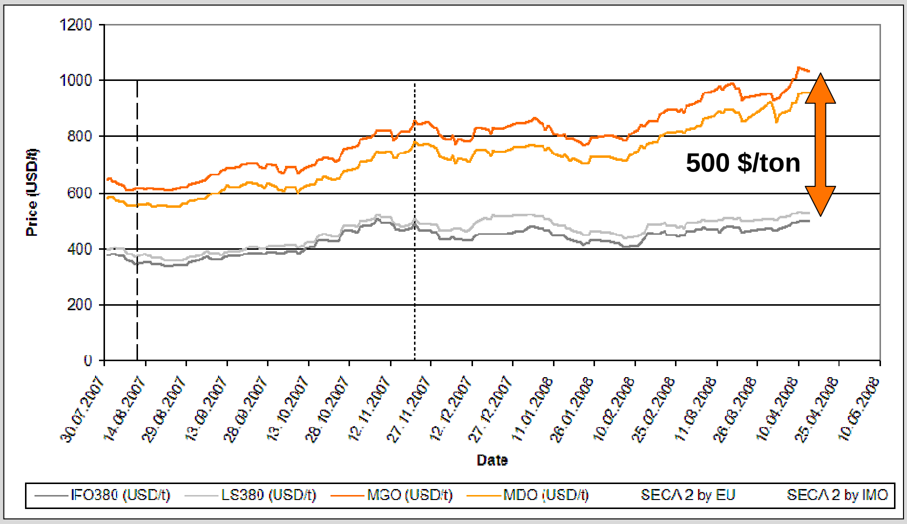
Options to comply with IMO SO_x regulation, both globally and in Emission Controlled Areas (ECAs)

1. Continuous operation on low-sulphur HFO or destillate fuel
2. Two different fuel qualities on board, switching over when entering ECAs
3. Running on high-sulphur HFO in combination with exhaust gas aftertreatment: Scrubber / Flue Gas Desulphurization (FGD)



WÄRTSILÄ

Fuel price development, Rotterdam

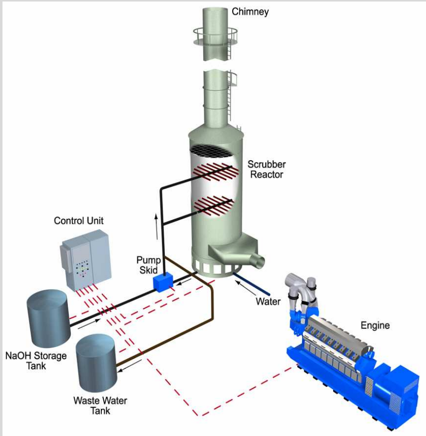


Source: bunkerworld.com

WÄRTSILÄ

Exhaust gas scrubber technology

- **Working principle**
  Using alkalinity to neutralize the dissolved sulphur dioxide from the exhaust gas
- **Different types** of scrubbers, using different absorbents for the sulphur removal process:
  - Seawater
  - Caustic soda (NaOH)
  - Limestone ($CaCO_3$)
  - …
- **Effect:** SO_x reduction ≥ 90%



WÄRTSILÄ

Stationary SO_x scrubber installations

Selected References (Diesel Engine)

	Delivery	Engine Type	Fuel	FGD Type
Wärtsilä Lungtan, Taiwan	2004	7x Wärtsilä 18V32	HFO 1%S	NaOH
Ankara Enerji Uretim Ankara, Turkey	2003	7x MAN 18V32/40	HFO 5%S	Limestone
Wärtsilä Puerto Quetzal, Guatemala	2003	10x Wärtsilä 18V46	High S emul fuel	Limestone
Wärtsilä Manisa, Turkey	2001	3x Wärtsilä 18V46	HFO 5%S	Limestone
MAN B&W Diesel Gaziantep, Turkey	1999	2x MAN 9L58/64	HFO 5%S	NaOH
Wärtsilä Cinkur, Turkey	1998	3x Wärtsilä 18V38	HFO 5%S	NaOH
Wärtsilä Kudremukh, India	1996	1x Wärtsilä 12V46	HFO 4.5%S	NaOH
Wärtsilä Cerestar, Germany	1995	1x Wärtsilä 16V46	HFO 1%S	NaOH
Wärtsilä Kudremukh, India	1994	2x Wärtsilä 12V46	HFO 4.5%S	NaOH

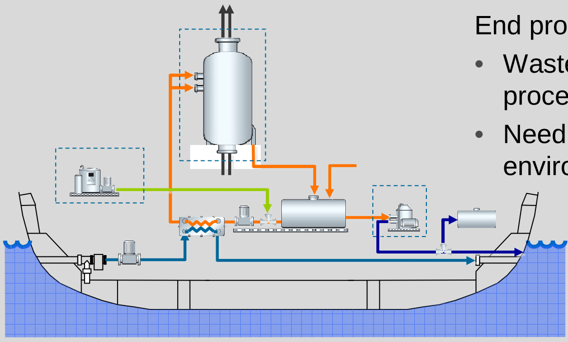
Total: 36 engines / 467 MW

WÄRTSILÄ

Exhaust gas scrubber technology

Wet NaOH scrubber

- fresh water, 50% NaOH solution
- closed loop system
- simpliest and most cost efficient scrubber solution



Consumables:

- Power consumption: 0.5 - 1 %
- Process water: ~ 1 m^3/MWhe
- NaOH: ~ 5 kg/MWhe / 1% sulphur

⇒ NaOH consumption:
3.2 m^3/day (10 MW, 2.7% sulphur)

End product:

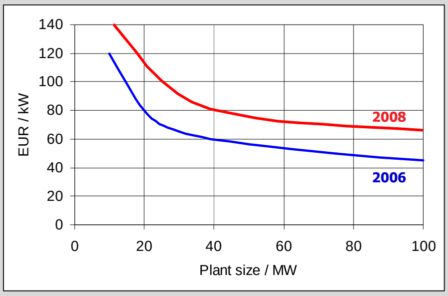
- Waste water ~10…20% of process water flow
- Need for storage on board and environmentally friendly disposal

WÄRTSILÄ

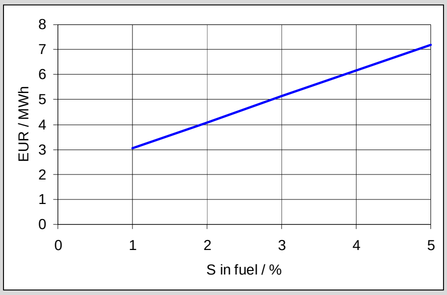
Exhaust gas scrubber technology

Wet NaOH scrubber

Investment cost:



Operation & maintenance costs:



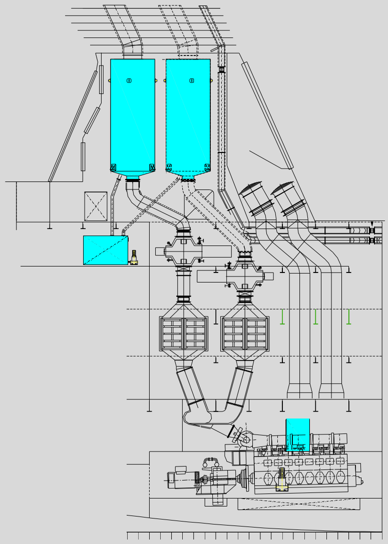
Assumptions: 90 % SO_2 reduction, stack height ≤ 45 m,
NaOH price = 220 EUR/t (100 %), water price = 1 EUR/t (only own heat recovery boilers in use)
Not included: reheat, raw water or wastewater treatment, by-product disposal costs

WÄRTSILÄ

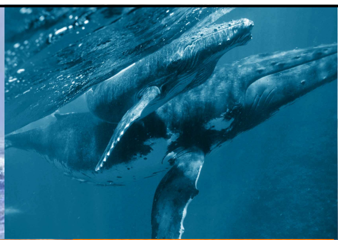
Exhaust gas scrubber technology

Next steps

- Reduction of size, weight and cost of scrubbers for marine applications
- Further improvement of cleaning efficiency
- Integration into ship design
- Testing and validation of scrubber technology in marine applications
- Infrastructure for environmentally friendly waste product disposal



WÄRTSILÄ


Thank you

WÄRTSILÄ