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Challenges faced when doing NH_3 impurity testing in PEM FCs

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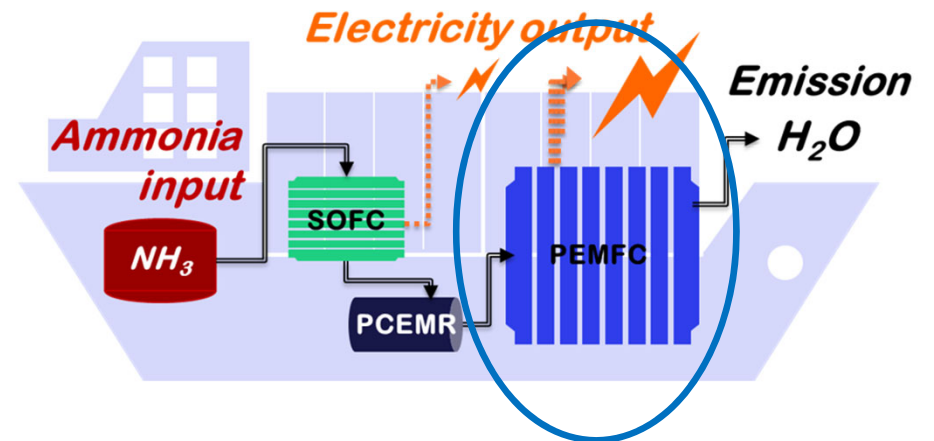
Content

- Introduction to WP4
- 1) Ordering gas bottles
- 2) Safety measures
- 3) Specific challenge with (sub)-ppm testing
- Summary



WP4 – 2nd power stage

- "Clean" H₂ from PCEMR into PEM FC
- Investigate NH₃ impurities in the H₂ gas
 - Sub-ppm concentrations





1) Ordering gas bottles

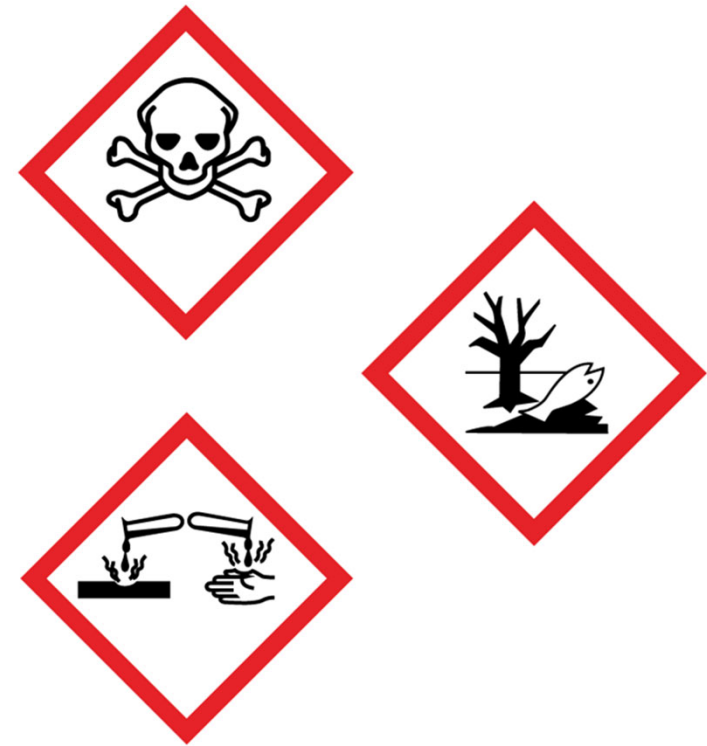
- Ordered from Linde, 5 ppm NH_3 in H_2 .
- Estimated delivery time: 3 months
- Actual delivery time: 9 months
- Backup bottle from Nippon Gases: 2 months
- Stability: 6 months





2) Safety measures

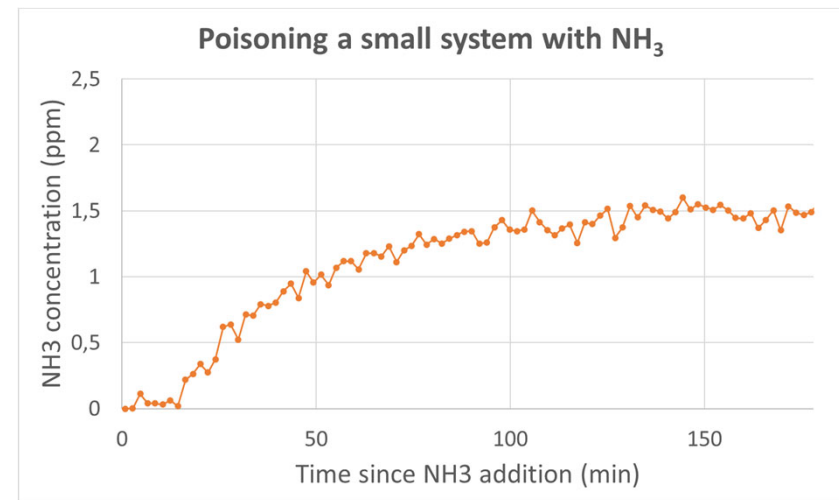
- Exposure limits:
 - 8 hours: 15 ppm
 - 15 mins: 50 ppm
- Gas bottles with <15 ppm NH_3 in H_2
 - Negligible harm to people and environment
 - No need for off-gas treatment
- Experiments performed in well-ventilated area





3) Specific challenge with (sub)-ppm testing

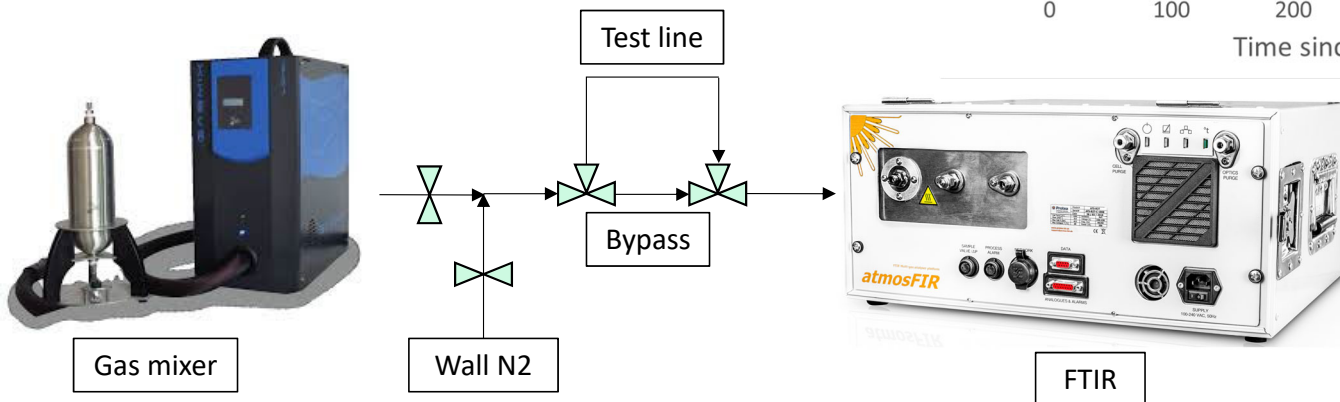
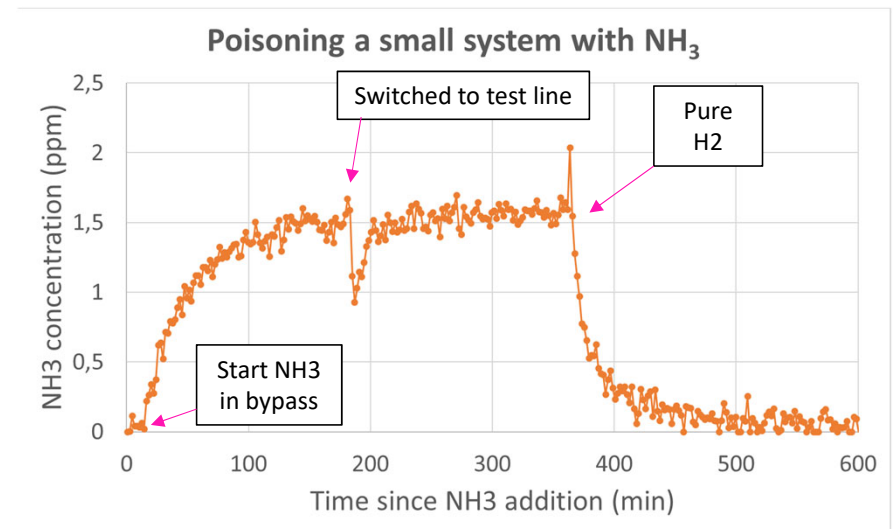
- NH_3 is a "sticky" gas
 - Easily adsorbs onto surfaces in a system
 - Some NH_3 is "lost" to adsorption
 - Important for small concentrations!
- Determine actual concentration reaching fuel cell
 - Literature
 - Setup-specific tests





3) Specific challenge with (sub)-ppm testing

- First system and bypass are poisoned
- Dip in signal corresponds to NH_3 adsorbed
- Test parameters to match real conditions
 - Material selection, relative humidity, temperature



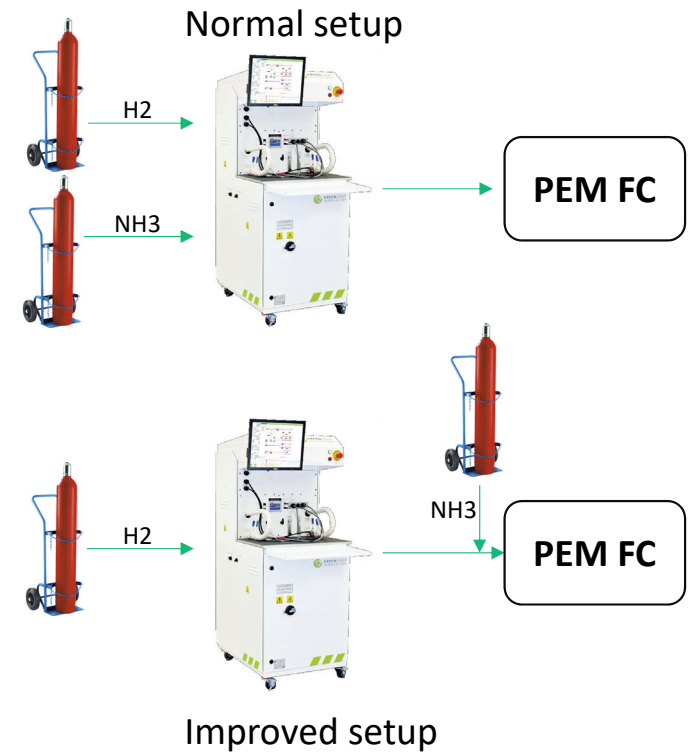
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3) Specific challenge with (sub)-ppm testing

Mitigation strategies

1. Test setup design
 - Minimize surface area before PEM FC
 - Move NH_3 gas inlet as close to the FC as possible, not running it through the test station
2. Experimental procedure
 - Sufficient exposure time





Summary

1. Ordering gas bottles of ppm-levels NH_3 (in H_2)
 - Delivery time can be long
 - Shelf life of gas mixture might be short
2. Safety must be considered
 - But ppm-levels of NH_3 is "easy" to work with
3. Specific challenge with (sub)-ppm testing
 - Fraction of NH_3 is "consumed" due to its sticky nature
 - Experiments must take this into account
 - Test setup design
 - Experimental procedure



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