ABSTRACT - ORAL

Influence of colloidal binder chemistry on the gas permeability of cement-free refractory castables

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Cement-free refractory castables bonded with colloidal suspensions are increasingly considered as alternatives to calcium aluminate cement-bonded systems, especially when rapid drying is required. Colloidal silica is currently the most widely used binder for such systems because it promotes fast drying. However, its limited refractoriness may restrict its use in demanding high-temperature applications. Spinel colloidal binders offer a promising alternative due to the high-temperature stability of spinel and its known resistance to corrosion and thermal shock. Nevertheless, their ability to ensure sufficient vapour evacuation during drying still needs to be assessed.

This work investigates the gas permeability of alumina-based refractory castables bonded with colloidal spinel and colloidal silica suspensions. Three bonding systems were compared: a 50 wt.% spinel suspension, a diluted 30 wt.% spinel suspension and a 30 wt.% colloidal silica suspension. After curing, samples were thermally treated between 110 °C and 1500 °C, and gas permeability was measured to follow the evolution of the permeable pore network.

The results show that both the nature and solid loading of the colloidal binder strongly influence the permeability of cement-free castables. The castable bonded with the 50 wt.% spinel suspension exhibited the lowest permeability, indicating a reduced ability to evacuate vapour during drying. By contrast, the castable bonded with the 30 wt.% spinel suspension showed a more favourable balance between permeability and high-temperature performance, although its permeability remained lower than that of the silica-bonded reference. An increase in permeability was also observed after high-temperature treatment, suggesting microstructural changes during sintering that require further investigation.