WÄRTSILÄ
EXHAUST GAS CLEANING SYSTEM

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BPO Environmental Seminar 5th Mach 2014

- **Wärtsilä scrubber system technology options**
- **Types and amounts of waste**

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Wärtsilä scrubber system technology options

- **Wet scrubbers**
  - **Open loop**
  - **Closed loop**
  - **Sea water**
  - **Fresh water**

Wärtsilä scrubber system technology options

Engine Exhaust Chemistry:

$$S + O_2 \rightarrow SO_2 \quad (\sim 95\%)$$
$$SO_2 + {}^1/_2\, O_2 \rightarrow SO_3 \quad (\sim 5\%)$$

Scrubber Chemistry:

$$SO_2 + H_2O \rightarrow H_2SO_3 \quad \text{(Sulphurous Acid)}$$
$$SO_3 + H_2O \rightarrow H_2SO_4 \quad \text{(Sulphuric Acid)}$$

Seawater Reactions:

$$CaCO_3 + H_2SO_3 \rightarrow CaSO_3 + H_2O + CO_2$$
$$2CaSO_3 + O_2 \rightarrow 2CaSO_4$$

Wärtsilä scrubber system technology options

- Global merchant fleet annual HFO consumption: 300,000,000 tons
- Average HFO sulphur content: 2.7%
- Average world ocean sulphate concentration: 2700 ppm
- Entire world merchant fleet scrub continuously for 150 years

- Resulting world ocean sulphate concentration ???

- 2701 ppm…

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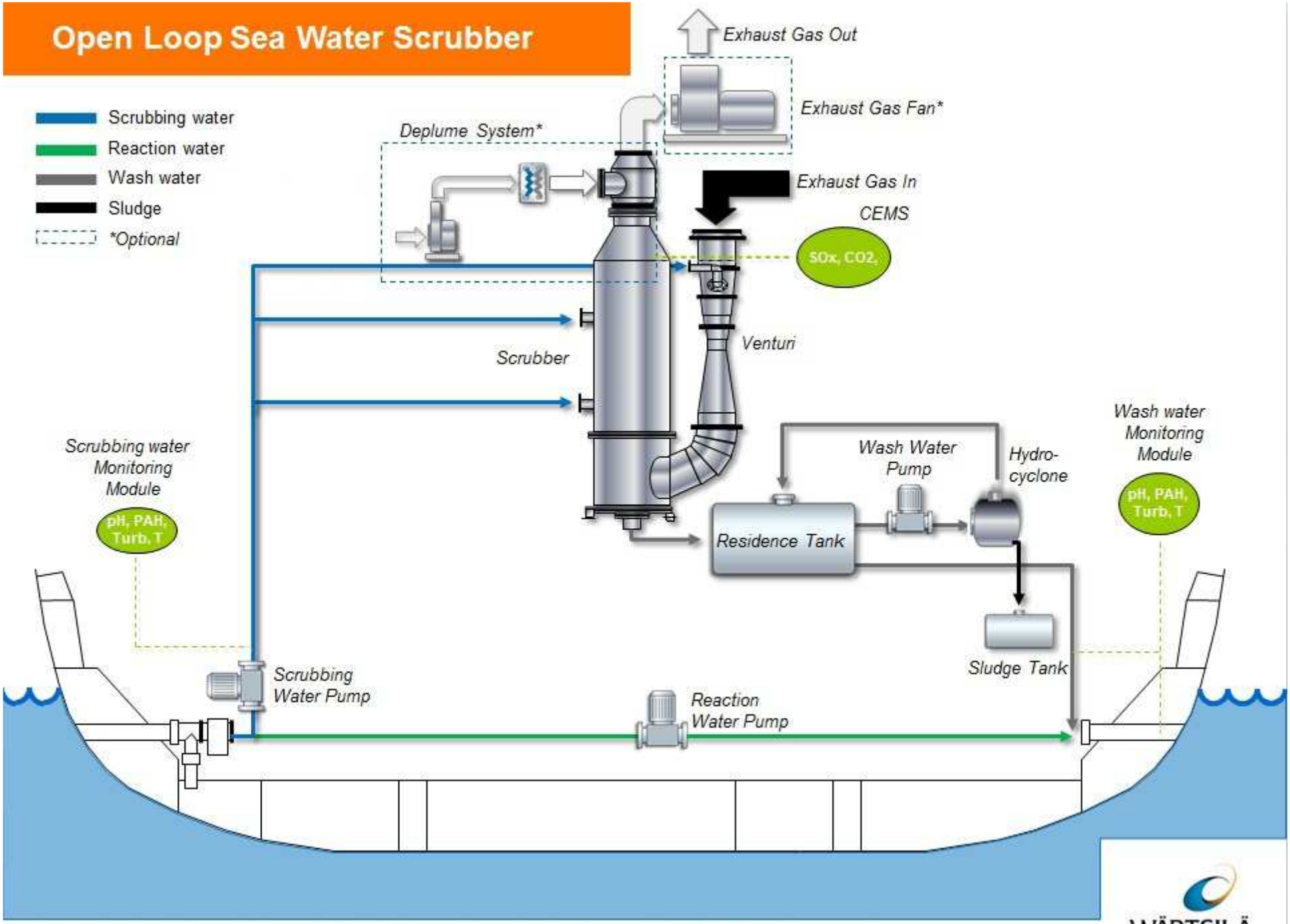
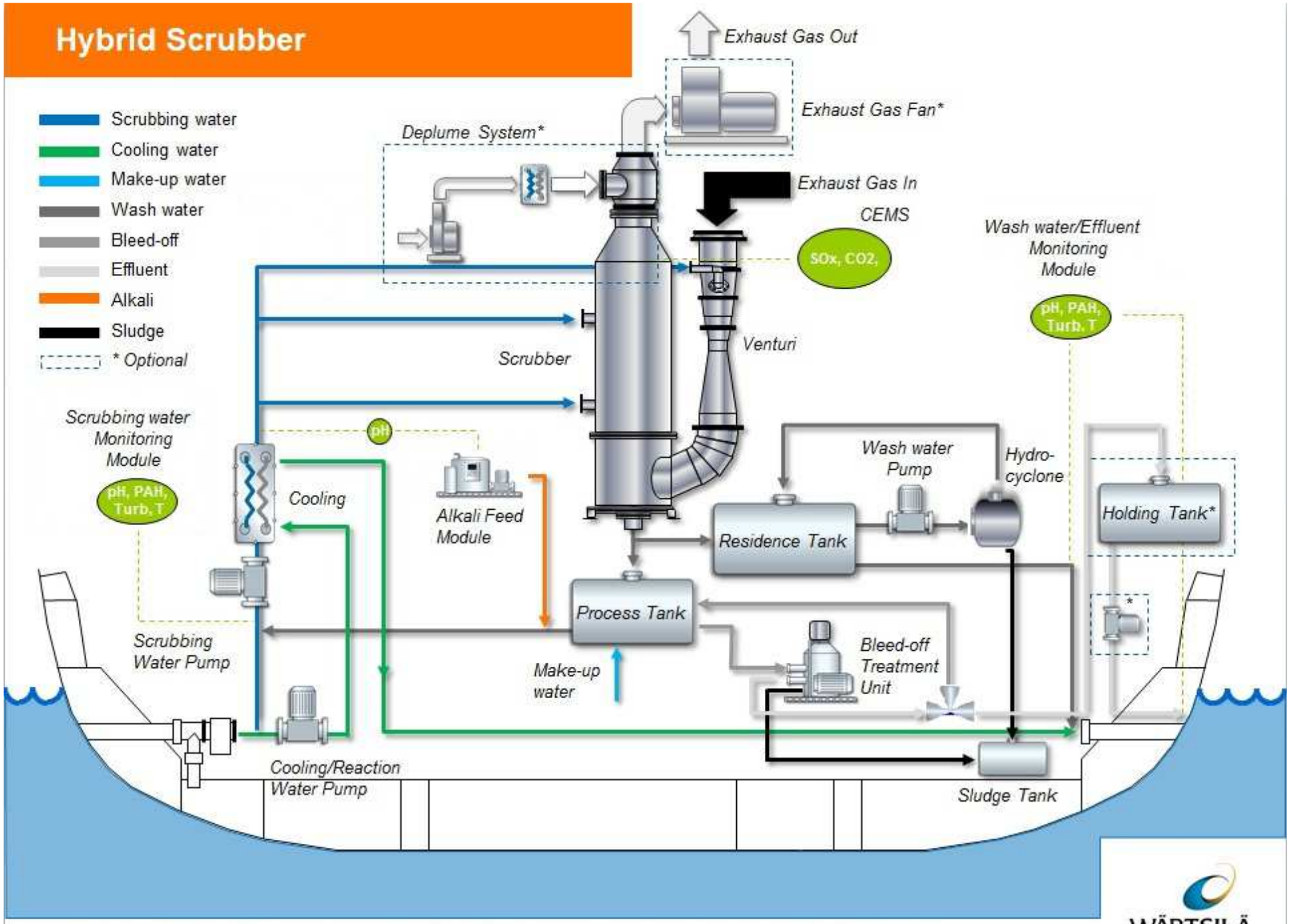
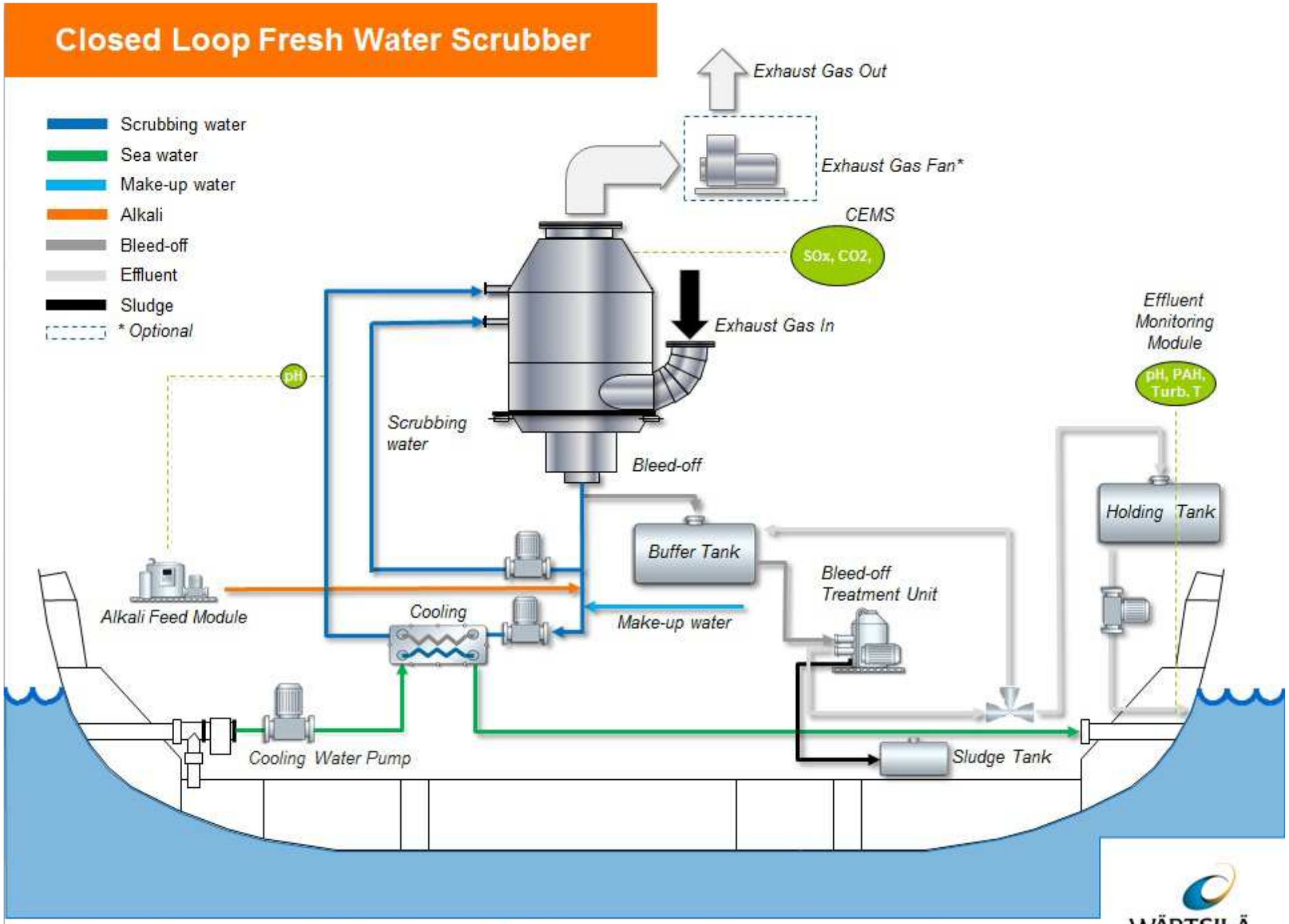
Open Loop Sea Water Scrubber



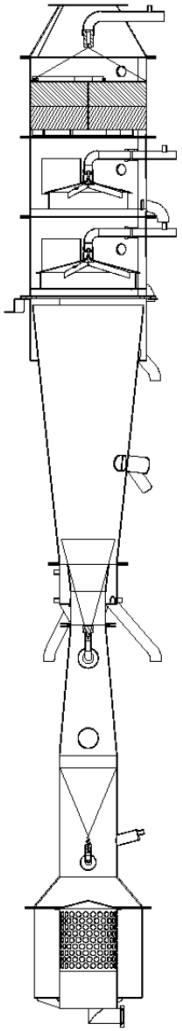
Hybrid Scrubber

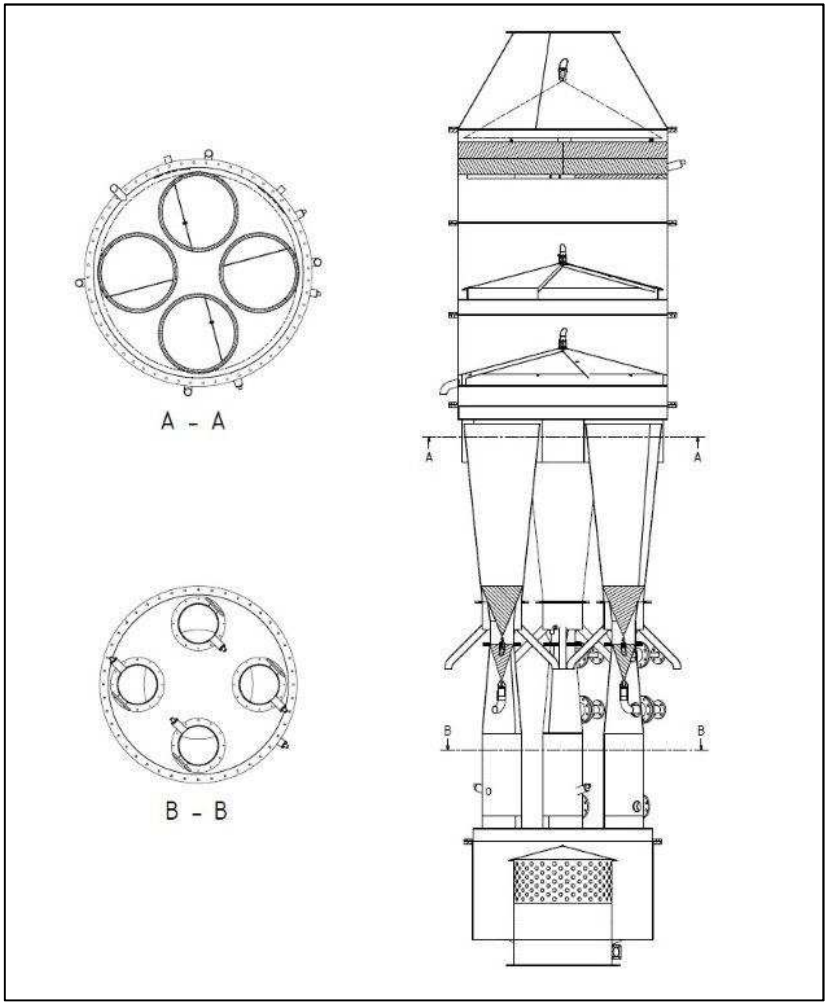


Closed Loop Fresh Water Scrubber



Scrubber technology – Type III (pat.)





Scrubber technology

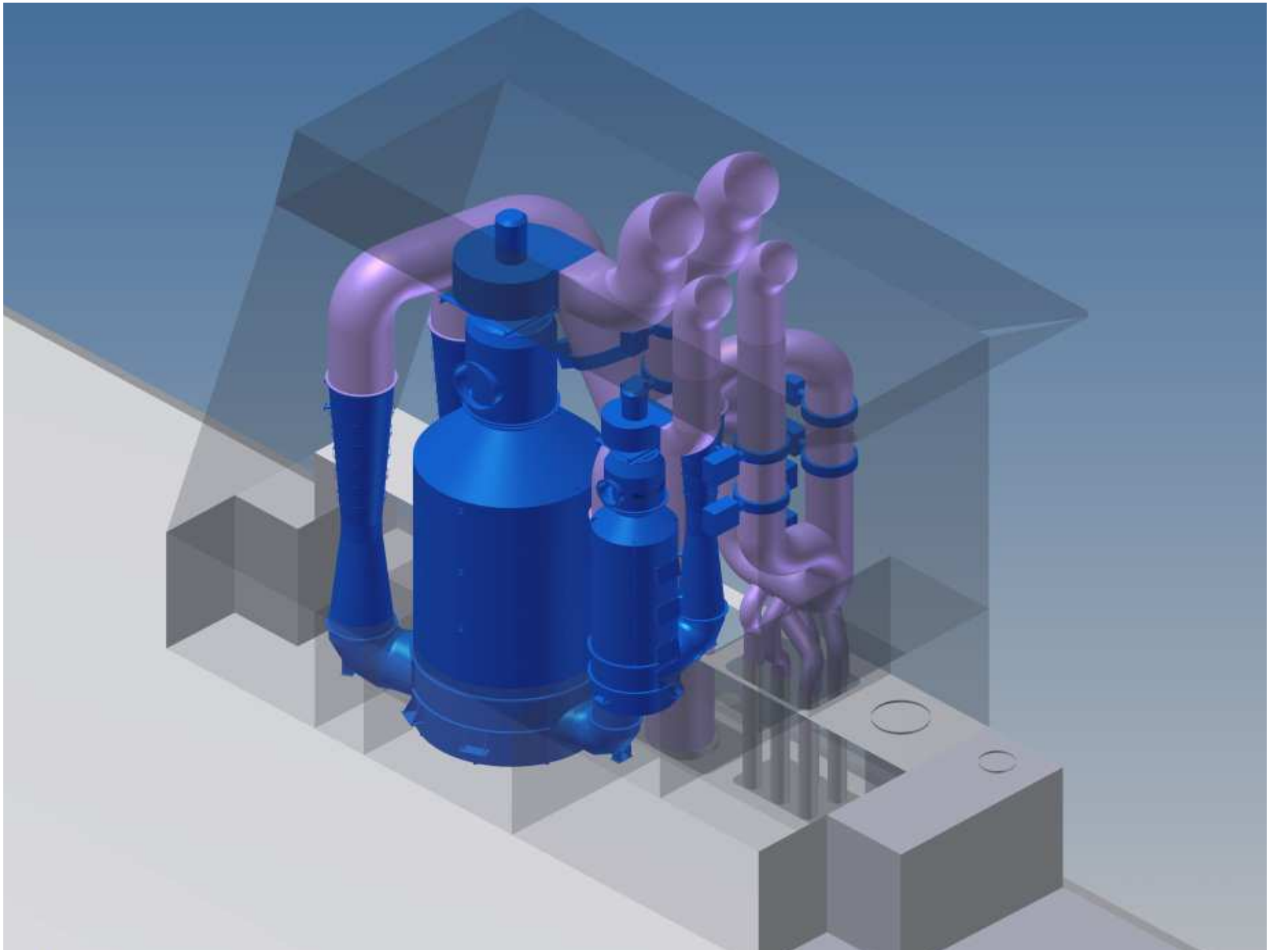
Owner:
- Wilh. Wilhelmsen ASA

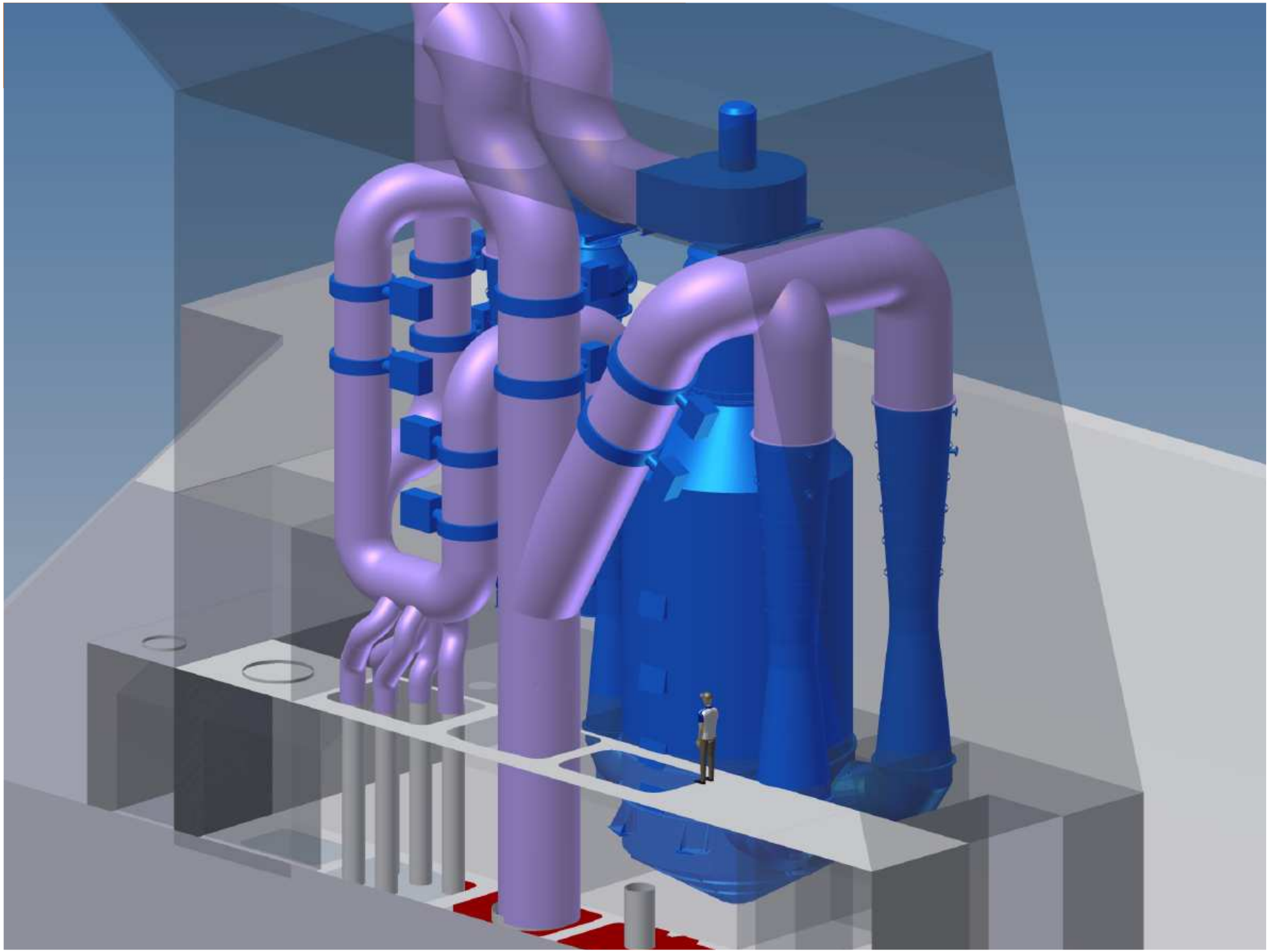
Vessel:
- MV Tarago

EGC System:
- Retrofit during dry-dock
- Operate Europe, America and Asia
- 1 x 25 MW 3 inlet scrubber for ME and AE
- 1 x 6MW 1 inlet scrubber for AE in port
- Hybrid system

Ship in dock: Q2 2013

Performance :
- Cleaning 3,5%S fuel down to 0,1,%S





Types and amounts of waste

Reductions in:
SOx, NOx, PM

Sludge

Wash water (sulphates)
pH, PAH, turbidity and temperature

Sludge producing units / water treatment plants

- Chemical/DAF-treatment systems
- Centrifugal separators
- Filtration ceramic/membranes
- Bioreactors
- Hydro cyclones/multi cyclones (open loop)

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Sludge properties

- Pumpable (water content 75-90%)
- Non flammable (caloric value <0.2 MJ/kg)
- Naturally high on sodium (Na) and Sulphur (S)
- Could be high on metals like nickel (Ni) and vanadium (Va) chrome (Cr) from the fuel / lube oil / engine wear

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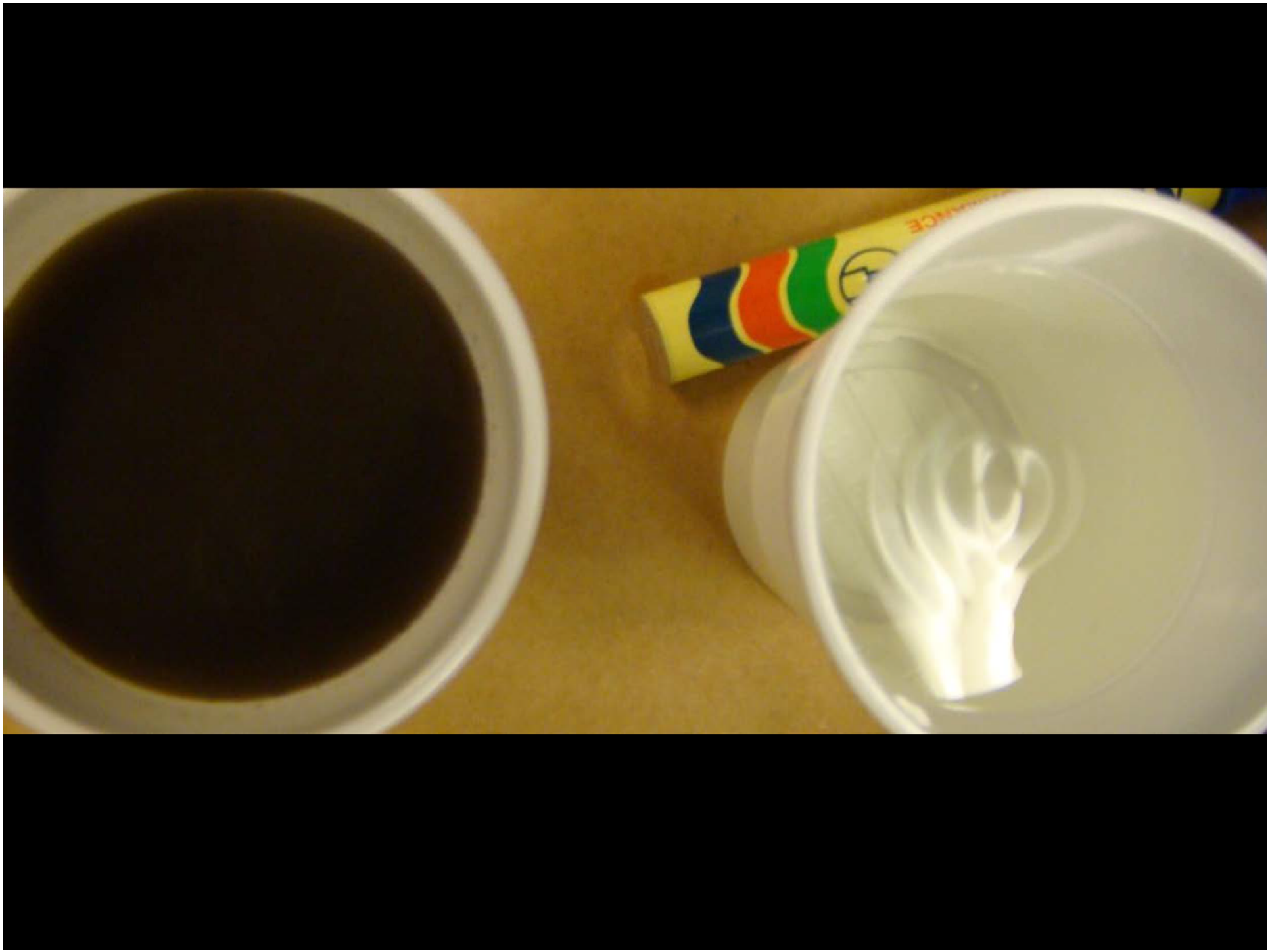


Thank You!