

**The ARIES (Accelerator Research and Innovation for European Science and Society)
2nd Annual Meeting in Budapest, Hungary,
8-12 04 2019**

Project meeting:

Accelerator system for the treatment of marine exhaust gases

Technical solution for the scrubber installation and off-gas measurements

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Assumptions

Flow rate	2 300 Nm ³ /h
Temperature at inlet	150 °C
L/G	10 ⁻² (vol.)

DIMENSIONS AND CONSTRUCTION OF THE SCRUBBER CHAMBER

Diameter of the apparatus: 1.2 m

Assumed residence time of the gas: 3 s

Height of the deposit: 2.6 m

Total height of the chamber: 5 m + chimney 1m

Total mass (scrubber, water, filling): 1.2–1.5 t

CHOOSING A NOZZLE

Recommended water speed:	1-3 m/s
Water flow:	6.4 l/s
Diameter of water pipes:	1.5 - 2 inches
Suggested nozzles:	1/2GG-SS40 (Spraying Systems Co.)
Nozzle efficiency:	29 l/min (p = 3 bar)
Number of nozzles:	13

WATER TANK (OPTIONAL)

Water accumulated in the lower part of the scrubber: 400 l

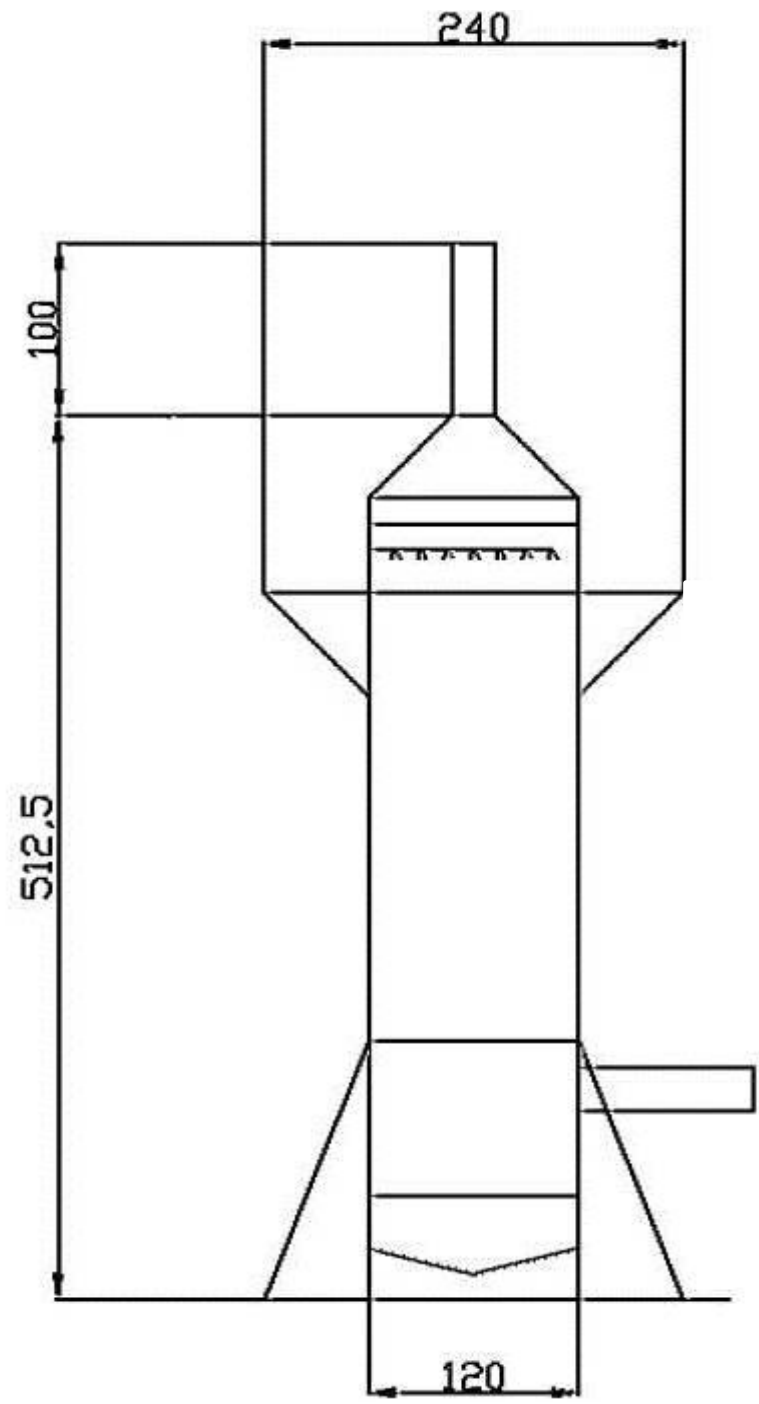
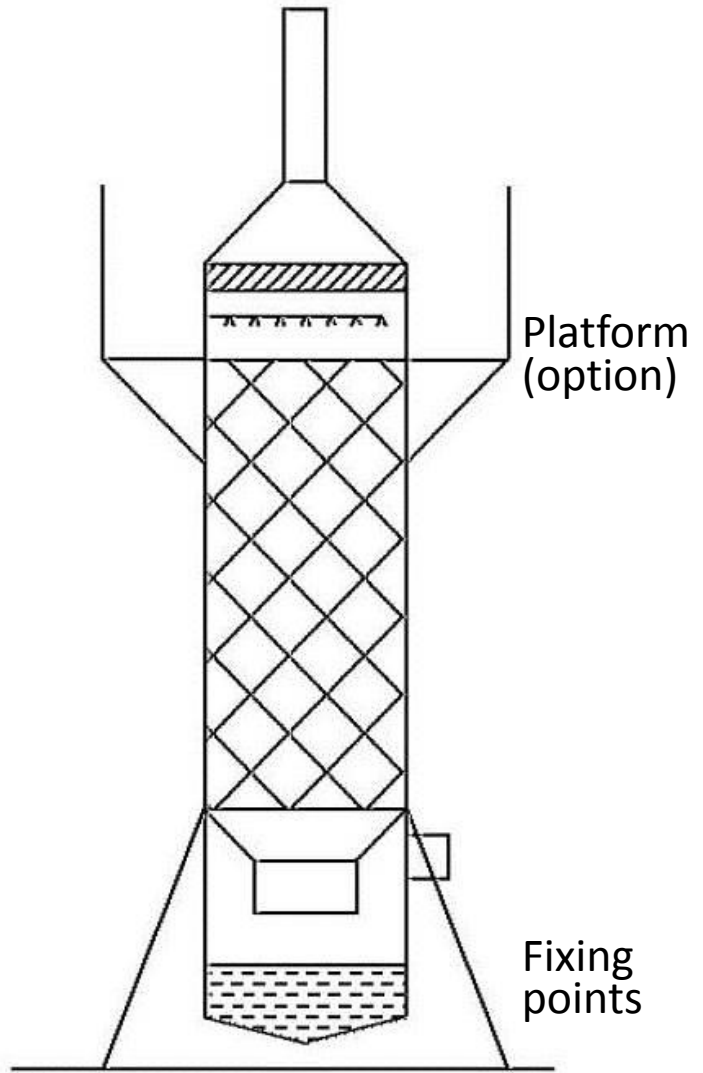
- 1 - water circulation in the open loop system,
- 2 - additional water tank with a capacity: 2 m³

In this case, the amount of acidic pollutants absorbed in water will be 230 mol/h, which will increase the concentration in the circulating water by 0.1 mol/l/h.

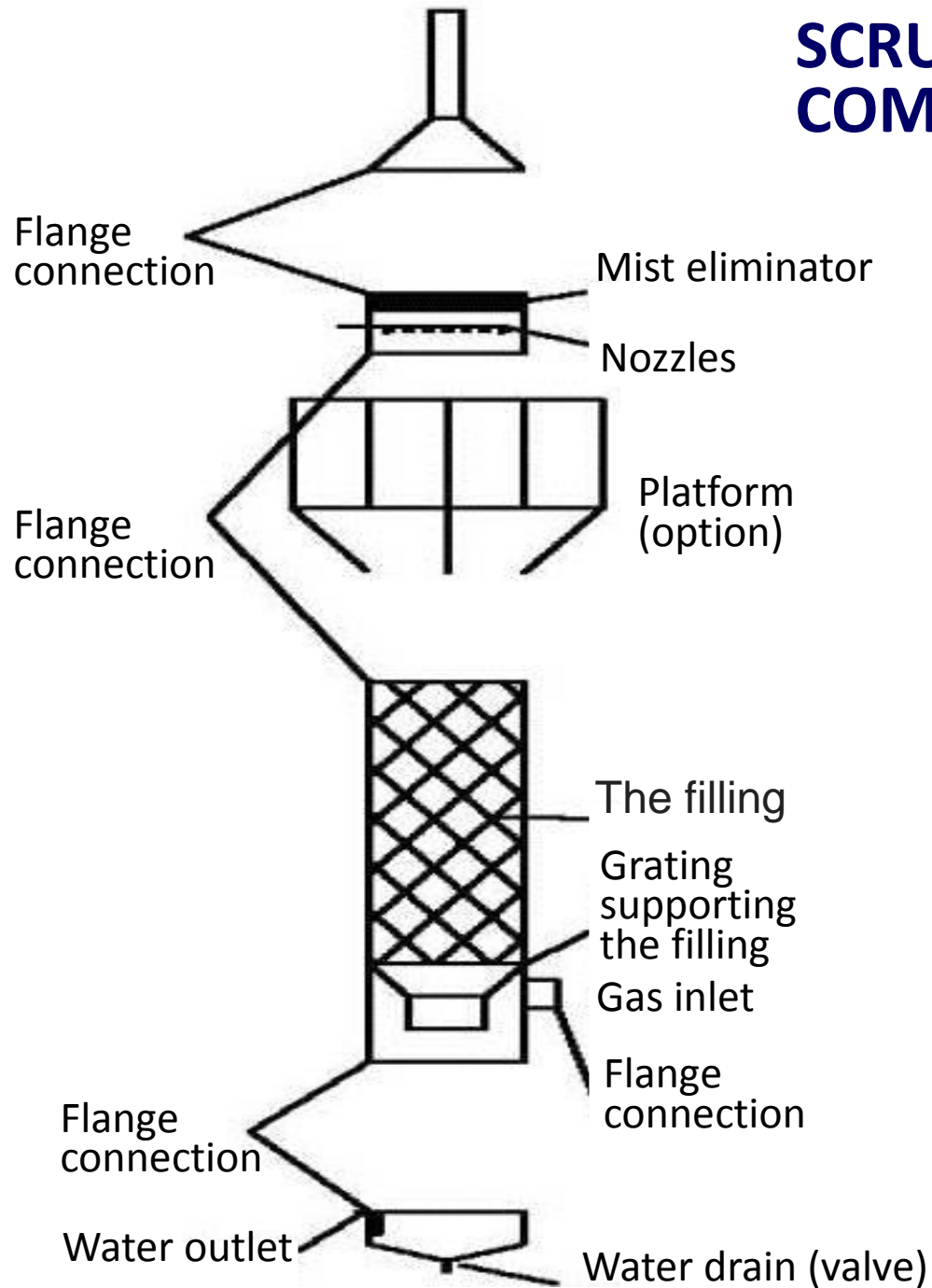
SCRUBBER

- A. Scrubber located on the trailer. The height of the accelerator along with the scrubber will be 9 m. After adding the chimney and the trailer base, the total construction height will be about 11 m above the dock level.
- B. Scrubber located behind the trailer. The height of the scrubber is 5 m, therefore due to chimney and the base, the total height above the dock level will be 5 m.

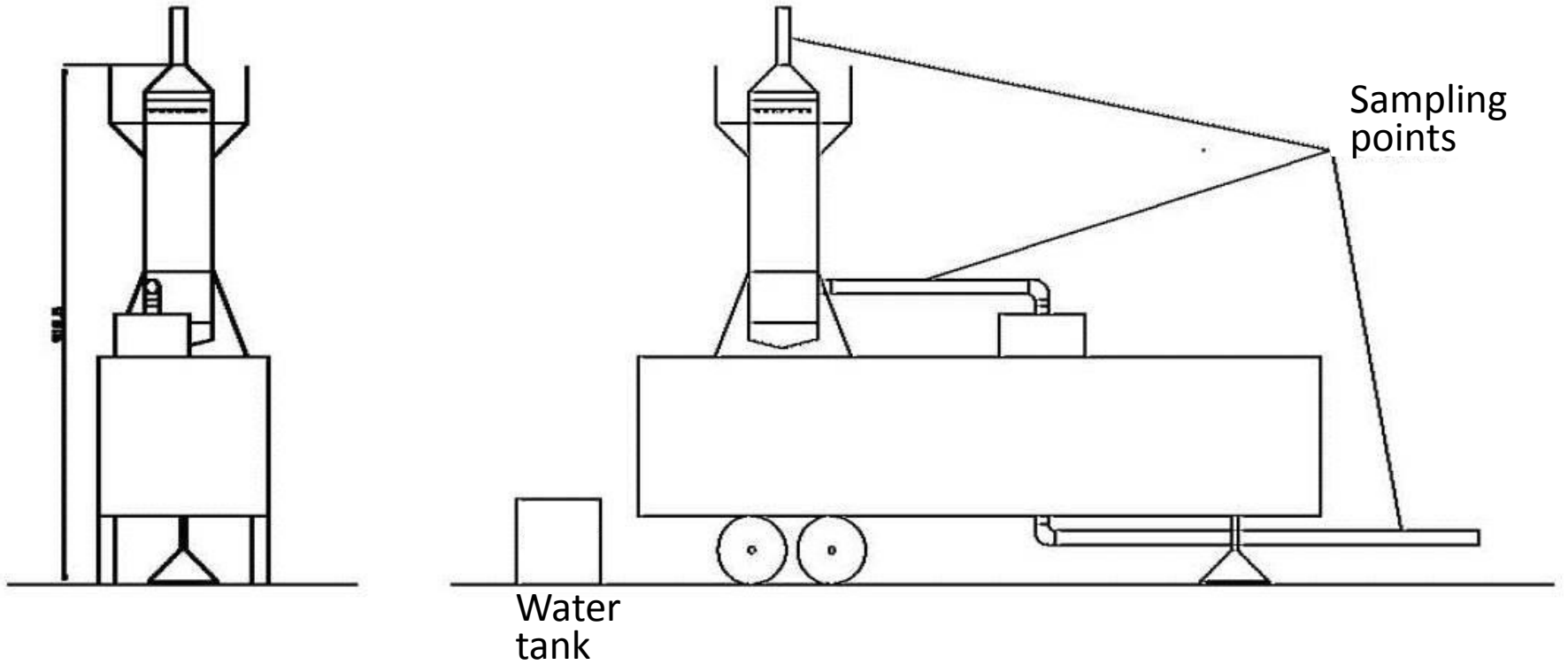
SCRUBBER CONSTRUCTION



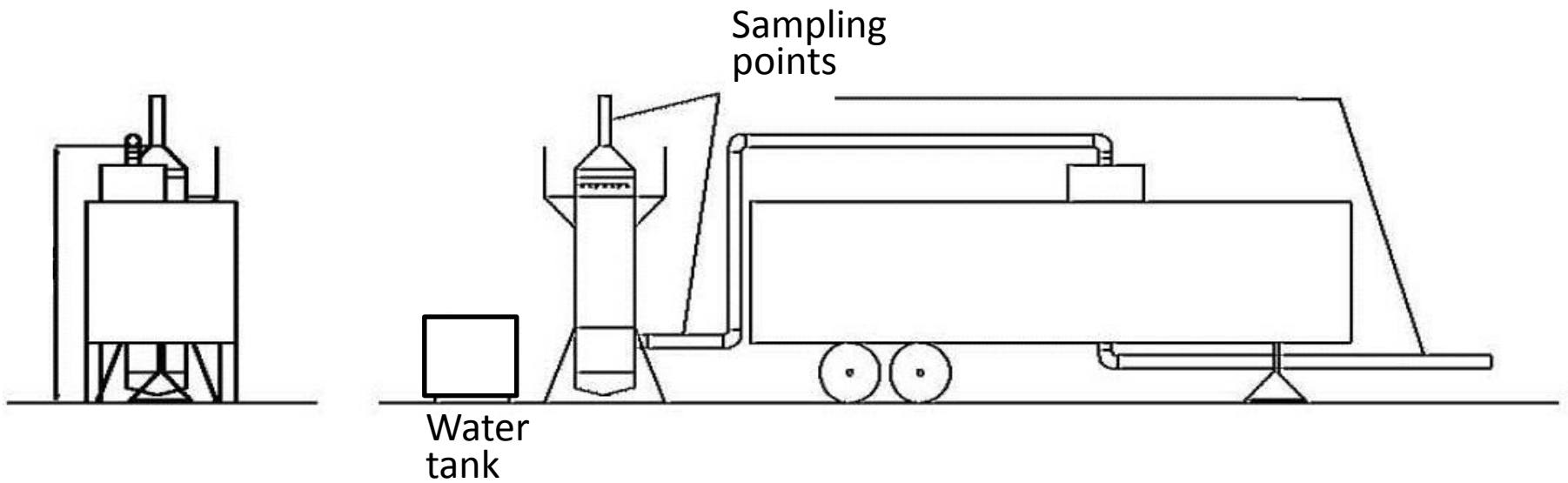
SCRUBBER COMPONENTS



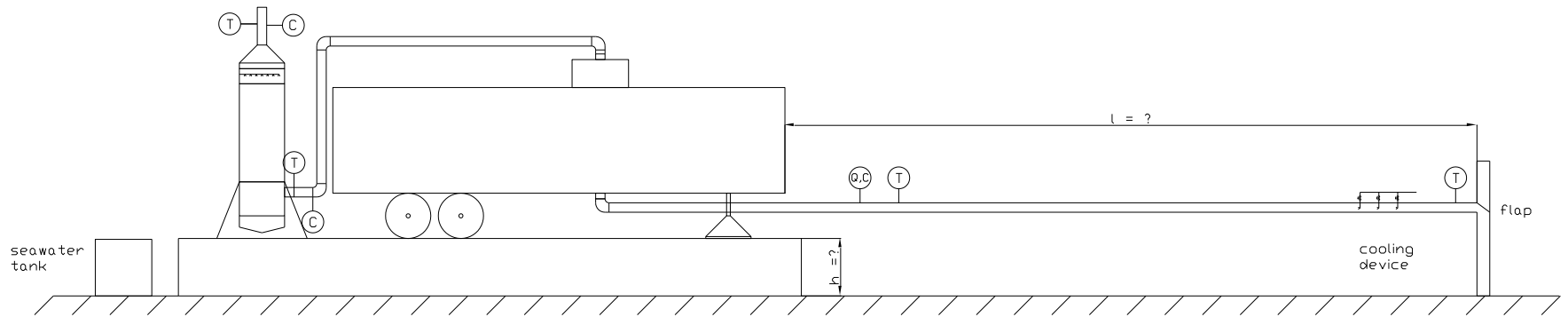
A. Scrubber located on the trailer.






B. Scrubber located behind the trailer

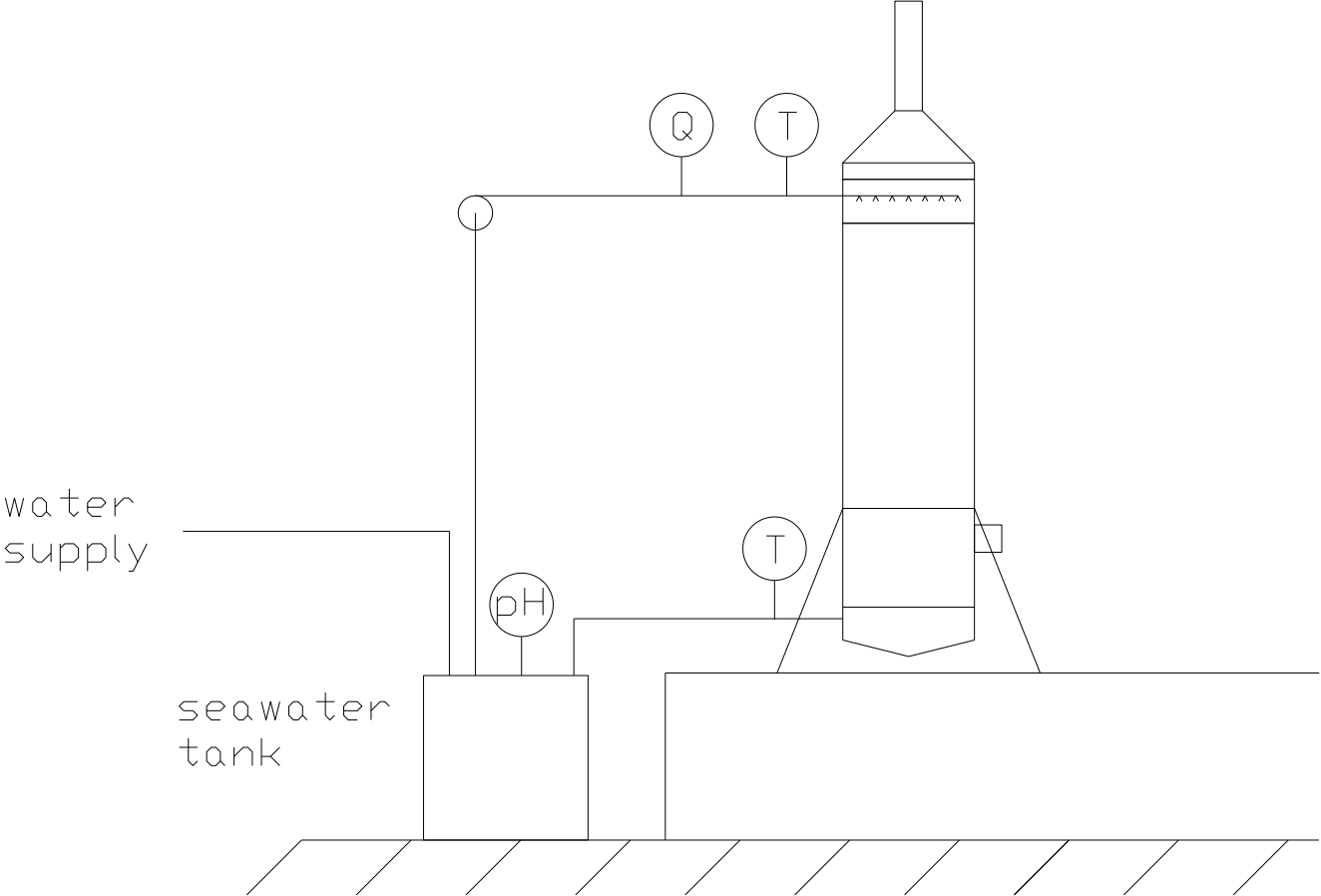


B. Scrubber located behind the trailer

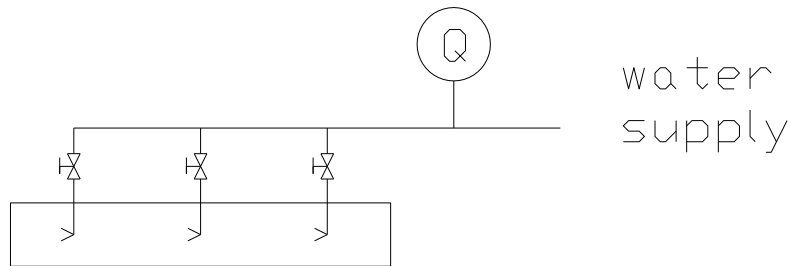
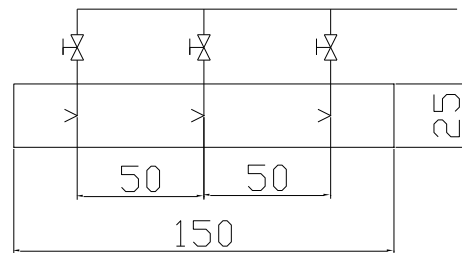


-  temperature control (thermocouple)
-  flow rate and composition control (sampling point)
-  composition control (sampling point)

B. Scrubber located behind the trailer



Flue gas temperature reduction



Water consumption: 250 l/h

Water pressure: 3-6 bars

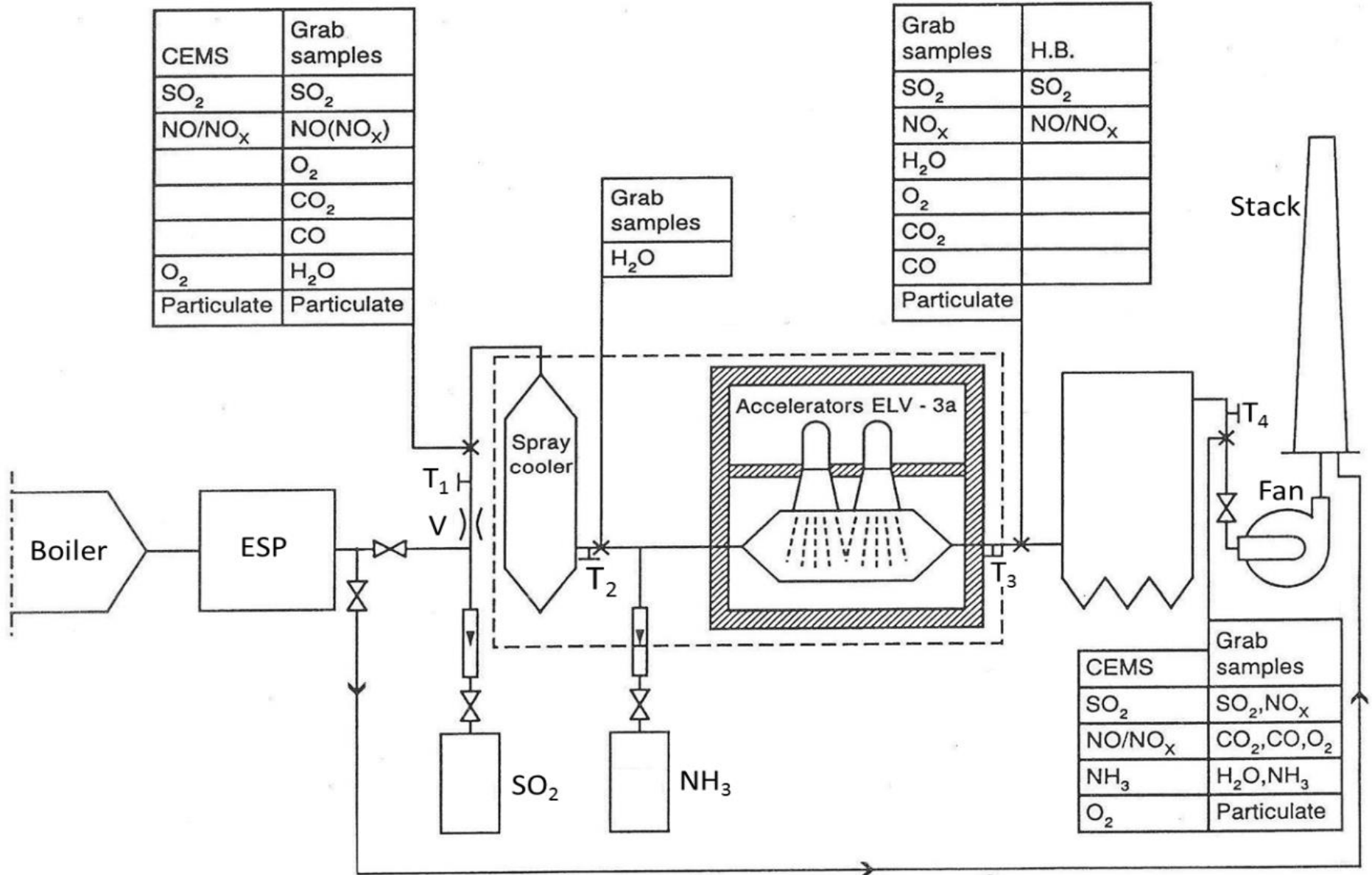
Nozzle:

INCT Pilot Plant Measuring System

CEMS	Grab samples
SO ₂	SO ₂
NO/NO _x	NO(NO _x)
	O ₂
	CO ₂
	CO
O ₂	H ₂ O
Particulate	Particulate

Grab samples
H ₂ O

Grab samples	H.B.
SO ₂	SO ₂
NO _x	NO/NO _x
H ₂ O	
O ₂	
CO ₂	
CO	
Particulate	



CEMS	Grab samples
SO ₂	SO ₂ , NO _x
NO/NO _x	CO ₂ , CO, O ₂
NH ₃	H ₂ O, NH ₃
O ₂	Particulate

Stack

Fan

T₁

V

T₂

T₃

HT₄

SO₂

NH₃

Accelerators ELV - 3a

Spray cooler

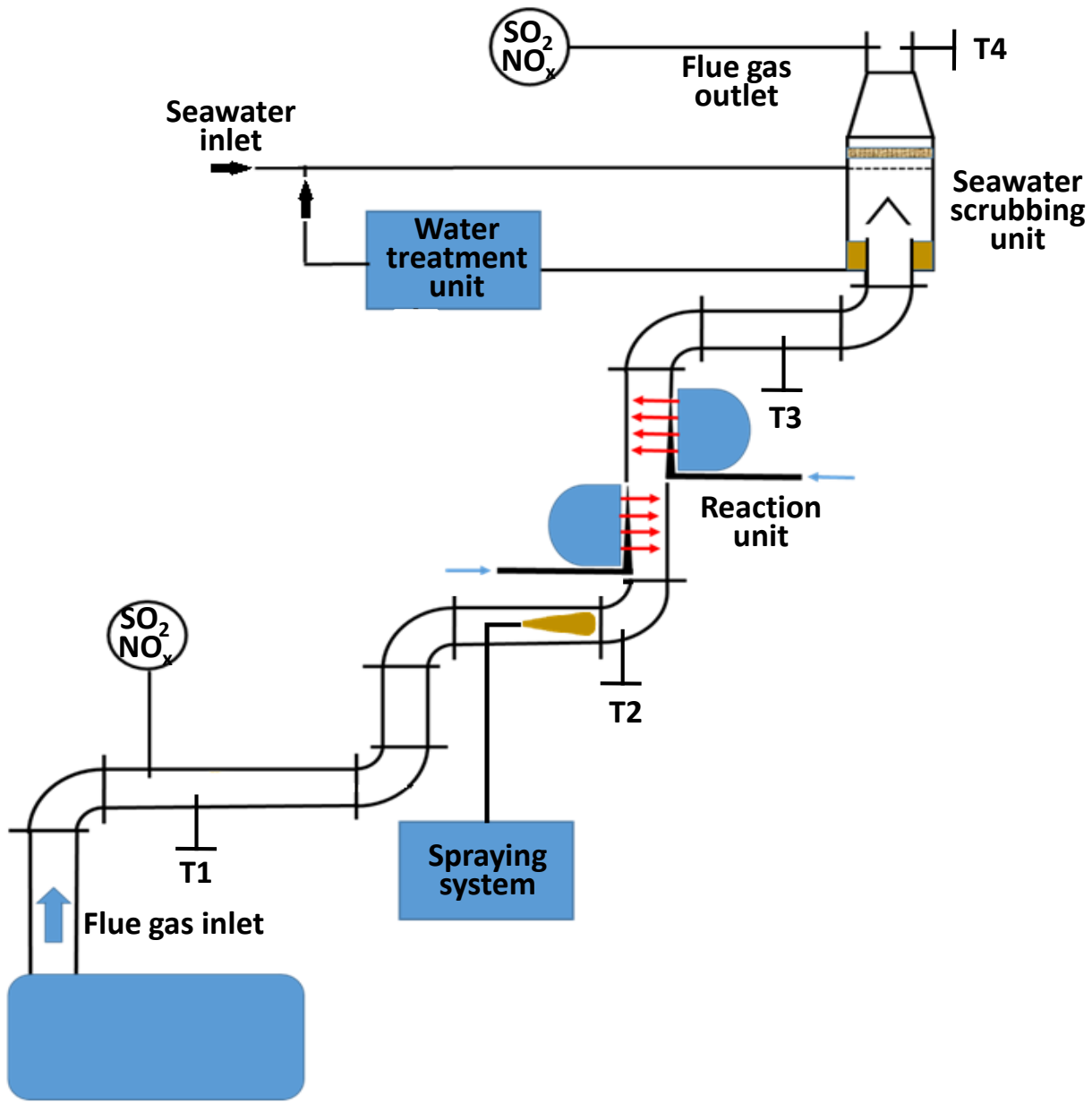
ESP

Boiler

MEASURED PARAMETERS OF THE FLUE GAS

- ❖ Flue gas velocity,
- ❖ Flue gas temperature,
- ❖ Concentration of selected flue gas components such as carbon monoxide (CO), sulfur dioxide (SO₂), oxygen (O₂), nitrogen dioxide (NO₂), nitrogen monoxide (NO) and hydrocarbons (C_xH_y).

- ❖ Flue gas velocity profile as well as temperature measurements:
 - Testo 452 anemometer produced by Testo, Germany,
- ❖ Gas components measurements:
 - Land Lancom series II portable gas analyzer (two sets) manufactured by AMETEK Land, United Kingdom.



Thank you
for your
attention