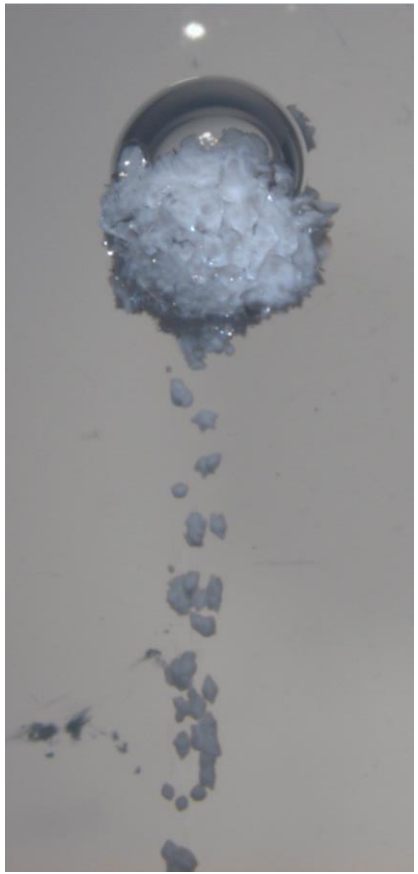
SCHOTT-tests for bubbles on refractories
Evaluation of Silica corrosion

Agenda

- Tests for evaluation of bubbling potential of refractories
  - Static test
  - Dynamic test

- Evaluation of Silica-corrosion
  - Isothermal test
  - Temperature gradient test



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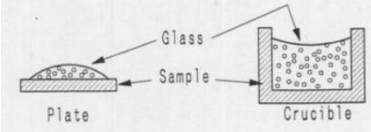
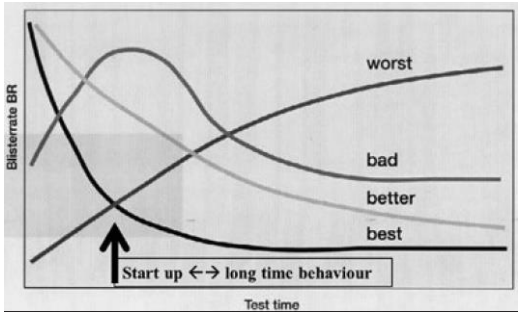
Lab tests to evaluate bubble potential

- Static bubbling tests
  - Glass pieces are molten on the refractory material to a certain test temperature for a certain time, then cooled and investigated -> results are dominated by short term effects



- Dynamic bubbling tests
  - Glass is molten in a crucible made of the refractory to be tested
  - The glass is renewed periodically
  - Evaluation of blistering is done periodically at the test temperature via video system
  - -> The evolution of blistering over time can be evaluated



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Static bubbling test

- Melting of glass on the materials to be tested
- Advantages
  - Simple experiment, easy to conduct
  - Suitable for screening experiments, multiple combinations of glass and materials can be tested in one experiment
  - Evaluation at room temperature via microscope can determine small bubbles
- Drawbacks
  - Sample preparation has a strong influence on the results (Impurities from machining, surface roughness)
  - Bubbling is influenced by the starting conditions of the refractory
  - No results on time dependent material behavior

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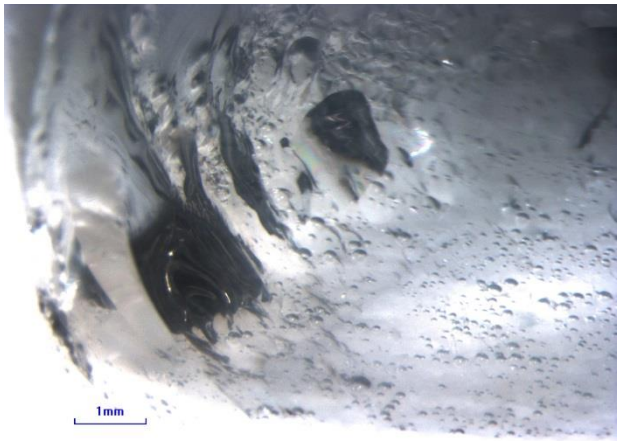
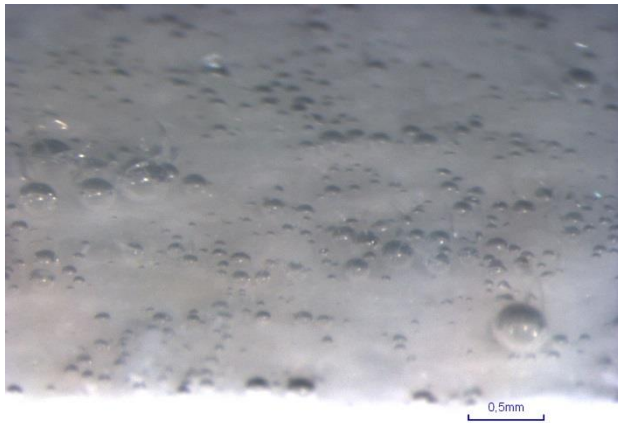
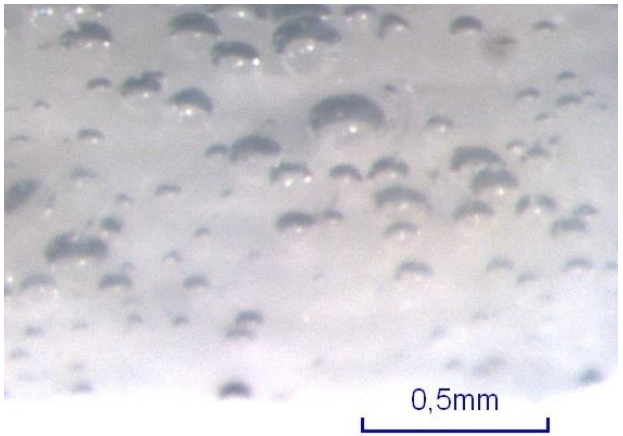
Static bubbling test

- Example:

  Test of Danner mandrel materials, evaluation after 48h
- Always include a known reference material for comparison

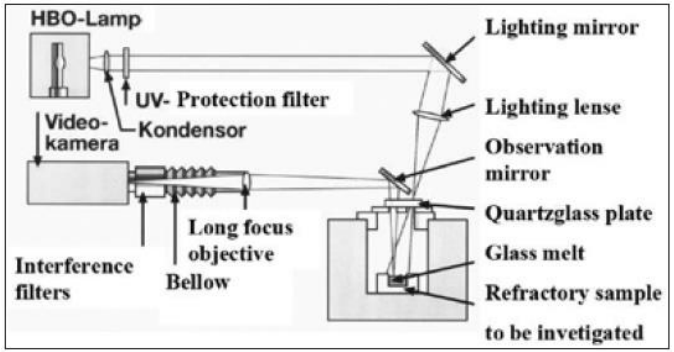


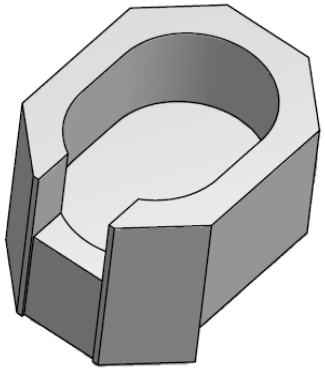


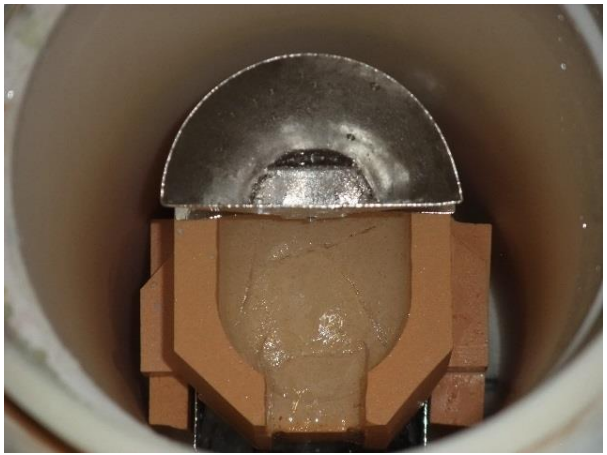


Dynamic bubbling test

- Test setup
  - Test crucible from the material to be tested
  - Vertical tube furnace, 1600°C inside the test crucible
  - Illumination and investigation from the top
  - Periodic renewal of glass and observation of bubbling at test temperature







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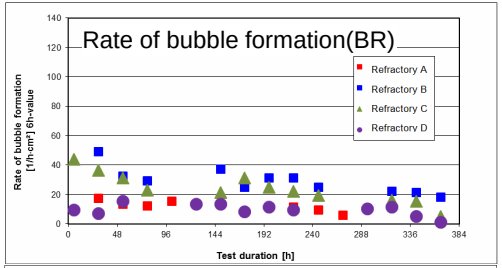
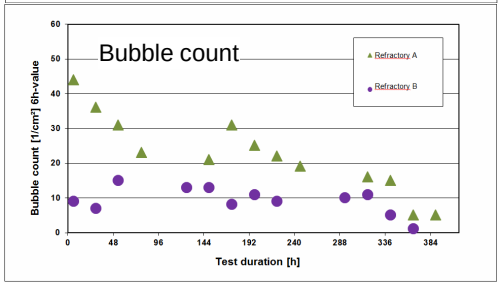
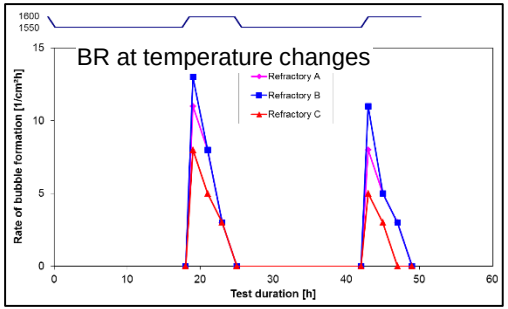
Dynamic bubbling tests

- Results
  - Visual evaluation of the crucible after the test
    - Conclusions on corrosion, infiltration, formation of layers…
  - Bubble formation rate vs. test duration
    - Number of newly formed and burst bubbles per time and area -> „bubbling activity“
  - Number of bubbles vs. test duration
    - Number of bubbles sticking to the refractory surface
  - Changes of bubble formation rate with (repeated) changes in test temperature (usually at end of experiment)
    - Conclusions regarding redox reactions from the intensity of the temporary increase in bubble formation rate







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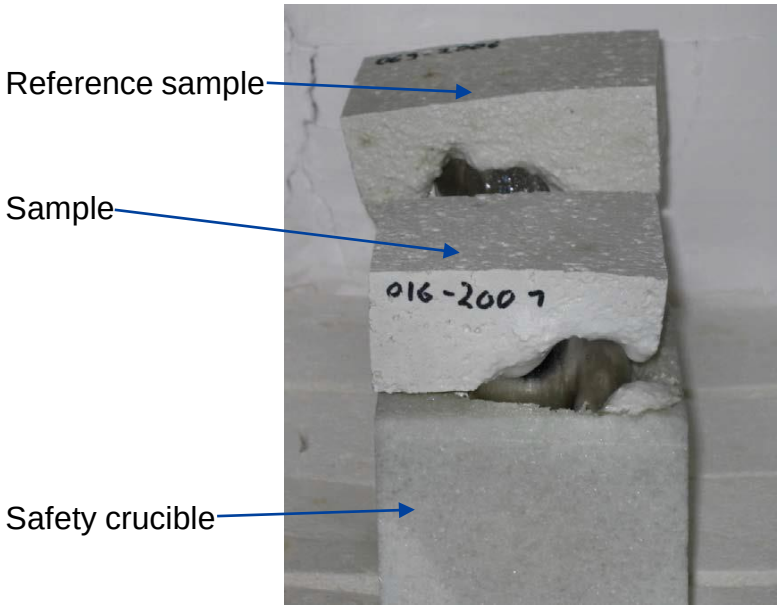
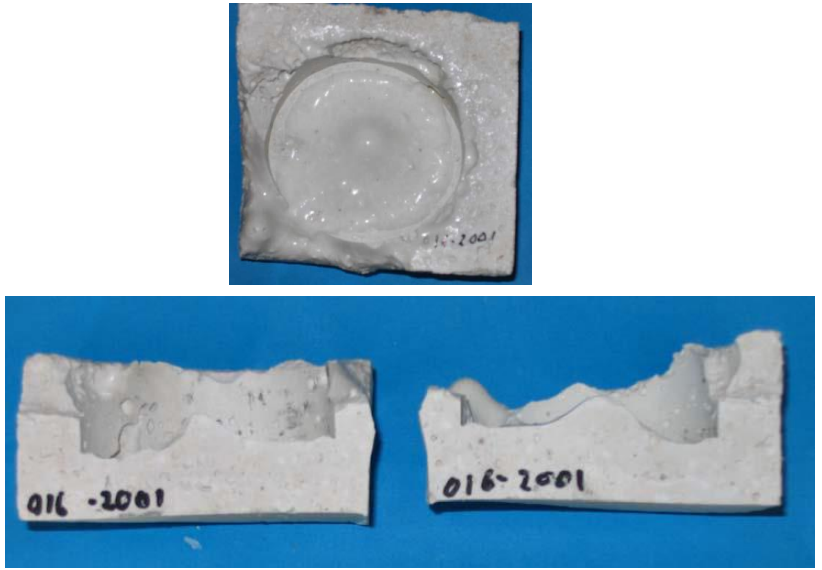
Lab tests to evaluate Silica corrosion

- For material evaluation, tests were conducted in 2007
  - Isothermal glass atmosphere corrosion test
    Silica cover onto of a Pt-crucible with glass inside a furnace
  - Temperature gradient corrosion test
    Silica sample onto of a Pt-crucible with glass partly inside a furnace

Isothermal glass atmosphere corrosion test

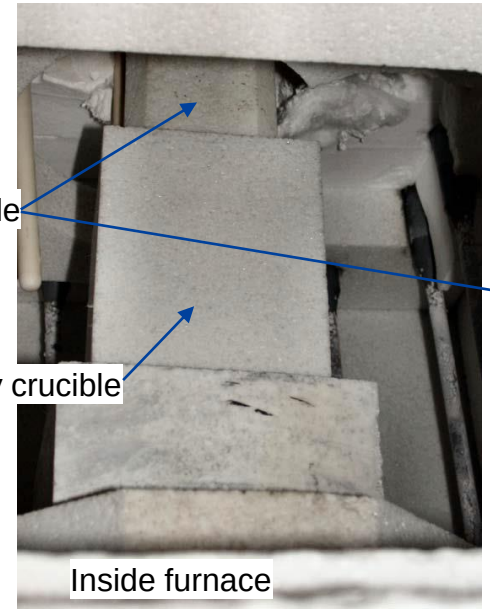
- Test setup
  - Pt-crucibles with glass cullet are covered with blocks of the materials to be tested
  - After a certain time, i.e. 120h at 1650°C, the corrosion is evaluated visually

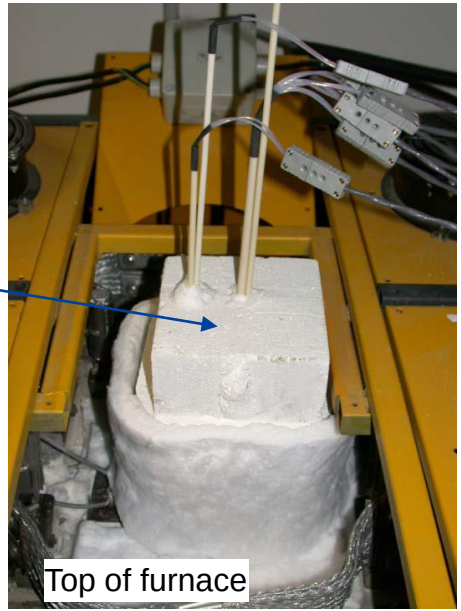


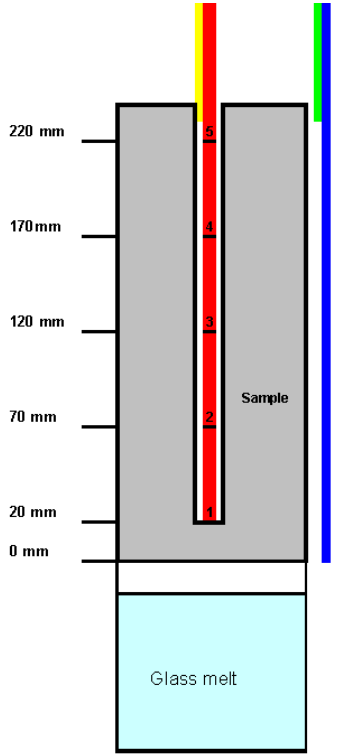


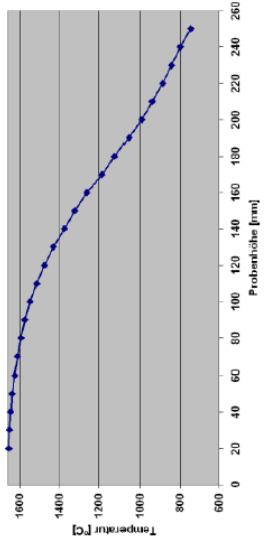
Temperature gradient corrosion test

- Test setup
  - Temperature gradient is realized by extending the sample out of the top of the furnace









Temperature gradient corrosion test

- Evaluation
  - The sample is evaluated visually for corrosion
  - A known reference material has to be tested in a second test to rate the corrosion behaviour against a known standard

Reference material | Alternative material