Deutsches Institut für Feuerfest und Keramik GmbH

Gas Corrosion Tests

All tests at our Institute are conducted by experts. Our employees include specialists from the fields of physics, chemistry, and mineralogy as well as material testing and technology.

Further testing methods are:

- Gas Corrosion Test for Reducing Media
- Rotary Kiln Test
- Gas Permeability of Refractories at Elevated Temperature
- Induction Melting Aggregates
- Wedge-Splitting Test
- Quantitative Oxidation Test
- Friction Wear
- Blast Wear
- Computer Aided Thermochemistry
- Thermal Conductivity

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Deutsches Institut für Feuerfest und Keramik GmbH

We are a central institute with more than 50 years of experience in all areas of refractories technology. We are absolutely committed to neutrality and are therefore a partner to all companies working in refractories technology.

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Gas Corrosion Tests for Reducing Media

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Example 1: H_2 corrosion

Typical applications for refractories in hydrogen atmospheres at high temperatures are:

- Heat treatment of powder metallurgical products, e.g. in annealing furnaces
- Petrochemical plants
- Plants for the production of ammonia

These plants operate in the range $1200 \leq T \leq 1300$°C, sometimes even to T = 1600°C (annealing of special alloys), with various atmospheres such as 100 % H_2, mixtures of N_2-H_2 to a content of 70 % H_2, endogas (consisting of: CO, H_2, N_2) and a possible water content of 50 – 500 ppm H_2O.

Test procedure

10 specimens with the geometry 150 x 25 x 25 mm³ (corresponding to a total specimen surface area of 1625 cm²) are installed in the furnace.

Fig. 1: Furnace

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The furnace is heated and cooled in 100 % N_2 atmosphere while in the isothermal phases ($T \leq 1300$°C) of the test the furnace is flushed with a rate of 180 m³/h at 100 % H_2 atmosphere. Every 50 h the test is interrupted to measure the weight loss and possible dimensional changes. The total duration of the test is 200 h and the specimens are analysed and described with SEM.

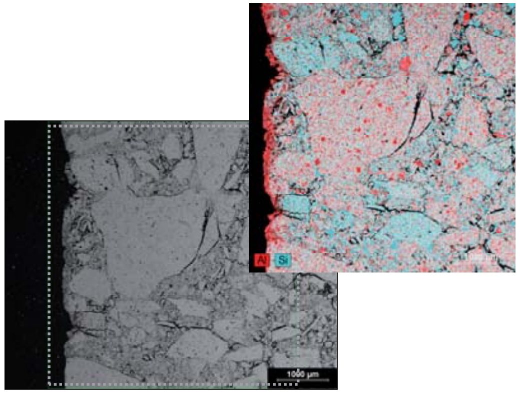

Fig. 2: porous alumina-zoneat the surface (red))

Example 2: CO corrosion

In industrial thermal treatment processes in the range of $400 \leq T \leq 800$°C, physico – chemical decomposition of the ceramic refractory lining in carbon-containing atmospheres poses a considerable problem.

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The destruction of the refractory as a result of carbon deposit from C – containing gases has long been known and occurs as a result of crystallization pressure of the carbon, which, starting from punctiform carbon nests, can effect the complete disintegration of the material or the components.

In addition comes the fact just 0.1% metallic iron can cause this disintegration. In simplified terms, the following reactions take place:

$$3\,Fe_2O_3 + CO \longrightarrow 2\,Fe_3O_4 + CO_2$$
$$Fe_3O_4 + 4\,CO \longrightarrow 2\,Fe + 4\,CO_2$$
$$3\,Fe + 2\,CO \longrightarrow Fe_3C + CO_2$$

Test procedure

On the basis of the CO test in compliance with ASTM C 288 and DIN EN ISO 12676, specimens are aged at temperatures of T = 500°C either in a pure CO atmosphere or a CO/H_2 mixture (3 %). The strength, porosity and sonic transition time of the specimens are then tested and qualified. Finally, tests based on SEM return clear-cut results in respect of the carbon forms formed in the matrix as a result of gas corrosion and their effect on the resistance and destruction of the ceramic structure.