



REACTION-BONDED ZrO_2 CERAMIC FOAMS – HIGH-STRENGTH, HEAT-STABLE, COST-EFFICIENT

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Application of zirconia filters

High-temperature-resistant ceramic foams made of zirconia (ZrO_2) are used in foundries to clean steel melts from non-metal inclusions, such as slags, molding sand residues and deoxidation products. Nevertheless, on account of their relatively high raw material costs, they have been significantly more expensive than alumina or silicon carbide filters, which are used at lower casting temperatures and in other metal melts. Now, thanks to a new material concept, raw material costs can be lowered by about 40 %.

Material concept

The composition of the newly developed reaction-bonded (rb) foams was adjusted by replacing 65 % of the original zirconia powder with a stoichiometric mixture of alumina and zirconium silicate. During the thermal treatment of the filter, these raw materials react to produce fine-grained zirconia and mullite. After sintering, the microstructure consists of 37 % coarse zirconia (primary grain), 23 % newly produced zirconia (secondary grain) and 40 % mullite. In order to achieve a complete reaction and material properties equivalent to those of conventional zirconia filters, alumina powders with different particle sizes and specific surfaces were investigated. The particle size of zirconium silicate was kept constant at 2 μm . A complete conversion was reached with alumina powder at a d_{50} of 2 μm and a BET of 2.5 m^2/g , at a sintering temperature of 1650 $^{\circ}C$ and with dwell of 3 hours.

Properties

In comparison to standard zirconia filters, the pore formation changes: the amount of total porosity decreases, as does the average pore size. Thus, reaction-bonded foam filters have a lower pure density and a higher strength.

Properties of new reaction-bonded filters compared with a standard zirconia filter

	rb filter	Standard
Pure density	4.3 g/cm^3	5.6 g/cm^3
Porosity of microstructure	20.5 %	24.4 %
Pore size	2.2 μm	4.7 μm
Fracture load	1500 N	900 N

For steel filters, we have developed particularly coarse-sized foams (ppi8). For this purpose, the coating suspension was adapted to the different particle sizes of the raw materials.

Services offered

- Materials and process development for open-celled ceramic foams
- Further development of, and new applications for, reaction-bonded zirconia

- 1 Cellular structure of the new zirconia filter.
- 2 Microstructure showing the new reaction bonding.