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# Na vapour resistance testing of silica refractory

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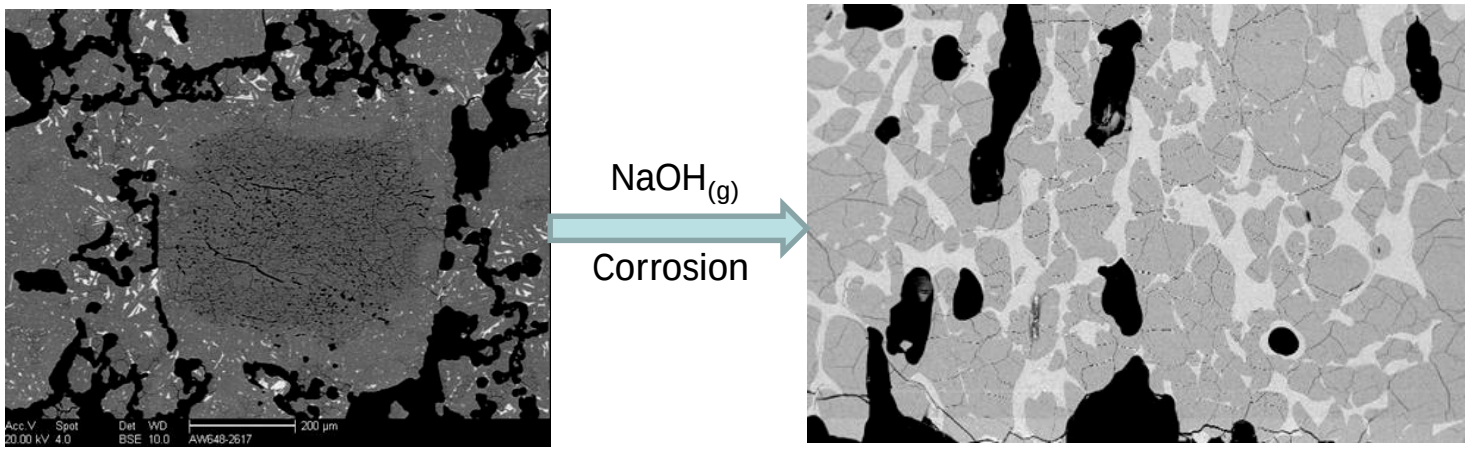
# Presentation overview

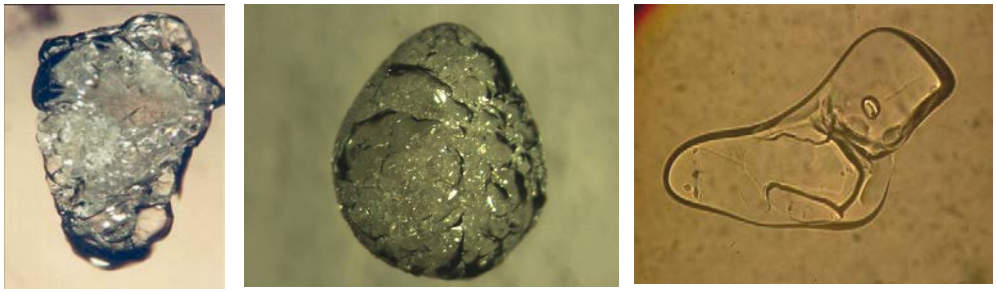
- Why is Na vapour resistance important?
- Indirect measures
- Direct testing
  - “Covered Pot” method
  - Rotating finger method
- Summary

# Na corrosion of silica refractory

- Simplified reaction: $2NaOH_{(g)} + SiO_{2(s)} = H_2O_{(g)} + Na_2SiO_{3(l)}$




- Corrosion or glassy phase development in silica refractory can directly influence campaign life and glass quality:

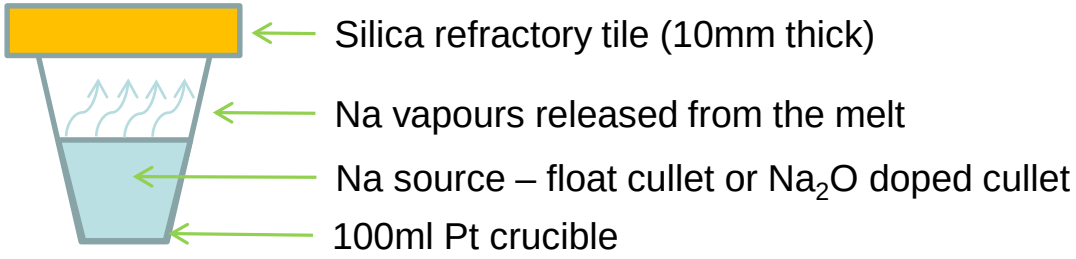


# Indirect measures

- Use various refractory characteristics or properties as a guide to the potential Na resistance
- Bulk Chemical Composition
  - Increased glassy phase content = greater “reactivity” with the Na rich furnace atmosphere
  - Flux factor = $(2*(Na_2O + K_2O)) + Al_2O_3$
  - Thermodynamic modelling – MtData, FactSage
- Apparent Porosity
  - Impacts reaction kinetics
- Permeability
  - Impacts reaction kinetics

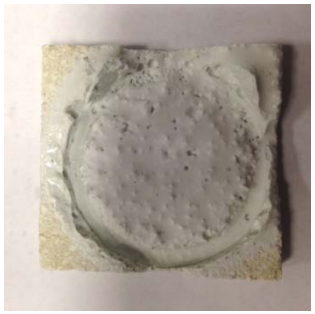
# Direct testing: Covered pot method

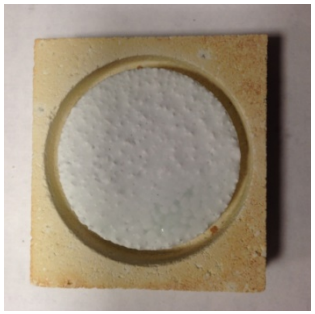
- Simple experimental set up aimed at assessing how the refractory interacts with a Na rich atmosphere.

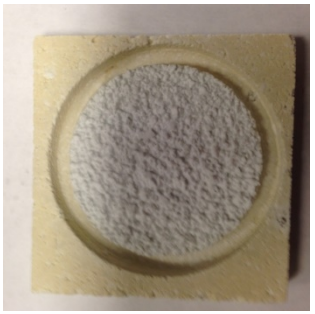



- Samples held at test temperature, typically 1500 and 1600°C, for 48 hours.
- Visual examination for a qualitative assessment. SEM analysis for a more quantitative assessment.

Poor Performance



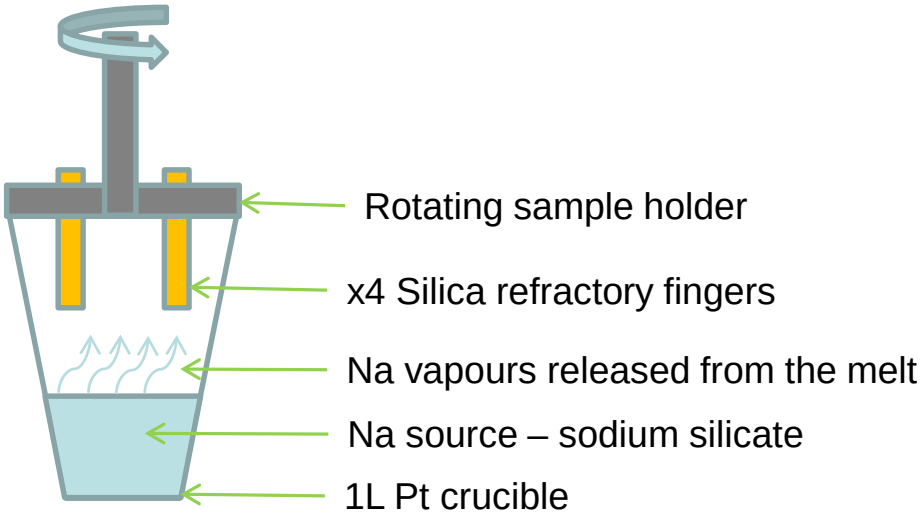




Good Performance

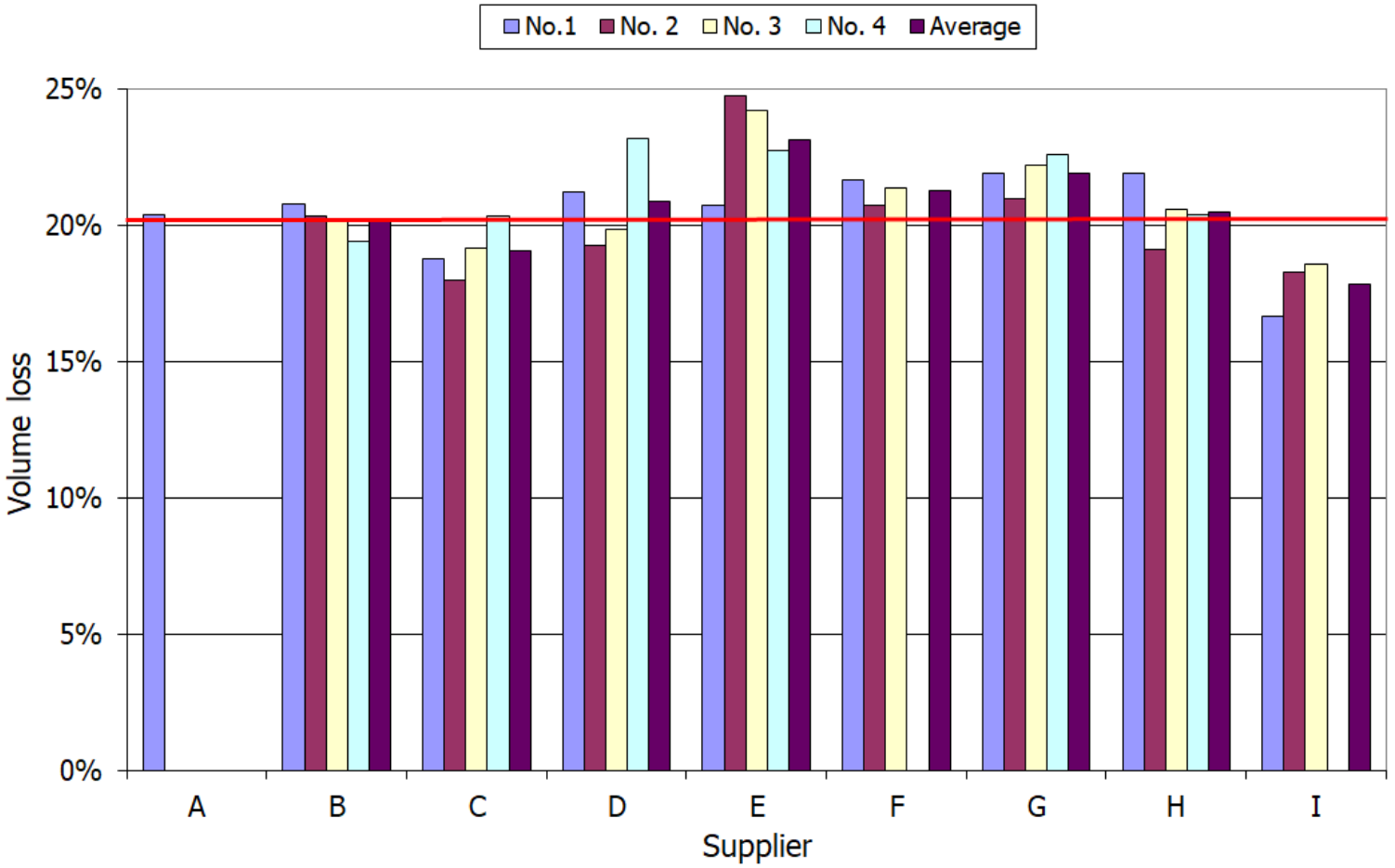
# Direct testing: Rotating Finger Method

- A more complex and time consuming procedure but does provide a quantitative result.




- Samples rotated above the Na source for 5 days at 1500$^{o}$C.
- Sample volume measured before and after the test and a % volume loss calculated.

# Rotating finger example results




- Allows a comparison of the relative performance of different silica refractory grades which can aide material selection

# Summary

- Indirect measures combined with two direct test methods provide a robust way of assessing Na resistance of silica refractory.
- However, the impact of any variation in the lab assessment on in service performance is difficult to quantify
  - Test conditions don't directly replicate those seen in service due to the need for accelerated tests
- A control sample is required to benchmark the performance
  - Control = refractory of proven in-service performance.
- Ultimately, if the furnace conditions favour corrosion, it will occur.
- No substitute for in-service experience.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