



**SOLVAY**

asking more from chemistry®

**SOLVAir**<sup>®</sup>  
SOLUTIONS

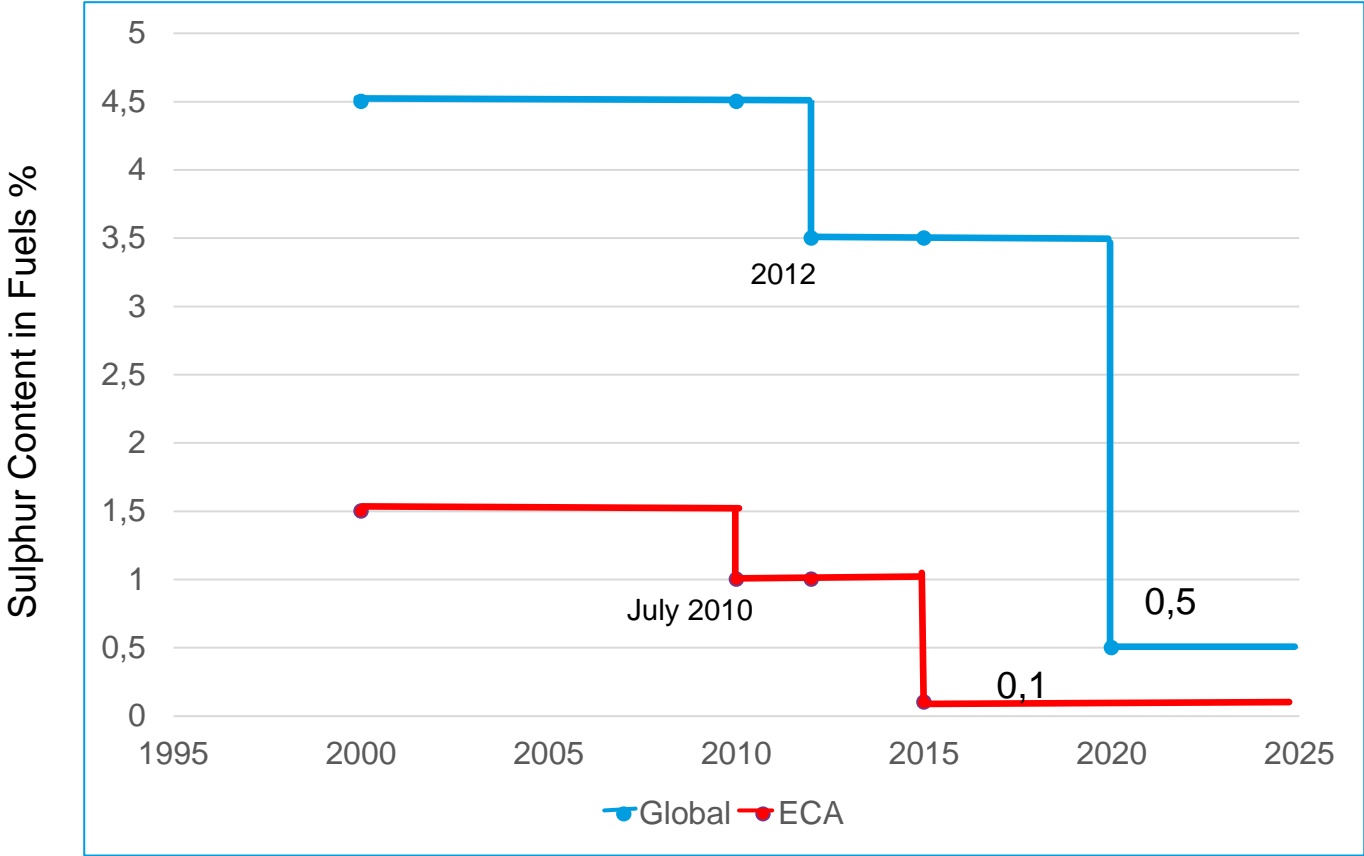
# New Exhaust Gas Cleaning Systems for Compliance with the IMO –SO<sub>x</sub> Regulations

**SOLVAir**<sup>®</sup> Marine

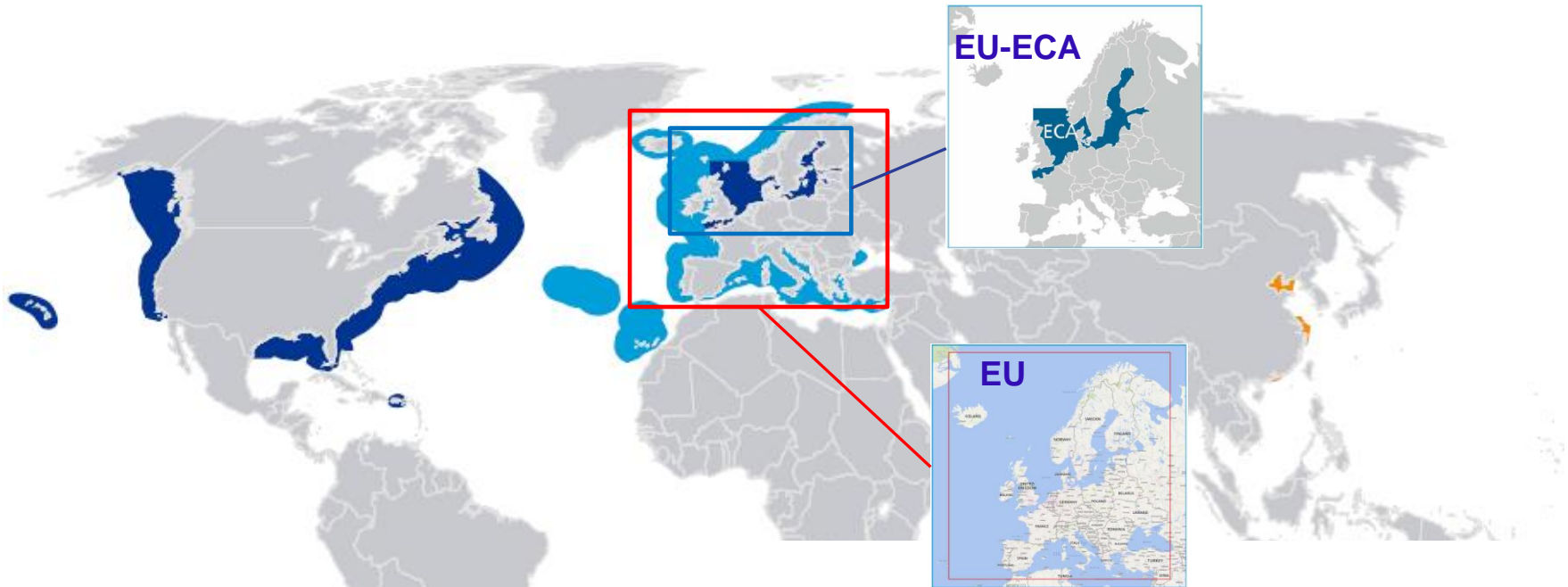
**Giordano Zappelli**

GBU Soda Ash  
and Derivatives

# Emission laws for the marine sector



# Context and legislation: Existing and potential ECA (Emission Control Areas) zones



- 0.5% global limit (MARPOL, 2020)
- 0.5% EU Sulphur Directive limit (2020)
- 0.1% Emission Control Area limit (MARPOL)
- 0.5% local limit (Hong Kong, China) \*

\* Note that China and Hong Kong may go down to 0.1% before 2020

Picture Font: Brochure DNV-GL Maritime  
“GLOBAL SULPHUR CAP 2020 – Know the different choices and challenges for on-time compliance”

<https://www.dnvgl.com/maritime/publications/global-sulphur-cap-2020.html>

# Context and legislation: tightening constraints on emissions and available solutions to comply

## Since 01.01.2015

- Use of fuel with max. 0.1% S binding in Emission Control Areas (ECA's)
- Current ECA areas: North- and Baltic Sea, North American coast areas

## As of 01.01.2020

- worldwide limitation of S-content in fuels: 0,5 % S

- **Currently available solutions to comply**
  - Compliant fuels (MGO, Low S fuel oil,...)
  - Alternative fuels (LNG, Methanol,...)
  - Wet scrubbers (open/closed loop, hybrid)
  - Dry systems using lime based sorbents (3 cases)
- **Alternative solutions:**
  - Dry systems using **sodium-based** sorbents (based on SOLVAir® Solutions)

## DeSOx: What means in Sulphur reduction

Vessels amount  
(units)

77.238

Sulphur (t)

Average Content 2018 : 2,5 %



5,97 Mt S = 11,94 Mt SO<sub>2</sub>

**2020**

1,19 Mt S = 2,38 Mt SO<sub>2</sub>



S: - 4,78 Mt

SO<sub>2</sub>: - 9,56 Mt

HFOeq consumption  
(Mton/year)

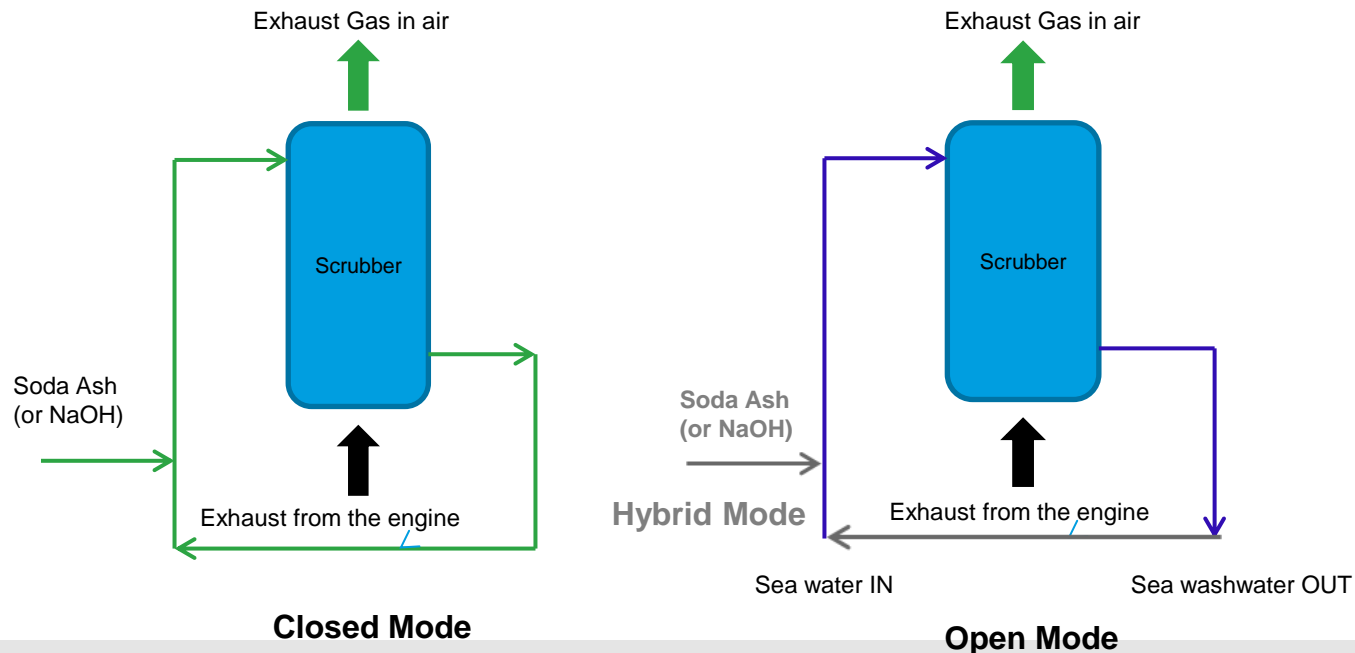
238,9

# Major Wet Scrubbing Systems

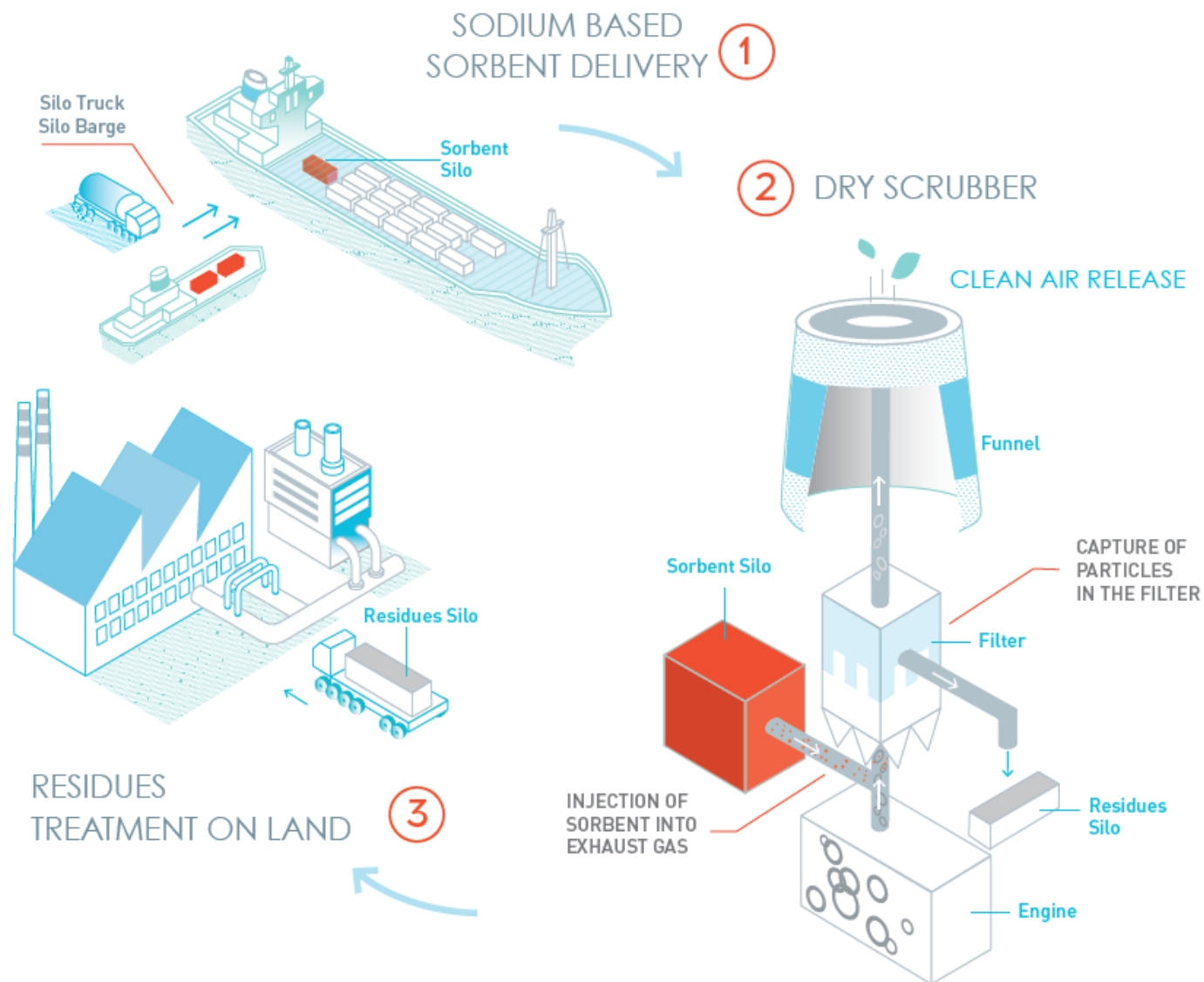
- Closed Loop;
- Open Loop;
- Hybrid.

## % of operating time in which chemical addition is requested

- Closed loop mode: **100%**
- Open loop mode: **0%** (where washwater discharge is forbidden, vessels are forced to shift from HFO to LSF)
- Hybrid Mode (i.e. it can work both in Closed and Open mode): vessels must work in closed mode only where washwater discharge is forbidden (e.g. at berth or mooring)..



# The Dry SOLVAir® Process: Simplified Flowsheet



# Product Characteristics of Sodium-Based Sorbents

A safe & mineral  
product

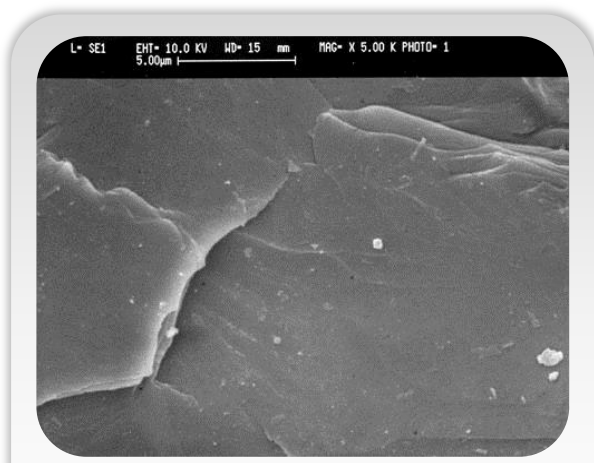
- Mineral Powder:
  - Non Corrosive
  - Non Irritant
  - Non Toxic
- Can be handled easily without any risk
- Essential raw material in numerous industrial and manufacturing activities





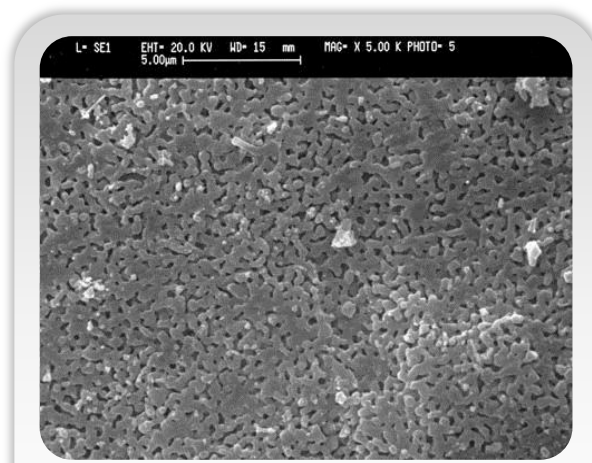
# Why is the dry SOLVAir<sup>®</sup> Process so efficient?

Activation of the sorbent after injection into the exhaust gas stream:



before activation

(SEM x 5000)



activated status

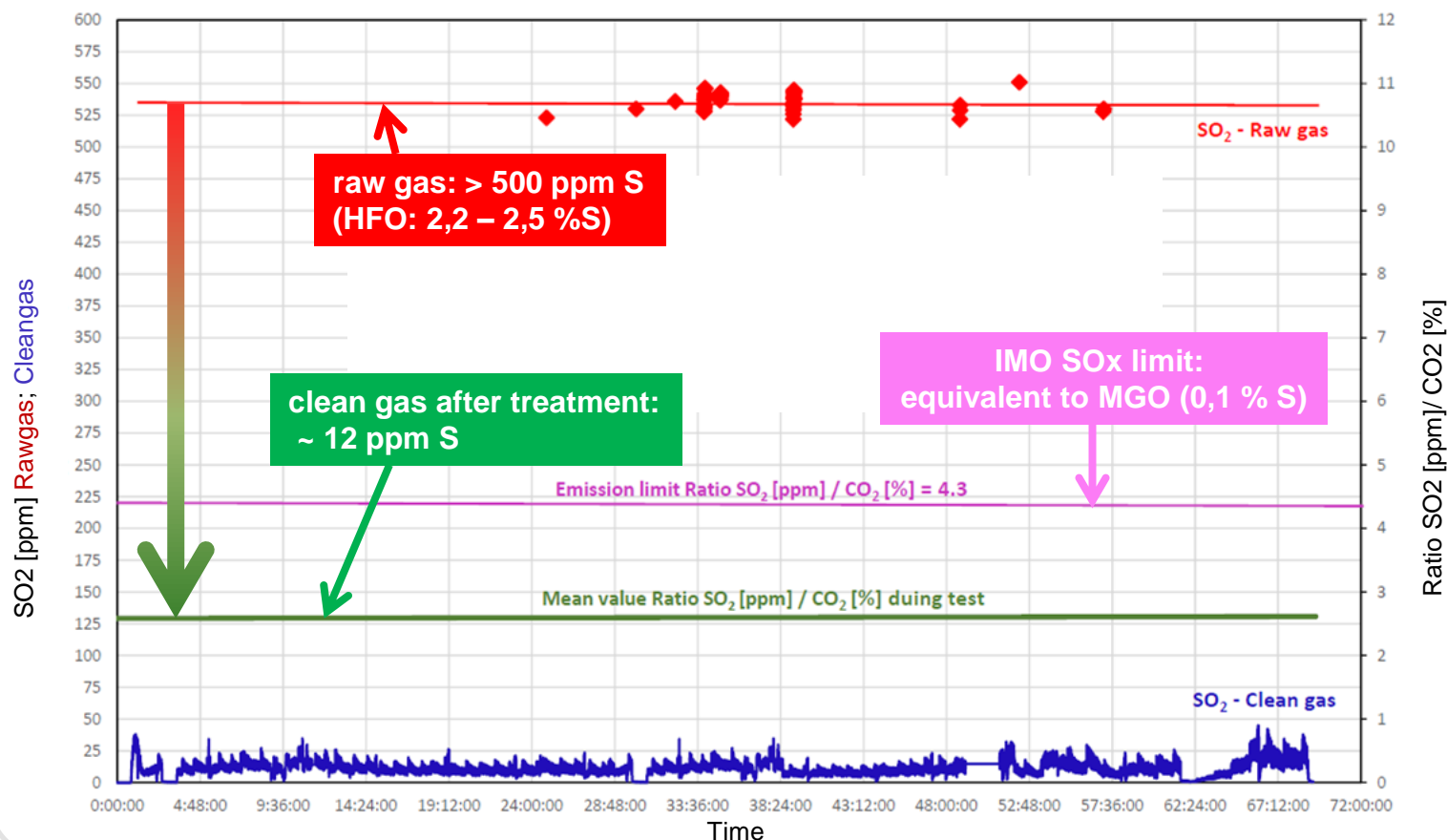
(SEM x 5000)

## 4. Results dry SOLVAir® Process for Maritime

achieved clean gas SO<sub>x</sub> concentrations << IMO emission limit

long term test run done

- ✓ with HFO with 2,2 % S
- ✓ legal limit of SO<sub>2</sub> concentration clearly respected



# Advantages of SOLVAir® Solutions in Maritime Applications

## The main advantages for ship owners and operators are

- Flexibility to use cheaper HFO even when cruising in already existing Emission Control Areas
- Readiness for the global regulation in 2020 and beyond

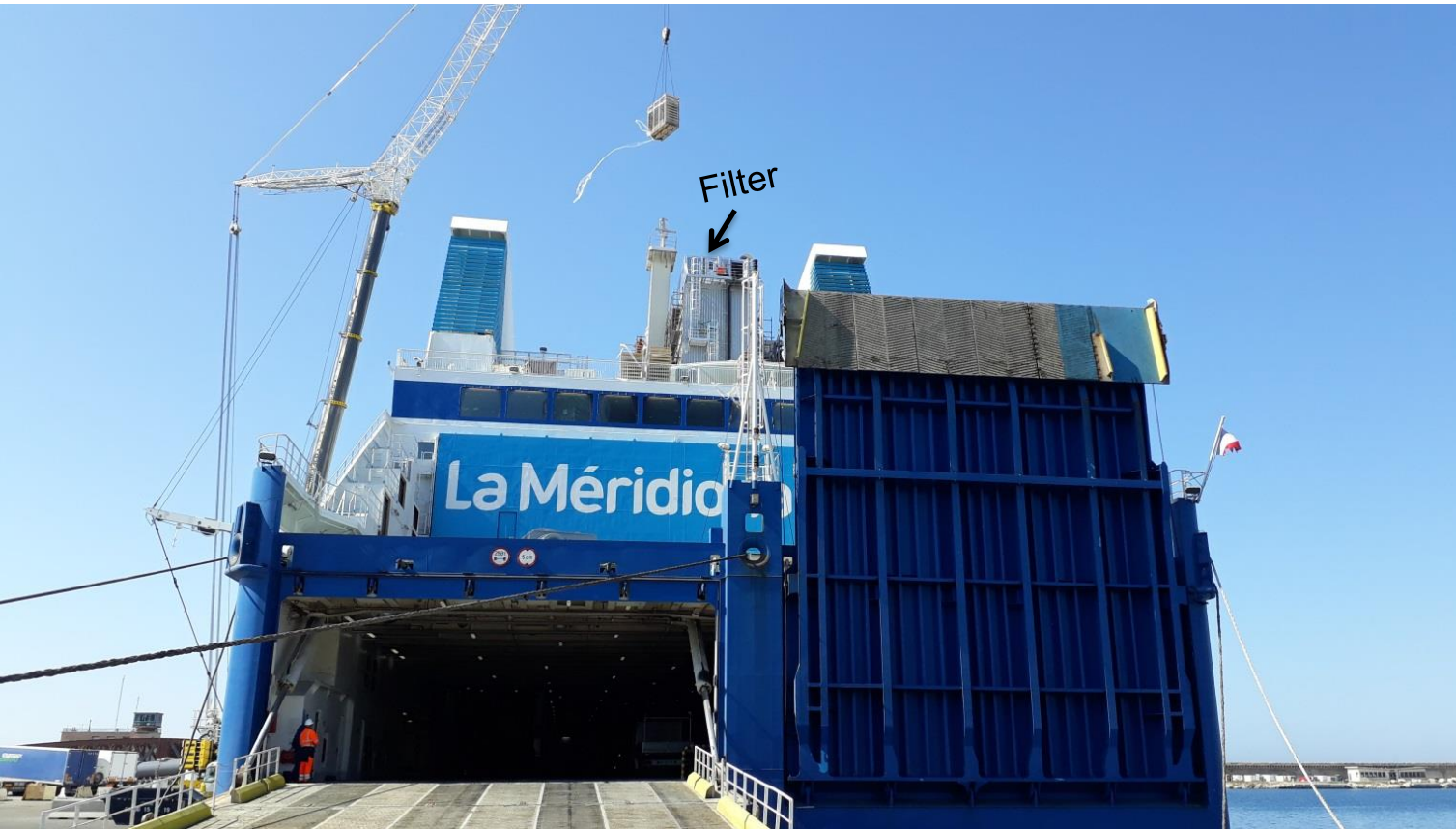
## SOLVAir® Marine

## SOLVAir® Solutions brings many advantages compared to wet scrubbers

- Comparable SO<sub>x</sub> reduction rate
- Higher particle removal rate (> 99 %)
- No liquid effluents
- Less internal power consumption (no pumps for washing water)
- Lower CAPEX, OPEX
- For installation no need for a dry dock
- Combination with SCR DeNO<sub>x</sub> possible
- Negligible effect on backpressure to the engine
- Smaller effort for maintenance and operation thanks to simplicity of the process
- Low sensitivity to failure

# The dry SOLVAir® Process for Maritime

## First Ship Equipped



[www.solvairsolutions.com/en/solvair-marine](http://www.solvairsolutions.com/en/solvair-marine)