Oral presentation ☒
Poster presentation ☐
Invited lecture ☐

THERMAL SHOCK DAMAGE ON SELF-FLOW REFRACTORY CASTABLES

D.G. Pinto[1*]; A.P. Silva[1]; T.C. Devezas[1]; A.M. Segadães[2]

[1] *Department of Electromechanical Engineering, University of Beira Interior, Covilhã, Portugal, deesypinto@ubi.pt*
[2] *Department of Ceramics and Glass Engineering (CICECO), University of Aveiro, Aveiro, Portugal*

[*] Presenting author

Self-flow all-alumina refractory castables (SFRC) containing no calcium aluminate cement nor additives (constant pH, MgO and SiO_2 free), were optimized in previous works in terms of a set of aggregates and a fine matrix, so that a fresh paste with high flowability index (FI) and minimum water content was produced. Upon firing, the SFRC showed other good properties, namely, high dimensional stability and reduced weight loss (linear shrinkage and weight loss below 1% in all cases), low porosity and high three-point bend cold flexural strength (modulus of rupture, MoR, ASTM C133).

The objective of this work was to evaluate the thermal shock behaviour of the sintered SFRC and the effect of the addition of 1 wt.% calcium aluminate cement (CA25, Almatis), in terms of retained mechanical strength after 5 and 15 thermal shock cycles from temperatures of 800, 1000 and 1200ºC.

The raw materials used were commercial tabular alumina (T60, Almatis), available in sizes from 0.3µm to 3mm, and reactive alumina (CT3000SG, d90 = 2.1µm), separated in aggregate (coarser size classes) and matrix (< 100µm). Powders in the selected proportions were mixed with water (28mg/m^2) and citric acid (0.36mg/m^2), as described in the Portuguese Patent #103432 (2008), to prepare two pastes: MA (without aluminate cement, AC) and MAC (with 1 wt.% AC). The pastes were cast, dried and sintered at 1600 ºC (ASTM C865).

The samples surface degradation due to thermal shock was qualitatively compared and selected samples were observed by scanning electron microscopy (SEM) before and after thermal shock damage. As an example, the results obtained in this study show that, when compared with the corresponding non-damaged castables, after 15 thermal shock cycles from 1200 ºC there is a 50% reduction in cold flexural strength of the SFRC without AC and 30% reduction in the strength of the SFRC with 1 wt.% AC. The MoR experimental results were analyzed with the Statistica Software (version 7.0) and valid response surfaces were calculated for both cases. The corresponding models equations were found to be statistically significant and were accepted as true descriptions of the real systems thermal shock behaviour, which allows the prediction of such behaviour in situations other than those experimentally investigated (different number and temperature of thermal cycles).

Acknowledgement: The authors acknowledge the Foundation for Science and Technology (FCT) for funding Project PTDC/CTM/66302/2006).

Keywords: refractory castables; thermal shock; aluminate cement; response surface methodology.