



PROMETH₂O

20IND06 PROMETH2O

Metrology for trace water in ultra-pure process gases

Final Workshop

Gas Analysis 2024 Symposium / Porte de Versailles, Paris - France

Tuesday 30th of January 2024

EMPIR



EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

Water measurement and control in pure gas manufacturing

S. Boggio

Nippon Gases

Meet **The Gas Professionals** now in Europe

The Gas Professionals

8

-  Over **3,000** employees
-  **12** CO₂ Plants
-  Over **150,000** customers
-  Over **600** trucks
-  **14** Pipelines
-  Over **2.8 M** cylinders
-  **5** Specialty Gases Laboratories
-  **40** PAG Plants
-  **30** Air Separation Units
-  **11** Dry Ice Plants
-  **6** Hydrogen Plants
-  **7** Operative Terminals
-  **44** On-Site
-  **3** CO₂ Ships



Nippon Gases Confidential

The analysis of moisture is crucial in our activity because it has significant repercussions on aspects related both to quality and safety:



Welding porosity: an example of a quality related issue.



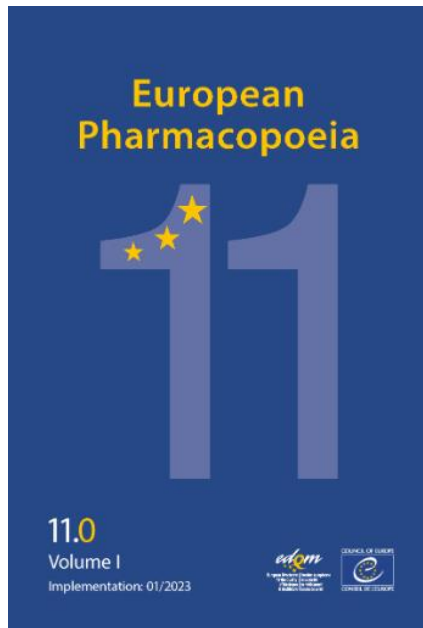
Corrosion on an oil/gas pipeline: a safety related issue.

Different aspects of water metrology pose a challenge:

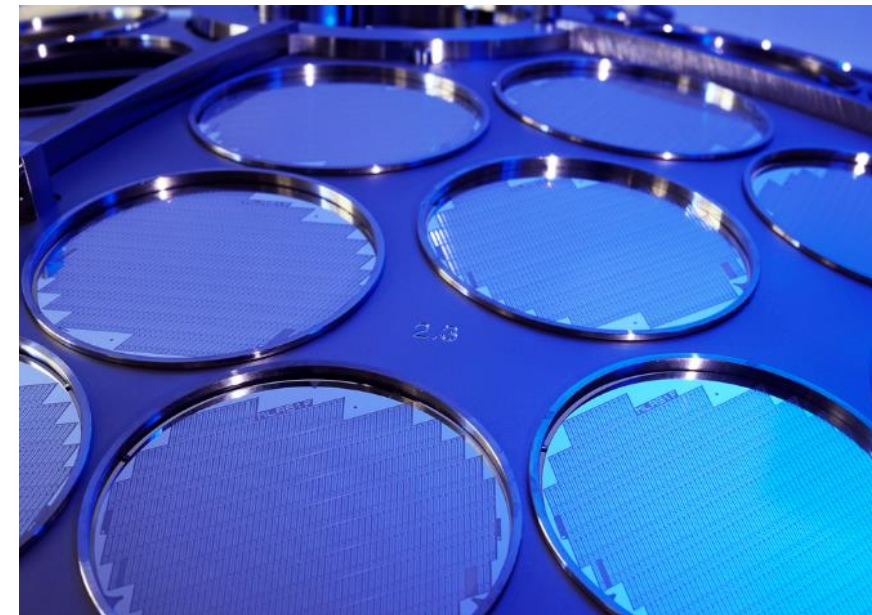
1. Measurement Interval;
2. Response time and sample usage;
3. Ambient conditions;
4. Materials;
5. Incomplete definition of the measurand;
6. Traceability.



Need to measure water vapour from percent level down to 10^{-9} mol/mol (-110°C or lower → frost point temperature in N₂):



Water (in nitrogen): maximum 67 ppm V/V



Water has to be well below 1 ppm V/V for electronic industry

Most of the time, it's not possible to use a large amount of gas for the measurements.

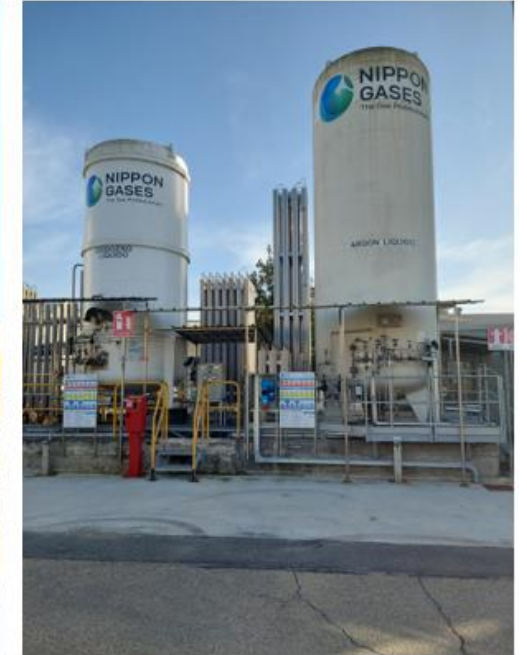
In some processes, it's only possible to deal with a very small amount of gas, and for a very limited time.



Temperature:

It's not always possible to control temperature in order to avoid (or at least minimize) the absorption/desorption process of H₂O on the tubing;

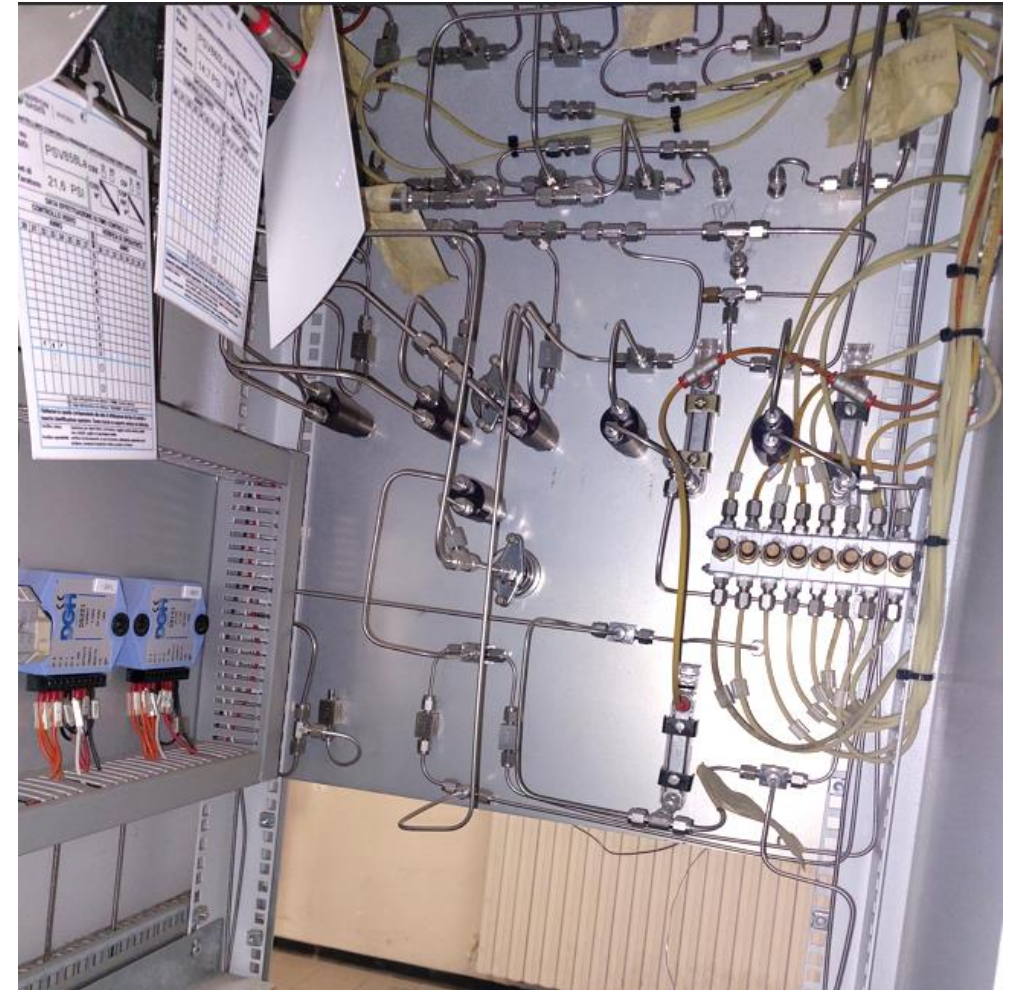
- Some installations are on the field;
- Industrial laboratories can't always respect very strict metrological requirements (temperature is controlled, but there's still a significant variability, +/- 2 °C)



Poor choice of materials and connections can negatively affect the outcome of the test.

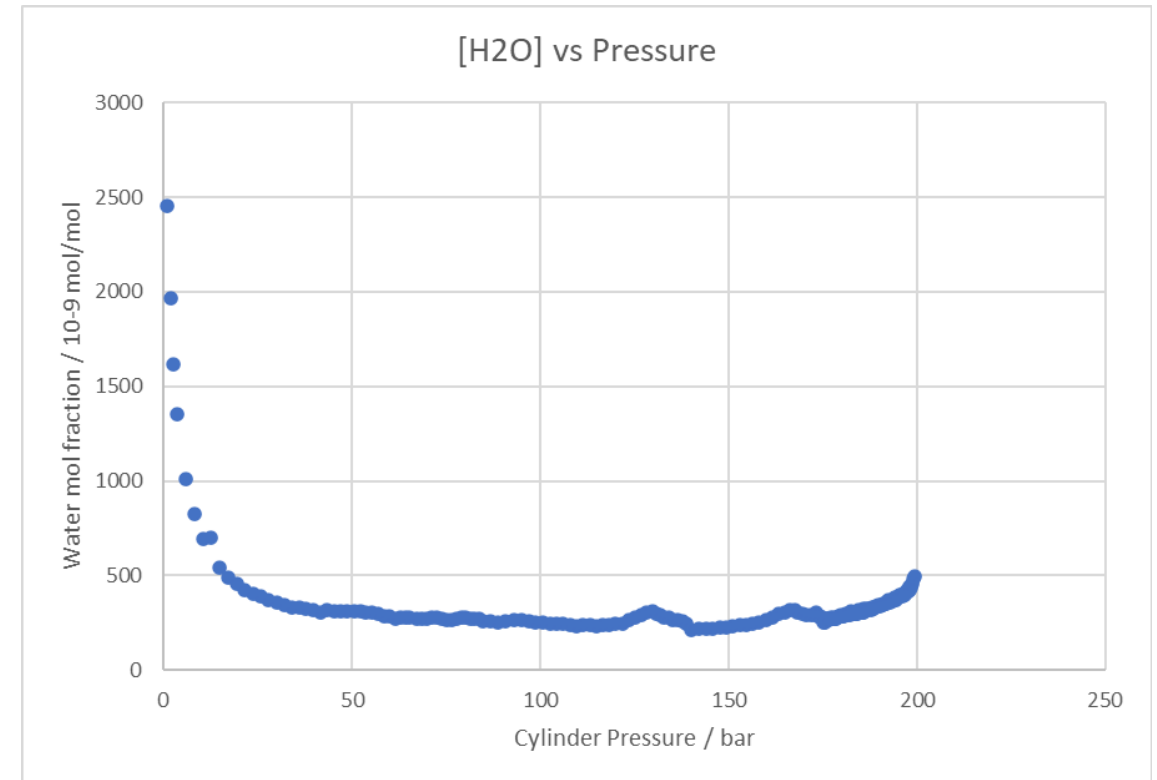


A proper He leak testing is always necessary.



5 - Incomplete definition of the measurand

Sometimes, in technical specifications or data sheets there isn't any information regarding the measurement conditions.



Reference materials traceable to SI are not easily available, particularly in the very low edge of the concentration spectrum

E.g. customer expect to have reference moist gases with an

$$\textit{amount of water fraction} \leq 50 \cdot 10^{-9} \frac{\textit{mol}}{\textit{mol}} \mp 5 \cdot 10^{-9}$$

A measurement uncertainty better than 10 % at 50 ppm or lower!

In order to improve the current situation projects like this one are fundamental. Like never before we are closing the gap between the academic knowledge and the industry needs.





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Thank you for your attention

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