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The thermomechanical behaviour of high alumina bricks

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Abstract

The modelling, design and optimisation of refractory masonry structures and refractory linings requires the understanding of its thermomechanical properties. The most used techniques for thermomechanical characterization of refractory ceramics is presented in this communication, as well the most important properties used for designing.

This study is focused on the work lining of steel ladles, the masonry studied is composed by high alumina bricks with dry joints. The mechanical behaviour of alumina spinel bricks is been investigated by compressive strain-stress curves at different temperatures.

The characterization of refractory masonry is required for calibration and validation of numerical models and for definitions of nonlinear homogenization techniques. The first step is the mechanical characterization of the bricks. Compressive tests are being performed at cylindrical samples extracted from the bricks to generate its compressive strain-stress curves at room temperature, 600ºC, 800ºC and 1.000ºC. The samples dimension is 50 mm in diameter by 130 mm in height. An electric split furnace will be used to heat the samples at the rate of 5ºC/min. The strains will be measured using a strain gage positioned at the opening of the furnace and the displacement given by the press will monitored. A 200 kN press with an electromechanical jack will be used to apply the compressive load.

The results of the brick characterization tests are the compressive strain-stress curves of the material. It will be possible to identify the compressive strength of the material at room temperature (f_c) and the compressive strength at a given temperature Θ ($f_{c,\Theta}$). The strain corresponding to f_c (ε_{c1}) and the rupture strain (ε_{cu}) may also be determined for each temperature.

The compressive strain-stress curves may be used for modelling, once they represent the damage plasticity of the material. This research will generate experimental results that will be used for calibration and validation of numerical models. Once the models are validated, they will be used to optimise the design of refractory masonry used at steel ladles.